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Special Session
Clinical Vascular Radiology

1.1

Management of CLI

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Definition and clinical diagnosis of chronic critical limb ischemia
Chronic critical limb ischemia (CLI) is defined as rest pain (for at least four weeks) needing regular analgesia or a tissue lesion (ulcer or focal gangrene) in the lower extremity where an arterial insufficiency can be verified as the underlying cause. CLI has an ominous prognostic significance with a high risk for limb loss and decrease of life expectancy. Therefore a correct assessment of the degree of leg ischemia has great prognostic significance. The clinical description distinguishes patients with CLI from those with claudication only, however even severe claudication may also coexist. In most cases walking capacity is very severely impaired. In clinical practice the criteria of CLI according the Fontaine classification (see Table 1) complemented with an objective verification of a decreased arterial perfusion in the foot should perform the basis for decision making. By SVS/ISVS ad hoc definition a patient with rest pain should have the resting ankle pressure <40 mmHg and a patient with minor tissue loss <60 mmHg to fulfil the criteria of CLI. Also reduced toe pressure (30-50 mmHg) or reduced TCP O2 (<30-50 mmHg) have been advocated for objective verification of CLI.
The value of measured ankle pressures for defining the risk of limb loss is limited, however, and the clinical symptoms are the most important indicator of the risk. The risk is greatest with tissue loss and smaller with rest pain. Ischemic rest pain most typically occurs at night but can occur even during the day when the patient is resting in supine position. The pain is localized in the distal part of the foot or in the vicinity of the ischemic ulcer or gangrenous toe. The pain is often severe, enough to wake the patient. Often, pain is only relieved by large doses of strong analgesics or opiates. Severe ischemia is often associated with atrophy of the calf muscles, but unless this is unilateral and produces asymmetry, it may escape detection. Loss of hair growth over the dorsum of the toes is another sign of severe arterial insufficiency; it is often accompanied by thickened toenails. The subcataneous tissue atrophies so that the foot comes shiny, scaly, and "skeletonized". In severe, long-standing cases the colour of the skin is extremely pale or cyanotic. Arterial ulcers usually involve the tips of the toes, the heel of the foot, or wherever local pressure has caused further decrease of perfusion. Gangrene usually affects the digits; in severe cases, it may involve the distal part of the forefoot. Any minor trauma may elicit formation of an ulcer and led to gangrene. Detection of distal arterial pulses does not preclude severe ischemia in cases of very distal occlusions such as in peripheral microemboli or some diabetic patients.
Differential diagnosis of CLI
In a minority of diabetic patients, sensory neuropathy can result in severe pain in the foot. This is often described as a burning or shooting sensation that is frequently worse at night. Other conditions that should be considered as differential diagnostic causes for rest pain are symphatetic dystrophy, nerve root compression, night cramps, and Buerger`s disease.
The most common causes for foot and leg ulcers, except PAD are venous insufficiency, diabetic neuropathy, vasculitis and collagen diseases, and Buerger`s disease. Venous ulcers develop 10 to 20 years after deep vein thrombosis and they are usually preceded by a long period of trophic changes in the skin, typically above the medial malleolus.
Incidence and risk factors of CLI
There is little direct information on the incidence of CLI. Two studies from Italy and great Britain estimated the annual incidence 400-600 per million per year. On the other hand one patient per year will develop for every 100 patients with intermittent claudication.
The prevalence of peripheral arterial disease (PAD) increases rapidly with age. In a Danish national discharge survey, the incidence of lower limb amputations increased from 0.3 per 100 000 per year for those younger than 40 years, to 226 per 100 000 per year for those older than 80 years. Smoking has also shown to be an independent risk factor and to be more important causing peripheral arterial than coronary artery disease. Diabetic PAD patients are approximately 10 times more likely to need amputation than nondiabetic PAD patients. Up to 40-45% of all amputees are diabetic. Diabetic atherosclerosis is more diffuse, more severe, and manifests itself at earlier age than atherosclerosis in nondiabetic patients. The problem is complicated by the frequent coexistence of diabetic neuropathy, that may involve sensory, motor, and autonomic nerve fibers. As a consequence of reduced sense of pain and temperature diabetic patient may not be able to notice e.g. environmental temperature changes and pressure from poorly fitting shoes. This will predispose to ulceration, gangrene, and infection.
Imaging in CLI
Because patients with CLI commonly have multilevel involvement of arteries, a complete angiogram from the level of renal arteries to the level of pedal arch should be performed to correctly plan treatment. Nonivasive techniques, such as Duplex US and MRA are useful additional studies, especially in patients with impaired renal function.
Management of CLI patients
All patients with ulcer, gangrene r pain in the foot possibly attributable to peripheral arterial disease should be considered as urgent cases and referred promptly to a vascular specialist centre with expertise in treating patients with CLI. Patients with acute onset or worsening of ischemic symptoms or an acute spreading infection in the foot should be referred immediately. Because patients with CLI are likely to have overt or subclinical multisystem disease, a multidisciplinary team approach would seem sensible for the diagnosis, assessment and treatment of these patients. Access to angiography and vascular laboratory assessment should be available within 24 hours, as well as access to operating theatre and interventional radiology. As a principle, revascularization should be attempted whenever possible and appropriate. Patients who require amputation should have rapid access to co-ordinated rehabilitation and limb fitting service.
Treatment of CLI
The principal urgent components of basic treatment of CLI are the control of pain and any infection in the ischemic leg, prevention of progression of thrombosis if this is thought to be a precipitating factor, and optimization of cardiac and respiratory function. Pain control may require short-term use of narcotics. Topical therapy for ischemic ulceration should be guided by the principles of wound care. The extremities should be kept clean, with appropriate debridement. Patients who have a viable limb in whom revascularization procedures are impossible, carry a poor change of success or have a previously failed, and particularly when alternative is amputation, may be treated with prostanoids.
In most patients, the various options for endovascular techniques, arterial surgery, or thrombolysis can be carefully weighted. In general, if both surgical and endovascular treatment are possible for a particular case, endovascular treatment should be preferred because it avoids general anesthesia, poses a lesser systemic stress, and has less complications.
Surgical revascularization
To avoid amputations in CLI, an arterial reconstruction is necessary for the majority of patients. In about one fifth of patients with CLI the main lesion is in the aortoiliac region. On the other hand, about 20% of all aortoiliac reconstructions are performed for CLI. Aortobifemoral bypass is the reference standard for treatment of aortoiliac obstructions. Aortoiliac endarterectomy is usually reserved for younger patients with very localized disease that are often alternatively canditates for endovascular treatment .When an anatomic reconstruction in the aorto-iliac region is contraindicated due to general or local risk factors an extra-anatomical reconstruction can give acceptable patency and limb salvage rates. Five-year patency rates after surgical reconstruction in the aortofemoral region is 80-90% with corresponding limb salvage rates.
The main impact of surgical treatment is achieved with high incidence of infrainguinal/infrapopliteal reconstructions. In 65-85% of patients with CLI an infrainguinal revascularization is necessary due to the location of arteriosclerosis. Although endarterectomy in the femoropopliteal region may give acceptable result, in most cases bypass operations are necessary. The patient´s own vein gives the best results. The superiority of the patient`s own vein reconstruction material is most prominent in long bypasses to the crural and pedal arteries. Of the sources the greater saphenous vein is the preferable choice due to its size, length and position, Randomized comparisons of in situ and reversed vein grafts have failed to show superior patency of either technique. In by-passess to the above-knee popliteal artery reconstructions wth synthetic material gives results comparable to those with the patient`s own vein. Infrainguinal bypass reconstructions with autologous vein can achieve 3-5 year patency rates 70-80% in popliteal bypass, 60-80% in crural bypass and 50-70% in pedal bypass. Limb salvage rates are usually 10-20% higher.
Endovascular treatment
Endovascular procedures are in general performed on patients with less severe disease than those undergoing surgical treatment. However, for patients with high surgical risks, endovascular treatment can be tried also on very long occlusions and diffusely diseased segments. In the iliac arter-

ies, the most suitable lesions are less than 5 cm long stenoses or occlusions. Unilateral iliac disease favours endovascular treatment. Although balloon angioplasty is the basic method, stents are commonly used as a primary treatment especially in case of total occlusion and they should be always considered in case of inadequate result (residual stenosis >30% and/or flow limiting dissection) after balloon angioplasty. In the femoropopliteal region lesions less than 10 cm are best suited for endovascular treatment, By using endoluminal recanalization with hydrophilic guide wires or subintimal traversing, it is possible to obtain technical success in up to 20-30 cm long occlusions, however. In general, PTA is the primary treatment and stents should be reserved for failures. In case of critical ischemia primary stent placement on <5 cm long occlusions may give more secure result than PTA. The role of infrapopliteal PTA is somewhat unsettled. The ideal trgets are local tibial lesions with good run-off distally. However, diffuse three-vessel disease has to be treated with concomitant femoropopliteal procedure in most cases. Restoration of straight-line flow to the pedal arch is by PTA is usually needed for clinical success. Technical success of infrapopliteal up to 90% can be achieved. Clinical success rates of 63-80% are published with about 80% limb salvage rates. Because infrapopliteal PTA has low rate of complications (major complications 2-5%) and it does not hinder possible later surgical treatment, attempt of PTA is warranted in most cases before femorodistal bypass, except in case of very long crural artery occlusion but patent distal artery well-suited for surgical anastomosis.

Indications for amputation

Primary amputation for CLi is indicated in advanced distal ischemia with uncontrollable pain or infection in the setting of unconstructable arterial occlusive disease, necrosis or significant areas of weight-bearing portion of the foot, fixed, unremediable flexion contracture of the leg, or in case of a terminal illness or very limited life expectancy because of comorbid conditions. The goal of amputation is to obtain primary healing of the lower extremity at the most distal level possible. The amputation level is selected based on the warmth and integrity of the skin, capillary refill, palpable normal muscle and absence of infection at the selected site.

Outcome of CLI treatment

Critical ischemia has a poor prognosis. Even when treated properly only a little more than half of the patients are alive with salvaged leg while one quarter is dead and one quarter has lost the endangered leg after one year. Furthermore, the quality of patients with critical ischemia is poor; a study of QL in untreated patients with CLI showed their health status to be poor and comparable to patients waiting for heart or liver transplantation. Quality of life after reconstruction is better than after amputation although amputation also improves some domains compared to the preinterventional status. Quality of life is correlated to preserved mobility. Most patients with leg salvage and preserved mobility can continue living outside institutional care. An amputation result in loss of mobility and independent living for most patients.

CLI is a manifestation of a chronic continious disease. Even after successful treatment new manifestations occur in 25-50% of patients. Patients with CLI should therefore have a long-time follow-up plan. Patients who have had an arterial reconstruction with known high risk of re-occlusion (long infrainguinal vein bypasses) should be followed intensively in a unit capable of identifying an impending occlusion risk.

Table 1. Fontaine classification

I. asymptomatic peripheral arterial disease
II. intermittentclaudication
III. rest pain
IV tissue loss; IVa ulcers, IVb:limited gangrene
Stages III and IV represent CLI

Special Session
Percutaneous Endoluminal Management of GI Diseases

2.1

Colonic Stents

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Acute obstruction of the large bowel usually requires urgent surgical treatment. It is caused by a number of benign and malignant diseases, but by far the most frequent etiology is colorectal carcinoma [1]. Eight to 29 % of these patients present with acute obstruction and have a poor prognosis [2]. Other causes include malignant infiltration from adjacent malignant tumor or metastatic involvement. Benign conditions such as diverticulitis or other inflammatory bowel diseases and anastomotic or post-irradiation strictures, are less frequent.

Patients with acute obstruction generally have a poor prognosis because of a poor general condition related to dehydration and electrolyte imbalance[2]. In most cases, a defunctioning colostomy is initially performed to relieve acute large bowel obstruction. According to a recent German multicenter study [3] the rates of mortality and morbidity in emergency operations for colonic cancer are approximately 12 % and 39 % respectively, decreasing to 3.5 % and 23 % when the patients are treated electively. Furthermore, it has been shown that the best oncologic approach to obstructing carcinoma of the colon is primary resection without colostomy. Self-expandable metallic stents facilitate single-stage surgery and thereby reduce costs, mortality and morbidity. Rapid relief of obstruction allows the patient to be prepared for operation and elective tumor resection with primary anastomosis, avoiding enterostomy. Stent placement has also been advocated as a method of definitive palliation of colonic obstruction in patients with disseminated metastatic disease who are not surgical candidates. In selected cases stents may be also used for preoperative decompression of obstruction in acute diverticulitis.

The diagnosis of acute colonic obstruction is made by plain film radiography and an enema with water soluble contrast medium. Colonoscopy and biopsy can help to determine the exact location and nature of the obstruction. Other diagnostic and staging procedures such as abdominal ultrasound, computed tomography etc. may be delayed until after stent placement. The stenosis can be negotiated with radiological techniques alone or with combined endoscopic-radiological methods. With the patient in supine or oblique decubitus position and under adequate sedation with midazolam and analgesia the stricture is negotiated with stearable or hydrophilic guidewires in combination with torque-control angiographic catheters. For stent placement a superstiff guidewire has to be used. As most colonic cancers are located in the rectosigmoid region these stenoses can usually be negotiated with interventional catheter techniques alone. However, we have found it convenient to use a combined endoscopic-fluoroscopic approach particularly for lesions beyond the distal descending colon. The endoscope is helpful as a stiffening tool for managing the rectosigmoid curvature, to straighten out kinks and to deal with elongation of bowel. It serves as a guiding tool, especially in lesions proximal to the descending colon and around the splenic flexure.

Immediate post procedural care consists of recording blood pessure and pulse at regular intervals, treatment of electrolyte imbalance and intravenous administration of fluids. Patients scheduled for elective one-stage surgery receive adequate bowel preparation. Plain films of the abdomen are usually obtained after 24 to 48 hours to assess adequate position and expansion of the stent and resolution of the radiological signs of ileus. In patients in whom stents are placed for palliation and for whom no subsequent surgery is planned, stool softeners should be used to prevent fecal impaction.

Analysing the compiled results of preoperative and palliative stenting using endoscopic, radiological or combined methods in two recent review articles with 234 and 198 patients suffering from ileus in colorectal obstruction, an overall technical success rate of 93% and 95 % was reported [4,5]. Clinical improvement was seen in 90% and 96% with a rate of recurrent obstruction of approximately 25% and 29 %, mainly in cases of palliative stenting. Significant complications were reported in an average of 14% and 10% consisting mostly of stent migration and perforation. Obviously distal lesions were usually easier to pass than obstructions in the transverse colon or the region of the colonic flexure.

In these larger series most frequently the 20 to 22 mm esophageal Wallstent, the vascular Wallstent, and the 'Enteral' Wallstent have been used. We currently favor the latter, because of its adequate radial expansile force, large diameter and longitudinal flexibility, which allow to conform to the curvature of the bowel. In addition, this device can be advanced through a 3.8 mm endoscopic working channel as it is mounted on a 10F-system. Stents should be 2 to 3 cm longer than the stricture to reduce the risk of migration. Gianturco-Z-stents have been used in one series [6], whereas Ultraflex esophageal and Memotherm stents have been used only occasionally [5,7,8]. Recently flexible modified Z-stents with polyurethane covering have been introduced, but these stents are not commercially available [9]. In our opinion, the additional cost of covered stents is not warranted for preoperative stenting where the stent serves only as a temporary means to keep the bowel lumen patent for bowel cleansing and normalization of intestinal tran-

sit until elective surgery. Even when stents are used for palliation, tumor ingrowth seems to be a rare event, making the use of covered devices unnecessary. We believe that the only current indication for the use of covered stents is the sealing of colonic fistulas [9].
In preoperative stent placement for acute ileus the two review articles by Mauro et al [4] and Zollikofer et al (10) compiling a total of 117 and 140 patients respectively a clinical success was achieved in 89% to 96%. The technical success rate for crossing the lesion with a guidewire and successive stent placement was 90% and 89 % respectively. The majority were treated with Wallstents (mainly of the esophageal, vascular or „Enteral" type) with initial success rates of 96% to 100 %. No significant difference in the results between Z-stents or the large caliber Wallstents could be found in the above mentioned reviews. However, small caliber Wallstents such as the 10 mm biliary Wallstent were prone to migration [7].
Experience with stenting of obstruction in inflammatory stenosis due to diverticulitis is still limited. Three of the four patients which we stented for acute diverticulitis, with short stenotic lesions, had fast relief of obstruction, whereas a fourth patient with a long segment stenosis had no significant improvement.
Palliative decompression for non resectable primary colorectal or metastatic malignancies has been described in more than 150 patients in recent publications since 1998 [5,7,9,11-15]. Technical success rates are in the range of 91 %. In the review by Zollikofer et al [5] where 58 patients were compiled an initial clinical benefit was achieved in 87 % to 100 % (mean = 96 %). However, recurrent symptoms due to fecal impaction or tumor in/or overgrowth and stent migration was seen in 29 % (range 21 to 71 %) even in cases where large caliber stents of 20 to 25 mm diameter were used. In the two most recent reports with the largest series so far (41 and 35 patients each) by Lobato et al [14] and Camùnez et al [15] the rate of reobstruction was only 17% and 9% respectively and secondary patencies after repeat intervention were a remarquable 95% and 100%. However, the average survival was only 4.5 and 5 months. In our own, though limited experience with palliative stenting, relief of initial symptoms was achieved in 13 of 18 patients (72 %) with a late recurrence due to stent occlusion by feces or tumor progression in 61%. However, after non-invasive interventions the secondary patency was improved to 78% (mean survival 4 months). Currently available designs of covered stents do not seem to improve results by their potential of preventing tumor ingrowth [9,12].
In our experience the length of the stenosis is an important determinant of long-term patency; stenting of long segment stenoses, particularly in extensive metastatic disease, requiring more than one stent, early dysfunction secondary to fecal impaction, and/or inadequate peristaltic propulsion was not infrequent (27 %). The higher tendency for dysfunction is probably due to disturbance of the propulsive peristalsis which leads to stool impaction. Because of these disappointing results we are currently reluctant to stent lesions which require more than one stent of 60 or 90 mm length. On the other hand stent dysfunction may be relieved by colorectal tubes which can easily be advanced through an obstructed stent. Placement of a large bowel tube through the stented segment is an effective method of bowel cleansing and preparation for elective palliative surgery in these cases.
The overall rate of severe complications ranges from 0 % to 32 % (mean 10 %) but is usually less than 10 % in experienced hands [4-9,11,16]. Perforation caused by guidewire manipulation usually has no sequelae, whereas perforation caused by balloon dilatation before or after stent placement prove to be more severe, requiring surgery in the majority of cases. Therefore, we never use balloon dilatation before stent placement, and only rarely following implantation if the stent does not expand adequately. Late perforations are rare but may be caused by steroids, chemotherapy and radiation therapy, or by the sharp free ends of the metal wire mesh. In one of our patients who declined surgery after rapid relief of symptoms following stenting of acute diverticulitis a late perforation occurred after 4 months. Stent migration occurs in 0 % to 26 % (mean 6.5 %). It seems directly related to the stent diameter and the severity of the stenosis. To keep the migration rate as low as possible stent diameters of not less than 22-25mm and a length of at least 6cm seem advisable. Prophylactic stenting for subacute ileus with incomplete obstruction or non-circular lesions should be avoided.
Inadequate bowel decompression is usually related to stent malpositioning, incomplete expansion or stent migration [4,7-9,11,16]. This may be corrected by additional stent placement.
In summary, the pre-operative use of self expanding metallic stents in obstructive colorectal cancer, particularly of the descending and sigmoid colon, is a cost-effective, minimally invasive alternative to emergent surgery. It buys time for improving the patient's overall condition and staging of the disease enabling the performance of elective one-stage surgery with tumor resection and primary anastomosis after appropriate bowel cleansing. According to Binkert et al [13] cost savings of up to 29 % can be achieved in preoperative stent placement for colonic carcinoma mainly due to a shorter hospital stay and fewer days in the ICU. Preoperative stenting to decrease the high complication rate of emergent surgery for diverticulitis with severe colonic obstruction can probably be done safely, provided the inflammatory tumor obstruction of the bowel lumen is short and elective surgery after treatment with antibiotics is performed in due course. However, the treatment of such strictures with stents alone is not recommended because of the risk of delayed perforation. In patients with non resectable malignant disease, stenting may provide adequate long-term palliation obviating the need for surgery or colostomy. However, long-segment stenoses which require more than one stent of 60 to 90 mm in length have a relative high risk of reocclusion due to stool impaction or mucosal prolapse. Tumor ingrowth or overgrowth may be of further concern in patients with prolonged survival. Therefore future developments need to address the optimal balance of radial force and large diameter to prevent migration, and a suitable covering with preservation of longitudinal flexibility to allow easy placement throughout the colon for prolonged patency in non-operative palliation.
Stents may be placed with a combined endoscopic-radiologic approach as far proximally as the right colon, whereas with radiologic guidance alone, stent placement is generally limited to the left colon distal to the splenic flexure. If both, the facilities and the expertise of fully trained interventional radiologists and gastroenterologists are available, this combination would seem optimal for treating obstructing lesions throughout the colon.

2.3

Interventions In Benign Oesophageal Obstruction

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Benign Oesophageal Strictures:
There are many causes of benign oesophageal strictures. The most common is reflux oesophagitis. Most benign strictures will respond to balloon dilatation and this is the method we usually employ, carrying out the procedure under fluoroscopic guidance. The main indication for endoscopy is to enable a biopsy to be carried out to confirm the diagnosis. Patients in whom fluoroscopically-guided balloon dilatation fails are often treated surgically. Generally we avoid the use of stents in benign disease because the long-term effects of these devices are unknown. However, there are occasions when repeat dilatation produces progressively shorter periods of relief of dysphagia, in which there is little choice other than to employ a stent or submit the patient to major surgery. In addition, there are rare occasions when it is simply not possible to dilate benign strictures successfully. In general, we restrict the use of self-expanding stents in benign strictures to patients who are not fit for surgery. Clearly the use of a stent does not preclude surgery at a later date should that become necessary, and should the patient's clinical condition improve sufficiently with adequate nutrition.
If the use of a n endoprosthesis is unavoidable, it is best to use a removable plastic stent, such as the *Polyflex* device, especially if there is even the most remote possibility that the patient might have surgery at a later date. However, in some situations the use of a metallic stent is indicated, as an attempt at permanent cure. The technique employed for deploying metallic oesophageal stents across benign strictures is essentially the same as that in malignant disease, though we consider uncovered stents more appropriate as in this clinical setting there is no potential for tumour ingrowth, making the stent covering superfluous. An additional advantage of using uncovered stents is that after a few months the stent is completely covered by epithelium and becomes incorporated into the wall of the oesophagus. A number of cases of the use of metallic stents in benign strictures are reported in the literature, and the results indicate a good response of dysphagia [1-3]. However the major problem in the long term is the occurrence of epithelial hyperplasia related to the stent. This is amenable either to balloon dilatation, or to laser treatment. The hyperplastic epithelium is considerably easier to deal with than the original benign stricture, so although stents are not ideal for the treatment of benign disease, they do at least help to make an almost unmanageable situation manageable. Biodegradable stents, currently under development, are likely to make a major contribution to the management of

benign oesophageal strictures.

Achalasia of the cardia

Achalasia is a disorder of oesophageal motility characterised by loss of peristalsis and failure of relaxation of the lower oesophageal sphincter on swallowing (4). Treatment is directed towards symptomatic relief of the disorder, by disrupting the circular muscle fibres of the lower oesophageal sphincter (5). This can be achieved by surgical cardiomyotomy or by balloon dilatation. The therapeutic results following either technique are broadly similar (1) but balloon dilatation has several advantages: thoracic or abdominal surgery is avoided, the average hospital stay is shorter, and there is a lower incidence of subsequent oesophageal reflux (6).

Minimally invasive surgery using laparoscopic or thoracoscopic myotomy has shortened hospitalisation and decreased morbidity compared to traditional myotomy, without increasing complications (7). However, long term results are not available yet.

Medical treatment with anticholinergic agents or calcium antagonists is disappointing and bougienage produces only transient relief with a reported six per cent incidence of perforation of the oesophagus (8). Injection of botulinum toxin is an attractive alternative because of its safety and low cost per treatment, but the response is short-lasting and there is a need for repeat injections leading to increased overall cost compared to pneumatic dilatation (12).

Pneumatic dilation remains the first choice in the treatment of oesophageal achalasia in many institutions (9,10,11, 12). Many different types of balloon dilators were used in the past, but the *Rigiflex* balloon (Boston Scientific, Watertown, MA) is currently the most popular (12). We have carried out a study to assess the effectiveness of this form of treatment in our institution.

Seventy-six patients (mean age 51 years; range 17-88) underwent balloon myotomy using the *Rigiflex* balloon (Boston Scientific, Watertown, MA) under radiological guidance. A total of 110 procedures (mean: 1.4 per patient) were performed over a six year period from April 1994 to April 2000. Thirteen patients had undergone one or more previous dilatations elsewhere. Fourteen patients had undergone previous oesophageal surgery; ten patients had Heller's cardiomyotomy, three patients had antireflux surgery and one patient had surgery for oesophageal rupture. Three patients had received botulinum toxin injections. The diagnosis of achalasia was based on the appropriate clinical, radiological and manometric data. Dysphagia was a presenting symptom in most patients (90%), regurgitation was present in 39%, retrosternal pain in 22% and weight loss in 12%. The dilatations were performed in a progressive manner starting with a 15mm diameter balloon and progressing to 20mm, 30mm and 40mm balloons as required. The follow-up data was collected retrospectively from patient notes, and by telephone interviews with the patients and/or their local doctors (mean follow-up 26 months).

There were no cases of oesophageal perforation. 89%, (98/110) of dilatations were considered to be successful with the patients having restoration of normal or near-normal swallowing ("excellent" or "good" initial responses). Fifty-two patients required a single dilatation, 22 between two and four dilatations and two patients required five dilatations. Of those who had undergone previous surgery 50% (7/14) required more then one dilatation. Those patients who had undergone unsuccessful initial dilatation elsewhere were more difficult to treat than those who presented primarily to our unit; however, in 46% (10/22) there was substantial improvement in dysphagia following a single dilatation.

We concluded that balloon myotomy under fluoroscopic guidance is a safe and successful treatment for oesophageal achalasia, even after previous oesophageal surgery. We believe that the use of fluoroscopic guidance, combined with the gradual increase in the size of dilatation balloons only when no evidence of trauma to the oesophageal wall is present, helps to minimise the incidence of oesophageal perforation. The high rate of success using this technique even in those patients in whom an apparently similar method has previously failed suggests that it should be performed in a specialist unit.

Interventional radiologists have an important role in the management of benign oesophageal obstruction.

Special Session
Percutaneous Procedures in Urology and Nephrology

3.1

Percutaneous Nephrostomy

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Imaging guided percutaneous nephrostomy (PCN) has been widely used since its first appearance in the medical literature in 1955 (1). It is associated with some complications, most of which are minor. Although, for an interventional radiologist it is a relatively common and straightforward procedure, it can lead to serious morbidity or even mortality if certain guidelines are not followed in patient selection, technique, patient follow-up and managing the complications.

INDICATIONS: Although initially most PCN's were done for urinary diversion (either for obstruction or urine leak), today we have a wider spectrum with the development of endourologic techniques. These relatively newer indications include management of nephrolithiasis (symptomatic stone disease, adjunct therapy to extracorporeal shock wave lithotripsy, primary treatment of recurrent stone formation in the setting of metabolic disease), therapy for complex urinary tract infections, ureteral intervention, nephroscopy and ureteroscopy (diagnostic or therapeutic) (2).

TECHNIQUE:

The patient is placed prone on the fluoroscopy table. The flank and back area are cleansed in a sterile fashion. The skin and the subcutaneous tissues are infiltrated with the local anesthetic. Conscious sedation with Midazolam and Fentanyl is used for patient comfort. Selection of the puncture site is the initial step. A posterior lower pole calyx is usually the ideal puncture site for most nephrostomies but if there is a potential plan for ureteral stent placement or ureterolithotomy, than a posterior middle zone calyx may be a better choice (2). Either fluoroscopic or US guidance can be used (3). 18G needles with 0.035 inch guide wires or 21G needles with three part co-axial systems can be used. Preferred entry site into the collecting system is through a calyx or calyceal infundibular junction. The pelvis should not be punctured directly since this can cause injury to the larger blood vessels. Also a posterolateral approach will lead to an access through a more avascular area. After the puncture, a stiff guide wire is advanced into the collecting system. The floppy tip of the wire should be advanced into an upper pole calyx. This will make the placement of a pigtail catheter easier than when the wire is in the ureter. To advance the catheter over the wire, either the metal or plastic stiffening cannula can be used. After confirming adequate position of the catheter in the pelvis, the locking mechanism is used for the self retaining catheters. Tube size should be selected according to the type of the urine. Smaller tubes (8-10F) are usually enough to drain non-infected urine. For infected urine and for hematoma in the collecting system, larger catheters should be used. The catheter is stabilized at the skin with sutures or other devices.

COMPLICATIONS: Major complications occur in 3-7% of cases (4-8). These are defined as complications that require therapy, prolonged hospitalization, increase in level of care or that have permanent adverse sequel or result in death (9).Minor complications occur in 7-10% of cases (4,5). These are the complications that require no therapy or minimal therapy, sometimes requiring overnight admission for observation. In case of an emergency PCN, the complication rate is much higher, up to 34% (10). PCN has a lower mortality rate when compared with surgical nephrostomy (0.2% vs6%) (2,5,8,10,11).

Some of the complications are technique related. For example the patient may experience pain if the puncture is done too close to a rib or if the catheter is pushed against the pelvic wall. These can be corrected by intercostal nerve block and by pulling the catheter respectively. Catheter related problems are blockage, kinking and dislodgement. To prevent blockage, one should consider larger bore catheters when dealing with pyonephrosis and clots in the collecting system. In case it occurs, it can be managed by flushing or exchange. Kinking can be corrected by repositioning. If the catheter is accidentally dislodged, repositioning should be done as early as possible, ideally in the first 6 to 8 hours to prevent tract closure. Although the dislodgement rate is as high as 15 to 25% in some series, with usage of self retaining catheters, the rate goes down to 0.9% (6-8). In early cases the tract can usually be negotiated using a hydrophilic wire but if the collecting system can not be reached, puncturing the collecting system again is the only way to

restore access.
In cases of urinoma, the cause of the leakage should be sought with a nephrostogram. Any problem that leads to ineffective drainage (ex: catheter kink, blockage etc) should be corrected and larger bore catheters should be considered. Drainage of the urinoma cavity can also be done. If the urinoma gets infected it should be drained as soon as possible. During percutaneous lithotomy, there is a higher risk of perforation of the pelvis if it is small, bifid or filled with stones.
Sepsis is one of the most serious complications of PCN. The rate of septic complications is 1-3% (2,5,9). In many centers routine wide spectrum antibiotic coverage is done before PCN's. If there is persistent fever or new fever after PCN, the effectiveness of the drainage should be checked, and if there is a blockage it should be addressed. Another common reason for sepsis is forceful antegrade nephrostogram which causes pyelotubular and pyelovenous backflow, which in turn can lead to bacteremia and sepsis. Also, secondary procedures as percutaneous nephrolithotomy procedure should be delayed in an obstructed system until the infection is cleared.
Hematuria in the first 48 hours is seen after most PCN cases and it is not considered a complication. In cases of hematuria that persists beyond the first 2 dasy, the cause should be sought. One of the most common reasons for this is a side hole placed in the parenchyma. This can be addressed by repositioning the catheter. Knowing the patient's bleeding parameters, history and medications helps the interventional radiologist to correct them before the procedure. Farrel reported that while only 2% of non-coagulopathic patients required transfusion in their series of PCN, 4% of coagulopathic patients, all of whom treated prior to the procedure to correct coagulopathy, required transfusion. While in patients with a baseline platelet count more than 100.000/mm^3 only 5% transfusion required, in patients with a baseline platelet count less than 100.000/mm^3 50% transfusion requirement occurred despite routine preprocedural administration of platelets (8). Slow oozing of blod with a drop in hematocrit is conservatively treated with blood transfusion and bed rest. The treshold for transfusion is reported as a hematocrit of 30% or less, or in the preexisting anemia, a drop of hematocrit by 4% (10). Although transfusion requirement is about 1-4% after PCN, this complication occurs about 10 % following stone extraction. It has been reported that in cases of percutaneous staghorn stone removal, transfusion requirement is as high as 57% (7, 12).
Major vascular injury may cause severe bleeding. Usually the reason is arterial laceration, pseudoaneurysm or arteriovenous fistula formation. Larger caliber catheter insertion usually solve the bleeding problem due to vascular laceration. Sometimes balloon catheters are preferred for this purpose (2,13). If these methods are not successful, then selective catheterization must be performed followed by embolization. Very rarely, if embolization fails, surgical intervention might lead to partial or total nephrectomy (2,13).
Although thoracic complications are rare in PCN (0.1-0.2%), it is not uncommon in patients who undergo percutaneous nephrolithotomy (5-15%) (2,8,9,14).Especially in cases where stone removal is performed via supracostal approach, there is a high risk of injuring the pleura and lung. Urine leakage resulting in hydrothorax can be managed by inserting a large bore nephrostomy catheter. If needed, chest tube can be placed under fluoroscopic guidance in cases of pneumothorax or hydrothorax (14).
Colonic perforations are seen in less than 0.5 % in percutaneous nephrostomy cases (9). This risk is higher in cases of percutaneous nephrolithotomy (2.7%) (14). Risk factors for colonic perforation are patients with very little retroperitoneal fat or renal anomaly such as horseshoe kidney as colon tends to have more posterior location. High risk patients for colon injuries during percutaneous nephrolithotomy are young, lean males with minimal retroperitoneal fat (15). A too lateral nephrostomy puncture is associated with an increased risk of colonic injury. The presenting symptoms range from subtle (low grade fever, paralytic ileus, and leukocytosis) to dramatic (fecaluria, pneumaturia, rectal bleeding and obvious peritonits). Sometimes it is incidentaly diagnosed during routine nephrostogram. Retroperitoneal colon injuries can be successfully managed conservatively with early recognition and appropriate drainage of the urinary and intestinal tracts separately besides administration of broad spectrum antibiotics. However intraperitoneal colon injuries after percutaneous renal stone extraction demand open extraction and repair.

3.3

Long Term Urinary Drainage

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Introduction
The last 30 years have seen a remarkable increase in interventional uroradiological procedures. There is now a wide variety of procedures for patients who require long term urinary drainage including percutaneous nephrostomy, ureteric stenting with antegrade/ retrograde/ combined approach, extra-anatomic stents and prosthetic urinary ureters. The management of various urinary obstructions are dependant upon the underlying pathology, ureteric stricture type and length and also patients' choice. The lecture aims to give a broad overview of various techniques we use in our department, detail the indications, and discuss techniques and outcome.
Percutaneous Nephrostomy
Percutaneous nephrostomy (PCN) was first described in 1955 (1) and is an important technique for providing temporary or permanent drainage of an obstructed urinary system or for establishing diversion of urine flow. Long term urinary drainage with PCN is used when internal ureteric stenting is impossible or unsuitable and when patients decide not to have an extra-anatomic stent.
In our department, we employ 2 different ultrasound guided techniques: the 'Seldinger' and the 'One-stab' techniques (2). Patients are placed in a prone or prone-oblique position. Prophylactic antibiotics are routinely administered to patients with suspected pyonephrosis and renal stone disease. Routine coagulation profiles are obtained prior to the PCN.
The selection criteria for each technique are dependant upon the collecting system configuration. The Seldinger technique is used for minimally or non-dilated collecting systems and cases with suspected pyonephrosis. This technique, with fluoroscopic guidance, is also the usual technique for out-of-hours cases so that both ultrasound and X-ray screening are available if difficulties are encountered. The Bonanno technique is used without fluoroscopic guidance for moderate to severely dilated collecting systems.
The 'Seldinger' technique involves an ultrasound-guided puncture of the dilated collecting system with a 19 G sheathed-needle. This is followed by a 0.038" heavy duty J guidewire insertion and serial track dilatation with 6-10F dilators to accommodate 8 to 12F nephrostomy catheters with or without fluoroscopic guidance. With fluoroscopy, we routinely administer 5 mls of urograffin contrast to confirm the position of the 19G sheathed-needle prior to guide wire insertion. We use either All Purpose Drainage (APD) catheters (Boston Scientific) or Locking-loop pigtail catheters (Cook) for nephrostomies.
The second technique used is the ultrasound-guided 'One-stab' technique using a 6F Bonanno catheter (Beckton Dickinson). This 6F pigtail Teflon catheter is mounted on a hollow 18G needle that has a sharp bevelled edge. Under ultrasound guidance, the tip of the needle is inserted into a dilated pelvicalyceal system, urine backflow is obtained, and the catheter then slides over the needle into the collecting system.
All catheters are secured to the skin by a catheter fixation disc, covered with adhesive dressings and connected to a closed system urinary drainage bag.
For patients requiring long term urinary drainage with percutaneous nephrostomy, we will exchange all the 8F APD and 6F Bonanno catheters with the 8F locking loop pigtail catheters. We routinely exchange the nephrostomy catheters in our screening suite every 3 months as an outpatient basis.
Ureteric Stenting
Long term urinary drainage in patients with malignant and benign ureteric strictures is often treated with ureteric stenting. These strictures may be negotiated using the antegrade, retrograde or combined (rendezvous) approach. A benign stricture can be treated by dilatation with balloon catheter or a PTFE coated Van Andel dilator. The results however are dependant upon the blood supply and the age of the stricture (3).
With either route, a combination of wires and catheters are required to traverse the stricture. Using the antegrade approach, an angled tip hydrophilic Terumo wire is usually used to negotiate through the ureteric strictures and pass down into the bladder. In most cases a 6F torque-controlled manipulation catheter is used to cannulate the stricture and bladder, although in difficult cases a 4 or 5F hydrophilic-coated Cobra catheter may be used. The Terumo wire is then removed and replaced by a stiffer wire (e.g. Amplatz superstiff wire), over which the ureteric stent can be inserted. We routinely use a 6 to 8F (Meditech,

Boston Scientific) or 7F (Optimed, Ettlingen, Germany) ureteric stent. These are electively changed every 3 to 6 months to prevent encrustation.

The combined (rendezvous) approach (4)

Occasionally, a combined approach may be required between radiologist and urologist to negotiate difficult strictures. The radiologist uses the Terumo wire antegradely to cross a difficult stricture and the urologist grasps the distal end and brings it out of the urethra. With one end of the wire secured with an artery forcep to prevent the slippery wire being pulled out, the ureteric stent may be advanced from either route.

Extra-anatomic stents (EAS) (5)

Extra-anatomic stents should be considered for patients in whom conventional ureteric stent insertion has failed in impassable strictures or complete ureteric disruption in iatrogenic injury and when PCN is inappropriate. EAS are inserted under general anaesthesia. Under ultrasound guidance the proximal of a 60cm 8F double-pigtail stent (Boston Scientific) is inserted into the collecting system of the kidney via a PCN approach. A small incision is made over the puncture site and a subcutaneous tunnel created using telescopic metal dilators within a sheath to a second incision made at the iliac crest. The subcutaneous tunnel is then extended to a third transverse incision in the suprapubic region from which the bladder is punctured under ultrasound guidance. The distal end of the stent is inserted into the bladder through a 'peel-away' sheath. The incisions are then sutured and a final radiograph taken to confirm the position. EAS are electively changed every 6 months.

Subcutaneous Prosthetic Ureters (6)

Occasionally, we also use subcutaneous prosthetic ureters to bypass urinary obstruction in patients who had a trial of EAS and long term EAS is indicated. These are patients with malignancies but who have reasonable life expectancy, patients with ureteric disruption from iatrogenic injury and also in complex benign ureteric strictures. This is a large bore permanent prosthetic ureter that does not require any interval exchange.

It is a composite prosthesis, consisting of two co-axial tubes with an internal pure smooth silicone covered by coiled e-PTFE. The internal diameter is 6mm (18F) and the external diameter 9.5mm (28.5F). This tube is inserted percutaneously into the renal pelvis through a 30F Amplatz sheath (similar to conventional percutaneous nephrolithotomy techniques for renal stone extraction), tunnelled subcutaneously, and introduced through a small open cystotomy for insertion into the bladder.

Conclusion

Many new techniques are evolving in interventional uroradiology to manage challenging ureteric strictures. These often require a combined involvement with radiologists and urologists, and depending on the local expertise, interchangeable percutaneous and endoscopic skills are required. A true team approach is needed in order to provide the appropriate interventions and management for the benefit of the individual patient.

Special Session
Complications (Vascular)

4.1

Thermal ablation of bone metastasis for pain control

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Radio Frequency thermal Ablation (RFA) has been used as treatment for a variety of neoplasms, such as hepatocellular carcinoma, renal cell carcinoma, liver metastases, lung tumors, osteoid osteoma. Papers published show that it is a safe and effective technique; potential benefits of percutaneous in situ tumor ablation include decreased mortality and morbidity, the possibility of performing the procedure in outpatients, and the possibility of treating patients not candidated for surgery due to age, comorbidity, or extent of disease. In selected patients rfa can be used in place of more invasive surgical techniques. In most cases RFA can be performed during conscious sedation.

The intent of RFA is to destroy tumor cells without their removal and the main limitations are the size and site of the lesions to be treated.

It has been recently suggested for treatment of osteolytic bone metastases, for pain relief.

Standard treatment for skeletal metastases is external beam radiation therapy (RT); in addition systemic therapies like hormonal therapy, radiopharmaceuticals and biphosphonates can be performed. However 20-30% of patients treated with conventional therapies do not experience pain relief and dose limitation may not permit further RT.

In these patients the only chance is medical treatments, opioids and nonsteroideal anti-inflammatory drugs: increasing analgesics doses toxicity and intolerable analgesics-related side effects may develop. These complications affect quality of life and reduce performance status.

When standard methods fail RFA may be considered and preliminary results seem to prove efficacy and safety on pain control with quality of life improvement and reduction of analgesics use.

RFA can be performed in osteolythic and mixed osteolythic-osteoblastic lesions, in patients with a good performance status, life expectancy greater than two months and with pain resulting from no more than two sites. Using the Brief Pain Inventory-Short Form (BPI-SF) RFA is generally performed in pts with $\geq$ 4/10 worst pain scores on a numerical rating scale (0 for no pain and 10 for the worst pain imaginable) during a 24 hour period.

Even if osteoblastic lesions are generally excluded, we treated with success a iliac sclerotic lesion with pathological fracture.

Lesions located within 1 cm of the spinal cord or major nerves, brain, aorta, vena cava, bowel and bladder are excluded. Metastases with impending fracture may be treated, because of the possibility to inject cement, after ablation, in order to consolidate the bone.

While in the liver or in other primary tumors RFA is a potential curative treatment and the main end-point is the complete necrosis of the lesion, in bone metastases RFA has to be considered a palliative therapy and the aim is pain reduction: the diameter of the lesion may be not an exclusion criterium and also in big metastasis it is possible to obtain good results.

Main mechanism advocated for pain control seems to be the destruction of sensory afferent nerve fibres in the bone cortex and periosteum, for this reason for larger lesions the goal of the procedure is to obtain a good treatment of the interface between soft tumor tissue and bone.

In addition destroying tumor cells we obtain mechanical decompression of tumor volume decreasing stimulation of sensory nerves and reduction in cytokines and tumors factors production, both involved in nerve sensization and osteoclastic activity.

For this reasons in osteolytic metastases the electrode should be placed in the soft-tissue component of the lesion, close to the involved bone. Even if the complete necrosis of the lesion could not be obtained, it is however possible to interrupt pain transmission, destroying tumor at the bone/soft tissue interface. In our experience, the treatment of a huge bone metastasis (more than 7 cm) of right ileum involving the acetabular roof in a patient with renal cell carcinoma was obtained with a multiple insertion technique: six applications were performed placing the electrode close to the lesion interface with the bone; even if a CT scan 15 days later showed the incomplete necrosis of the lesion, an area of nonenhancing tissue just along the bone-tumor interface was detected and the pain was effectively controlled.

Published results suggest that bone lesions RFA is a safe procedure: no major complication was observed in treated patients.

Possible complications are mainly related by the site and characteristics of treated lesion. In fact, even if lesions within 1 cm from bowel or bladder are generally excluded, transient urinary and faecal incontinence after RFA of pelvic lesions involving the upper sacrum are described. Skin burns can occur at the ground pad site or around the site of RFA in superficial lesions and a cutaneous fistula may develop. In our experience one patient presented an abscess with a cutaneous fistula along the electrode course some days after treatment for a large painful soft tissue mass involving sacrum; local instillations of antibiotics and a surgical drainage were required.

In large osteolytic lesions involving bone segments subjected to functional load (e.g. in the femur or pelvis) fractures may occur. Some authors suggest the use of special cements after RFA to avoid this complication.

Preliminary results show that RFA of bone metastases is effective: some published papers reports significant mean worst pain reduction after treatment. A clinically significant pain relief is experienced in about 90% of treated patients; it is achieved rapidly, within one week and continuing reduction was recorded till week 24.

In our experience we also obtained a significant reduction in worst pain: mean score decreases from 7 to 3.25, 1.87, 0.71, 0.85, 0.75 respectively after one day and one, two, four, eight and sixteen weeks after

treatment.
RFA allows also a significant decrease in opioid requirements with less side effects.
For that reason patients refractory to most conventional treatments may obtain an adequate relief of pain and an improvement of quality of life, reducing opioids use. Therefore RFA seems to be a safe and effective palliative treatment for bone metastases when standard methods fail.
Moreover in case of persistence or recurrence of pain the treatment can be repeated.Anyway further studies are needed to provide effectiveness of this procedure in palliation of painful skeletal metastases.

Special Session
Endoluminal Procedures in the Biliary Tract

5.2

Are plastic stents obsolete?

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There is general agreement that attempts at palliation are worthwhile for patients with malignant biliary obstruction who cannot be resected. Surgical decompression or placement of an endoprosthesis by endoscopic or transhepatic route are the main options. Several randomized controlled trials compared surgical bypass with either endoscopic (1-3) or percutaneous stent placement (4). All of these trials, and a more recent meta-analysis (5) exclusively concerned placement of plastic stents (PS) and concluded that stenting was associated with lower procedure related mortality and major complications rate with no significant difference in overall survival. Consequently, PS has been the most popular palliative procedure along years. Endoscopic and percutaneous PS have been compared in only one randomized trial (6) that strongly demonstrated disadvantages of the percutaneous route in terms of complications. As a consequence of this trial, endoscopic placement became the standard for PS. Development of self expanding metal stents (MS) for percutaneous route along the last 15 years could have changed this assumption since it decreased the incidence of complications of percutaneous route (thanks to decrease in diameter of the delivery system), while improving duration of stent patency. However, the incidence of MS on results obtained with percutaneous drainage has been rarely evaluated. Nevertheless, MS are now available as well for endoscopic placement, so that the question "Are PS obsolete?" may be ask to both endoscopist and radiologist.
Plastic stents: Advantages and disadvantages
Occlusion is the main complication of plastic stents. It results from clogging caused by adherence of proteins, bacteria and sludge to the inner stent wall. Many critical parameters have been studied for trying to slow down PS clogging. It had been suggested that placement of a PS with its distal end above the ampulla of Vater could minimize the occurrence of bacterial colonization or obstruction of the stent by food material, but this failed to be clearly demonstrated. Moreover, occluded stents cannot be easily removed and replaced by endoscopic route when initially placed above the ampulla. Stent material (Teflon, polyethylene, polyurethane, hydrophilic polymer-coated polyurethane, perfluoro alkoxy°) could also influence the rate of stent occlusion by modifying friction coefficient and eventually reducing biofilm formation. But conflicting data concern stent material, the recent literature included, so that no dramatically major gain in stent patency seems to be obtained by changes in stent material (7-9). Several works indicated that presence of side holes increases the occlusion rate and does not provide better drainage (10,11) and most of endoscopists actually prefer to place PS without side-holes in distal malignant obstructions. Stent diameter: Large internal diameter should decrease occlusion due to bile encrustation stents. But the endoscope channel size limits the possibilities and anyway, increasing the diameter generally stiffens the stent, which makes the placement more risky. Large stents also require large tracts if placed through transhepatic approach, which increases pain and incidence of bleeding. Moreover, no controlled study has clearly shown benefit for placing PS larger than 10F. Prophylactic administration of antibiotic agents active against Gram negative germs (ciprofloxacin, norfloxacin, ofloxacin) leading to clogging could have potential advantages. Nevertheless, inconsistent effects were reported, including a recent controlled trial failing to demonstrate any benefit in prophylactic combined administration of ofloxacin + ursodeoxycholic acid compared with ursodeoxycholic acid alone (12-14) and efficacy of prophylactic antibiotherapy still needs further studies.
Despite the attempts to play with the supposed critical parameters, median PS patency does not exceed 4 to 5 months in the literature. Consequently, most of the primary placed PS will have to be removed and replaced along the course of the patient disease, either on demand when the symptoms recur or electively every 3 months.
Migration is another main complication of PS. Migration rates generally remain below 10% in most of the studies but have been exceptionally described up to 40% in first series. Different anti-migration designs have been proposed for endoscopic as well as for percutaneous devices. The most popular one for transhepatic route is probably the Carey-Coons system in which the stent is attached to a subcutaneous plastic button with a suture. However, most radiologists discard the button before using the stent because it may cause pain and local infection or predispose to tumor seeding. On another way, one can say that PS removal is generally easy, that is an advantage when the stent occludes and has to be exchanged.
At last, if a PS has to be placed the recommended state of the art would be a 10F, polyethylene stent without side-holes (at least within the medial part of the stent), in a transpapillary position and without any prophylactic antibiotic treatment.
Endoscopic versus percutaneous stenting
ERCP is the technique of choice for assessment of obstructive jaundice and it may be followed by stenting during the same session. As success rates of endoscopic stenting are relatively high-75% to 95% in the literature (15)- it is broadly admitted that endoscopic route is the first choice in most of the cases.
Percutaneous transhepatic route tends to be reserved to failures of the retrograde endoscopic approach related to anatomical limitations (mainly due to previous gastroduodenal surgery) or technical failure of stenting. Removal and exchange of an occluded PS is obviously easier through endoscopic approach whatever the initial route of stenting.
However, in malignant hilar strictures (types II to IV of the Bismuth classification), catheterization is frequently easier and consequently safer by antegrade transhepatic approach (16). The radiologist can also select the most appropriate lobe for access, or drain more easily both lobes than the endoscopist when indicated, which limit the occurrence of cholangitis. This is true even when using PS, but this is availability of MS that definitively increased the role of percutaneous management in these patients.
Metallic versus plastic stents
To our knowledge, PS and MS have been compared in seven randomized controlled trials. Most of them compared stents placements by endoscopic route alone (17-20). One trial compared percutaneous MS with combined (endo+precut) 14F-PS in hilar obstruction(16), one compared percutaneous MS with endoscopic PS (21), and one concerned comparison of MS and PS both placed under percutaneous route (22).
All these trials demonstrated a significant advantage of MS when considering stent patency. Median duration of patency of PS and MS varied respectively from 96 days to 5.6 months and 272 days to 12.9 months. When placed through the same transhepatic approach (22) MS were followed by a significantly lower major complications rate (10%) than PS (24%; p=0.05)
No controlled study compared MS with PS in hilar obstructions, but there is a broad agreement that MS is the technique of choice. Drainage of collateral biliary radicles remains hazardous through a PS, even if a side-holes stent is used. On the contrary, MS is likely to ensure a proper drainage through its mesh.
Easiness of PS removal and exchange via endoscopic approach might be considered as an advantage compared to the impossibility for removing a MS. Removal may be a real advantage of PS when treating non malignant obstruction, for instance during chronic pancreatitis, where temporary drainage is likely.
However, in malignant diseases, an occluded MS can be managed either by endoscopic or transhepatic route. Food debris can be cleared with a balloon catheter. If there is tumor ingrowth or overgrowth, the bile flow can be restored by inserting another stent (either MS or PS) in the occluded one.
In randomized controlled trials comparing MS and PS, the overall cost of MS (including primary stenting and reinterventions) was significantly lower (16,19,20,22) or not different (21) than that of PS. Lammer et al (22) who compared stents placed by transhepatic route founded the highest advantage in placing MS (7542 $) rather than PS (12129 $)($p<0.001$). Nevertheless, for Arguedas et al. (23) patients survival have the most influence on results and MS for initial palliation is cost-effective only for patients with a relatively long life expectancy (expected to

survive more than 6 months). Pinol et al (21) found that the overall cost of MS was superior to that of PS (respectively 6368 $ and 4767 $; NS) but this difference was reversed when the cost was adjusted for patient survival (respectively 3198 $ and 3241 $ per month alive). Prat et al (20) reported that MS placement was 904 $ cheaper than on-demand exchange of PS, but calculated that cost of MS was greater in the subgroup of patients surviving less than 3 months. They consequently advocate use of PS at initial palliation with exchange for MS after 3 months in patients with still good performance status.
Consequently, in a cost-effectiveness point of view, predictive factors for survival of patients with inoperable malignant jaundice should be essential. For Prat et al. (24) who analyzed seven factors (age, sex, bilirubinemia, weight loss, presence of liver metastases, size), tumor size was the only independent prognostic factor by multivariate analysis ($p<0.05$). A threshold of 30 distinguished two survival profile : median survival at 3.2 months and 6.6 months respectively for tumors greater or smaller than 30 mm. However, today, one can say that there is no reliable method of selection for placing the appropriate stents based on a life expectancy of more or less than 3 to 6 months.
Conclusion : Are PS obsolete ?
Hilar obstruction: PS may certainly be considered as obsolete in patients with malignant hilar obstruction where percutaneous MS stenting is the method of choice.
Percutaneous route: PS are also obsolete in most of the malignant patients who are treated by percutaneous approach: MS present lower rate of complications, remain patent longer and have a lower cost. It may still be useful for some patients in poor condition with a low life expectancy who cannot can not be treated by retrograde endoscopic route.
Endoscopic route: In many institutions, primary PS stenting remains the standard for palliation of malignant obstruction of the common bile duct.
Non malignant pathologies:
Single or multiple temporary PS may be placed in patients with biliary stricture due to chronic pancreatitis but this therapeutic option is debated since reported long term success rates do not exceed 30% (25). Temporary PS placement for dilation has also been proposed for patients with recurrent benign traumatic strictures of the common bile duct or of a biliary-enteric anastomosis. In fact, it is here in competition with iterative balloon dilation that remains the method of choice.

5.3

Treating Benign Biliary Diseases

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The field of percutaneous biliary interventions includes the management of malignant and benign diseases. Causes of benign diseases are congenital, traumatic, iatrogenic, inflammatory, or parasitic as well as others related to external parameters (1).
Iatrogenic trauma together with inflammatory diseases, are the two most common causes for benign biliary stricture formation (in combination or not with calculous disease). The most common traumatic cause is intraoperative biliary injury, usually during laparoscopic or open cholecystectomy (2). Unfortunatelly, injury revealing symptoms are found in form of bile leakage, bilomas or obstructive jaundice. Delayed obstruction can occur on the basis of a bilio-digestive anastomotic stenosis (3).
The second most frequent cause is inflammatory biliary disease, usually in form of secondary cholangitis. Cholangitis leads to formation or worsening of existing biliary strictures and stones. Untreated strictures and calculi are leading to new cholangitis, until the end stage of biliary cirrhosis (4).
Compared to malignant biliary disease, benign strictures present different clinical problems due to the fact of longer patient life expectancy and no palliative character of the interventions (5). Since their incidence is lower, the number of cases is rather limited, so that clinical experience is gained much harder (1,2,6).
Especially, complications after laparoscopic cholecystectomy should be managed by a multidisciplinary approach wherein the radiologists and endoscopists cooperate very closely with the surgeons (2,7). There is currently no consensus on which patient should have what type of procedure. Surgical and endoscopic repair is preferred in many cases, therefore percutaneous approach is reserved for special indications, which usually are the most complicated. Percutaneous treatment is relatively contraindicated in patients with primary sclerosing cholangitis, biliary cirrhosis and in cases where no transhepatic access is available.
Percutaneous biliary interventions include:
- treatment of post-inflammatory and post-operative strictures
- treatment of post-traumatic and post-operative iatrogenic bile leakage
- percutaneous management of intra- and extrahepatic biliary calculi.

The shorter the biliary stricture is, the better result we have after balloon dilatation (8,9). Depending on the site of the stenosis, balloons with a diameter of 8-14 mm are used. General anaesthesia may be required (5). Prognosis gets worse the sooner the stricture reoccurs (10). Strictures near the hepatic hilum are more difficult to be treated than strictures of the extrahepatic biliary system (11).
Re-stenosis may occur in more than one third of the cases after the first year (3). New dilatation can be performed in case of re-stenosis. Long term placement of large bore catheters is indicated (3-6 months) and high grade patient co-operation is required. Primary and secondary patency is 70% and 82% in five years, respectively (12). Best results are found in iatrogenic strictures (76% in 3 years), followed by bilio-digestive strictures (67%) and primary sclerosing cholangitis (42%) (4). Metallic stents do not seem to improve long term patency and cannot be advocated, except in special cases (1,13,14).
Complete stone extraction after dilatation can be performed in 77% of the cases (15). The stones may either be transhepatically removed by means of special baskets or pushed down to the duodenum (15,16). The procedure can be performed when ERCP and sphincterotomy with stone removal is technically impossible or refused and in cases with previously undergone choledochojejunostomy (16). Causes of failure are large or multiple impacted stones, as well as acute ductal angulations (17). Percutaneous transhepatic cholangioscopy can help in such difficult lithotripsy cases, especially in combination with electrohydraulic lithotripsy, which can be very effective (97%) followed by successful fragment removal (94%) (18,19,20).
Procedure related major complications such as hemorrhage or septicaemia may occur. Nevertheless, most of the complications are minor and can be treated conservatively, or by percutaneous radiological techniques.

Special Session
Procedures in Gynecology and Obstetrics

6.1

Pelvic congestion syndrome

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It is obvious that asymptomatic permanent pelvic varices are common since the second pregnancy. No further demonstration is needed to prove that they are frequently originating a specific symptomatology mainly represented by the pelvic congestion syndrome (PCS). This term was coined by Taylor.[1,2] It is corresponding to a stereotyped symptomatology which is fully described by Hobbs.[3] This kind of syndrome is often unknown and, by the way, poorly treated. It has been rarely seen in man. Before the 60s, lack of diagnostic means generated non evidence based hypothesis as psychosomatic and psychiatric aetiologies.[4-6] The various causes of this syndrome were reviewed and detailed by Hobbs.[3] This pathology knowledge improved initially with radiological studies[8-11] was completed later with anatomic,[12-18] hormonal[19,20] and haemodynamic[21,22] works.
Pelvic congestion syndrome is related to venous insufficiency of one or several pelvic venous sectors responsible for stasis, venous leaks and varicose veins. These sectors are made of broad ligament and gonadal vein territories mainly drained by ovarian veins to the renal vein on the left side and to the inferior vena cava on the right one. The visceral venous plexus are drained by visceral internal iliac tributaries as vesical, vaginal, uterine in woman and as vesicoprostatic in man and as medial rectal veins in both. The parietal sectors are drained by parietal internal iliac tributaries. In PCS, drainage by obturator and internal pudendal veins is significant. (internal pudendal is a mixed vein).
Valvuled veins are extensively interconnected through a system of valveless venules with a potential bidirectionnal blood flow. Connections are both intra pelvic (anterior-posterior, transverse, intervisceral, visceral-parietal), and extra pelvic more particularly with inferior mesenteric vein and veins of the lower limbs. Hormonal impact is significant. Presence of oestrogen, progesterone and androgen receptors have been demonstrated on the whole venous net. The receptor distri-

bution is different on each venous territory. The receptor density depends on the degree of hormonal impregnation and on menstrual cycle. At a physiological rate, sexual hormones have a favourable effect on venous system as venous constriction and antithrombotic substances secretion. Over production of oestrogen and/or progesterone during pregnancy produces venous dilatation responsible for venous stasis. Acquired or congenital valve insufficiency, genetic abnormality of the structure of the venous wall, mechanical and hemodynamic factors (notably present during pregnancy) are effective and can lead definitively to venous insufficiency of one or several sectors.

Symptoms are always made of pelvic chronic pain without any evidence of inflammatory disease. Pain increases during premenstrual period and prolonged standing up. Dysmenorrhea, perineal heaviness, dypareunia, post coital distress, blatter irritability (dysuria and frequent miction without evidence of urinary infection), fullness of leg veins are noted at different level. If non identified, these symptoms could lead to irritability, anxiety and depression. Previous history of varicose veins more particularly during pregnancy period, genital varicosities and presence of atypical leg varices are to be investigated.

When this clinical entity is identified an endovaginal ultrasound and a complete duplex scan examination are required looking for deep iliac venous thrombosis and May-Thurner syndrome. Endovaginal Duplex scan has an excellent predictive value for varicocele diagnosis, but is less efficient for identifying other varicoses sites. In the same manner, multi - dectector row CT is convenient for ovarian venous system study and for identifying compression of the left renal vein. This kind of examination is inadequate for internal iliac tributaries varices diagnosis. If MR venography can visualize pelvic varicose veins, supine position, venous pelvis complexity and great variability of blood flow velocity make this technique useless to define therapeutic strategy: it is still under investigation.. Coelioscopy is often proposed. It is useful to discuss pelvic inflammatory disease, endometriosis and other genital pathologies. Observation of broad ligament and ovarian varicosities allow diagnosis of pelvic varices, but in supine position or Tredelenburg's position and with abdominal cavity inflation these varices are tightened and less visible. Retroperitoneal varicose veins are not seen. In all cases, a typical symptomatology must lead to a retrograde selective pelvic phlebography as this is the only one procedure able to draw up an anatomic and hemodynamic cartography of pelvic veins. This is a well standardized procedure which is performed with 4F ancillary material according to the Seldinger's technique through the common femoral vein. It does not require in hospital stay and allows therapeutic decision making. We defined three varicocele types. Type 1 corresponds to a pathway to circumvent an obstacle, either an anomaly of left renal venous return or an obstructive ilio-caval syndrome. Type 2 occurs secondary to local involvement of broad ligament support tissue allowing venous distension. Among the causes to be considered are: obstetrical broad ligament ruptures (the Allen-Masters syndrome) and septic destruction, like that seen during salpingitis or pelvic peritonitis. Type 3 concerns dilatation caused by ovarian venous incompetence and pathological reflux of left renal vein blood; valves in the genital vein are always absent or leaky; dilatation because of the absence of hemodynamically correct drainage of the right ovarian vein into the inferior vena cava.

Embolisation as stand alone procedure could be dangerous if varices are related to supra pelvic or pelvic obstacle like a nutcracker syndrome[23] and embolisation could be ineffective if there is destruction of pelvic surrounding tissues. Surgical interruption of pelvic flow have been performed with good long term results[24,25] and coelioscopic approach which is less invasive could be used in some cases.

Endovascular treatment is well known for ovarian vein interruption.[26-28] Very few teams in the world use endovascular procedures for internal iliac tributaries occlusion.[29,30] Our seven years experience in pelvic embolisation led to define precise indications and led to the conclusion that this kind of treatment is efficient under the condition of a complete embolisation involving all diseased sectors. It is the reason why single varicocele embolisation is not efficient if any other pathological sector remained non treated. Six vein embolisations is a maximum, if more is required, it is considered as a global pelvic venous insufficiency which is rarely a good indication for endovascular treatment. The embolisation has to be delayed after the diagnostic phlebography. It is performed through a contralateral femoral percutaneous approach, under neuroleptanalgesia and required a half day hospital stay. Bilateral varicoses veins require two separate embolisation procedures: one pelvic side after the other with a 2-4 weeks time interval. The deletion of varicoses veins stemming from internal iliac tributaries is done by using surgical glue injected in varices through a micro catheter and by using platinum coils in the venous afferent which is located at the varices origin. Varicoceles embolisations are made by coils for interrupting ovarian tributaries as deeply as possible and coil, glue or sclerosing agents for the venous ovarian trunk. Because of the numerous tributaries often present along the trunk, embolisation must involve the whole ovarian vein. No significant complication requiring specific therapy was observed in our experience. In more than 500 embolisations, neither immediate or late migration of coils was observed. There are only very few cases reported in litterature.[27-30] Nevertheless asymptomatic migrations of small fragment of polymerized glue during the procedure were noted, in such cases thoracic CT Scan was normal. Contrast extravasation is more frequent but no sequela has been reported.

Success rates for decrease of chronic pelvic pain has been variable but tend to approach 80% in the recent published series,[27-30] probably with a better knowledge of techniques and a better selection of patients.

The pelvic venous syndrome is a frequent syndrome in women secondary to venous incompetence of varying causes. Transcatheter embolotherapy provides an effective option when it is indicated and complete.

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6.2

Embolization for Post Partum Hemorrhage

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Postpartum hemorrhage remains one of the leading causes of maternal mortality throughout the world. In addition, it is one of the most dramatic acute hemostatic and vascular disorders occuring in young women. Postpartum hemorrhage (PPH) is usually defined as blood loss of more than 500 ml (after vaginal delivery) during the first 24 hours following delivery. Uterine atony and lower genital tract laceration are the most common causes of PPH. Abnormal placentation has an increased incidence and is a potential life-threatening situation at the time of delivery. Conservative treatment is based on early administration of uterotonic drugs, vaginal packing and surgical repair of genital

tract tears. When bleeding fails to respond, surgical ligation of the hypogastric or uterine arteries may be effective particularly if performed at the time of cesarean section. Hemostatic hysterectomy is offered as the last resort treatment in the management of intractable PPH. However, it is associated with a high rate of morbidity and mortality, and the loss of subsequent fertility. Arterial embolization to treat PPH was first used in 1979 in a woman who previously underwent bilateral hypogastric arterial ligation and hysterectomy.

After pluridisciplinary evaluation, the protocol for treatment should be determined by means of consensus among the anesthesiologist, the obstetrician and the interventional radiologist. Initial medical treatment is aimed at three goals: correction of hypovolemic shock, treatment of disseminated intravascular coagulation disorders with fresh frozen plasma and with units of platelets or fibrinogen when needed, and management of uterine atony with pharmacologic measures including early introduction of intravenous prostaglandin analogues and uterine massage. The decision to perform embolization is made on the basis of active or persistent bleeding despite appropriate medical treatment and obstetrical measures.

Internal iliac artery angiography with selective study of the anterior division is performed on both sides to identify the uterine artery and the potential site of bleeding. Flush pelvic aortography may be useful to identify additional arterial supply to the uterus from other sources such as the ovarian or round ligament arteries. Angiography reveals extravasation of contrast material, which arises from the uterine artery or the vaginal artery in 10-50% of cases only. In the absence of extravasation of contrast agent, the characteristic appearance of uterine atony with enlarged spiral arteries or diffuse arterial spasm may be found.

Selective embolization of the bleeding arteries (with identified extravasation of contrast material) or both uterine arteries (in case of uterine atony) should be performed. Bilateral embolization is mandatory because of potential recurrence of bleeding due to right-to-left anastomoses after unilateral embolization. In case of severe vasoconstriction or failed selective catheterization, bilateral embolization of the anterior division of the hypogastric artery, which maintains flow to the branches of the posterior division, is an alternative technique that permits a shorter procedure and reduced radiation exposure without significant complications. Pledgets of resorbable gelatin sponge, which provide a temporary occlusion are particularly suitable because the injury and coagulation disorders should be resolved in a relatively short period. In selected cases such as abnormal placentation, the use of large non-spherical polyvinyl alcohol particles or calibrated microspheres (> 500 μm) has proved its value with no side-effects. Steel coils or acrylic glue are occasionally useful to treat massive extravasation of contrast material (i.e. arterial rupture).

The clinical success rate associated with arterial embolization is around 80%. Uterine atony following vaginal delivery is the best indication for embolization with a success rate of 90% whereas embolization seems to be less affective after cesarean section. Coagulation disorders can be successfully corrected by embolization. Abnormal placentation (placenta accreta and percreta) which remains a major cause of hysterectomy may also benefit from arterial embolization although the number of reported cases is low. Embolization can be offered after failed arterial ligation or hysterectomy. Complications are minimal in these young and otherwise healthy women and a high degree of flow to the uterus tends to protect against unexpected reflux of the embolic material. However, training of interventional radiologist is a key to successful embolization for this life-threatening condition.

Embolization allows preservation of future reproductive function. Pregnancies have been reported after arterial embolization in a wide range of clinical settings including PPH, arteriovenous malformations or uterine fibroids. Even a significant percentage of women treated by embolization for PPH don't want to be pregnant again because of the potential risk of recurrence, the reproductive potential seems intact.

Arterial embolization is a very effective treatment to treat life-threatening postpartum hemorrhage after failure of medical treatment and obstetrical measures. Embolization should be applied early in the course of events in order to avoid hysterectomy. Pluridisciplinary management for these women should ideally be realized in highly specialized centers open 24 hours a day to provide low-risk conditions for the interventional radiologist.

Foundation Course
Vascular IR

7.1

Conversion of Retrograde to Antegrade puncture for Intrainguinal access.

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Antegrade puncture is the standard means of obtaining access to the common femoral artery to carry out infra-inguinal intervention. This access requires a much higher puncture than usual with a longer subcutaneous tract compromised by the abdominal apron particularly in obese patients and therefore is technically more difficult. This technique requires more skill and training than retrograde punctures which are usualy carried out for diagnostic angiography. Depending on the numbers of interventional cases within the unit the numbers of antegrade punctures carried out by any individual operator can be very small so that individual operators may constantly be on the learning curve. If a sufficiently shallow angle of puncture of the common femoral artery is not obtained then the guidewires preferentially enters the profunda femoris artery requiring additional wire and catheter manipulation and prolonging the procedure. It is important to avoid supra-inguinal puncture of the iliac artery or direct puncture of the SFA which cannot be effectively compressed. Other pitfalls include inadvertent puncture of the profunda femoris artery or femoral vein requiring additional punctures, this is particularly important to avoid in patients for possible thrombolysis. Duplex can be used to aid in direct antegrade punctures (1,2). However this may not be easily available in all departments and can be difficult to use in obese patients. Alternatives to direct antegrade puncture include a popliteal puncture, subclavian approach, contralateral approach or conversion from a retrograde to antegrade puncture(3-6).

The technique of conversion from retrograde to antegrade puncture is a very simple technique even in tortuous or ulcerated iliac arteries . Retrograde punctures are technically easier to perform and most operators have much greater experience of these, as they are routinely carried out for obtaining access for diagnostic angiography. The puncture tracts, except in very obese patients, are usually short. In the absence of severe aorto-iliac disease turning the catheter into the ipsilateral iliac system and then into the SFA is relatively straightforward although there is a short learning curve. The skin puncture site is lower away from the abdominal apron and is therefore easier to palpate with much reduced likelihood of supra inguinal, direct SFA or inadvertent profunda femoris arterial puncture.

Technique for conversion from retrograde to antegrade.

For conversion of retrograde to antegrade puncture ,a lower puncture site is chosen at the level 1-2cm above the inguinal skin crease and the needle angled more vertically, at approximately 60 degrees to the skin surface pointing cranially. As the angle of puncture required is more vertical than usual to facilitate turning of the catheter a slightly higher puncture site is required compared to punctures for diagnostic angiography. A satisfactory puncture is confirmed by easy passage of the guidewire or by contrast injection. A standard 5mm J guidewire (Cooks UK) is then passed into the lower aorta and the needle removed. Following this a curved vascular catheter (sos Omni or Simmons 1 Cordis UK) is introduced until the tip extends beyond the guidewire and formed in the lower aorta. The gudiewires is then exchanged for a angled terumo (0.035" Glidewire, Meditech, Watertown, MA, USA). The angled glide wire is then advanced back down the ipsilateral iliac system and both wire and catheter withdrawn into the common femoral artery and the guidewire then further advanced until a position in the SFA is achieved. The loop in the guidewire is then reduced by further withdrawal of the catheter until it was just traversing the arterial puncture site. Finally the guidewire and catheter are advanced into the SFA until there is sufficient guidewire to allow placement of a 6F vascular sheath .Using a angled glidewire negotiation of even the most difficult tortuous and calcified arteries is feasable and reduces the risk of plaque dislodgment. Although popliteal puncture, sublcavian puncture or a contralateral puncture approach can be used in some difficult cases. When complications arise such as distal embolization occur these can be more difficult to manage with these approaches. The torque control of catheters and wires using the subclavian and contralateral approaches particularly with the more distal interventions can be extremely difficult. Especialy when dealing with chronic and calcified occlusions.

The publication of standards for interventional radiology (7) has focussed attention on strategies to minimise complication rates. The causes of complications associated with interventions are multi factorial(8). Identified risk factors include obesity, hypertension, anti-coagulation and uncorrected coagulopathies, large diameter catheters and vessel wall calcification. Such factors should be identified before the procedure and optimised as far as possible. Apart from better training and more experienced operators to achieve the best results, any technique that makes intervention easier, including arterial puncture would be advantageous. Retrograde puncture with conversion to antegrade should be considered as an alternative to direct antegrade puncture particularly if direct antegrade puncture is likely to be difficult.
So why is this technique not suitable in all patients?
Despite it's clear advantages over direct antegrade puncture, there is a significant increase in radiation penalty. We found in our ranomized comporative study with standard antegrade puncture(6), the technique of turning a retrograde to antegrade puncture required a substantially longer screening time and thus resulted in a higher radiation dose than antegrade puncture. Mean screening time was 2.1 minutes (range 0.3-6.5), resulting in an average radiation dose of 7,950 mGy cm^{-2} (range 820-71250) for retrograde puncture conversion and 0.7 (range 0.0-3.2) minutes, giving an average radiation dose of 1120 mGy cm^{-2} for direct antegrade puncture. This is due the necessity of screening of the catheter and wire down from the aorta to the femoral artery in all patients in the retrograde group, through the thickest part of the patient ie abdomen and pelvis. Although the radiation dose could be reduced by using pulsed fluorography, which was not available to us at the time of our study. These differences justify antegrade puncture as the technique of choice for the majority of patients when this approach is likely to be straightforward.
Retrograde puncture with antegrade conversion should be considered primarly when direct antegrade puncture may be considered to be difficult epecially in such patients who are considered obese with a large overhanging apron or who have had previous surgery with colostomy or ileostomy.

7.2

Thoracic Aortic Dissection

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Aortic dissection represents the most common severe event involving the aorta with catastrophic consequences.
Dissection is generally secondary to degeneration of the collagen and elastin matrix within the aortic medial layer. The formation of a tear in the aortic intima allows pulsatile blood to enter and propagate into the aortic media. The blood-filled space between the dissected layers of the aortic wall becomes the false lumen.
Shares forces may cause further tears in the intimal flap producing exit sites or additional entry sites. The distension of the false lumen, moreover, can make the intimal flap bow into the true lumen narrowing its calibre.
The dissection can proceed for a variable distance, usually in an antegrade direction but sometimes retrogradely from the site of the intimal tear. The propagation of the flap follows an unpredictable course and the true and false lumens may appear in different complex configurations and the branch-vessel origins may be distributed in unpredictable patterns, with potentially life-threatening ischemia of the viscera and lower extremities. (1,2)
The most frequent dissections originate either in the ascending aorta, few centimeters far from the aortic valve (Stanford type A), or in the aortic arch, or in the descending aorta, just distally to the origin of the left subclavian artery (Stanford type B).
In addition to the classical intimal tear, aortic dissection may also develop as a consequence of vasa vasorum rupture within the aortic media with consequent formation of an intramural hematoma that may remain confined within the media or propagate into the intimal layer. Penetrating atherosclerothic ulcer may also represent a precursor of aortic dissection. (1,3,4)
The creation of a false aortic channel predisposes the patient to the development of life-threatening sequelae such as aortic rupture, cardiovascular failure related to pericardial tamponade or adverse hemodynamics and organ ischemia secondary to the involvement of the primary aortic branch vessels. (5,6)
Infact the most frequent complication of aortic dissection is represented by peripheral vessels ischemia that can be divided into three groups: static, dynamic and mixed. (7)
In the static group, ischemia is due to the extension of the dissection into a branch vessel with no re-entry point, producing a focal stenosis that may cause end-organ ischemia. This complication can be managed with percutaneous placement of a stent into the true lumen.
In the second group, the dissection flap is pushed across the ostium of a branch vessel and held there by the pressure in the false lumen limiting the blood flow. A fenestration to create an interluminal communication will divert blood flow, if there is a proven gradient pressure, from the false to the true lumen thus decompress the false lumen and relieve branch-vessel obstruction.
A combination of the characteristics of the static and the dynamic group represent the mixed group.
For all these reasons, the prognosis of untreated acute (defined as less than two weeks after onset) aortic dissection is dismal with a mortality rate of 36-72% within 48h, 62-91% within 1 week and 90% within 3 months. (8)
The increasing use of modern non-invasive imaging modalities, such as Magnetic Resonance Angiography (MRA) and Multidetector-row CT Angiography (CTA), allow the identification of a dissection process at an earlier stage. Axial and multiplanar 3D images (MPR-multiplanar reconstruction, MIP-maximum intensity projection, VR-Volume rendering) are utilized to localize the primary entry tear, to evaluate the extension of the intimal flap, to measure the dimension of the aorta (false and true lumen), to evaluate aortic branches.
Transesophageal ultrasound (TE) and digital subtraction angiography (DSA) represent two more invasive techniques that can be used, especially in doubt cases, to visualize the intimal flap, to evaluate the blood flow into the two lumens and in the branch vessels.
Analysis and measure of the true and the false lumen can be also obtained with intravascular ultrasound (IVUS).
Symptoms may mimic common disorders and characteristic physical findings may be absent.
All patients with acute aortic dissection should be monitored in the intensive care unit and should receive immediate aggressive medical therapy with intravenous administration of beta-blockers to eliminate pain, to reduce blood systolic pressure (less then 100-120 mmHg) and to decrease the left ventricular dP/dt in order to lower arterial wall stress.(9) Refractory hypertension resulting from renal arterial compromise with consequent rennin release may respond to angiotensin-converting enzyme (ACE) inhibitors. (10)
Because of the high risk of aortic rupture and consequent early death, patients with a dissection involving the ascending aorta (Stanford type A) should undergo emergent surgical aortic reconstruction with or without valve replacement. (11)
In case of uncomplicated type-B dissections, the medical therapy with administration of vasodilators and beta-blockers is far better than surgery but 14-20% of patients who survive the acute phase develop aneurysms within 1-5 years and then a surgical repair is necessary. (12,13,14)
When the medical therapy is not effective or when vascular complications are present, a surgical or endovascular treatment is mandatory. The surgical therapy is however associated, especially in the acute setting, with high mortality rates (5-26%), spinal cord injuries (3-20%), and heart or renal failure (3-15%).(14,15)
The primary objective of the surgical treatment is to close the entry tear by placing a graft or by repairing the open re-entry site. The blood flow into the false lumen is obliterated by the circumferential reapposition of the dissected septum to the aortic wall at the distal graft anastomosis. (16)
Many groups have recently investigated the feasibility of the percutaneous treatment of type-B aortic dissections. (13,14,17,18,19)
In the last few years, the endovascular stent-graft therapy has progressed from the placement of home-made devices to the routine use of commercially manufactured
endoprostheses which are deployed within the true lumen across the primary entry tear for its complete obliteration.
Presently, there are very few commercially available thoracic stent-grafts: Talent LPS (World Medical/Medtronic Inc., Santa Rosa, CA, USA), AneuRX - DTA (Medtronic AVE, Sunrise, FL, USA), Excluder TAG (W.L. Gore & Associates, Flagstaff, AZ, USA) and Zenith (Cook Inc, Bloomington, IN, USA).

The initial results of these feasibility studies suggest that stent-grafts offer an attractive alternative to open surgical repair since this treatment can potentially reduce operative risks, hospitalization times, and procedural costs.
Stent-graft coverage of the entry site closes the primary communication to the false lumen whose flow is markedly reduced or choked of completely. In acute type B dissection, the true lumen immediately increases in diameter without a corresponding incremental change in the overall aortic diameter.
Downstream, any dynamic branch vessel involvement of the abdominal aortic true lumen arteries, compromised by the dissection process, is reversed after stent-graft placement. The time of this process is variable and based on the size of the false lumen, on the abdominal branch vessel distribution off the aortic lumens, on the retrograde thoracic aortic false lumen branch vessel flow from collaterals and on the retrograde perfusion from the abdominal aortic false lumen.
Early results from different clinical series of stent-graft management in patients with acute and chronic type B dissection are encouraging. [18-21] The flow obliteration through the entry tear into the false lumen was achieved in more than 90% of cases, with complete thrombosis of the proximal thoracic aortic false lumen in 80-95%.[8] On the contrary thrombosis of the distal thoracic false lumen was noted less frequently.
A post-implantation syndrome is reported by Won in 23 patients treated with stent-grafts for thoracic aortic dissections and aneurysms with fever, mild leukocytosis and elevated C-reactive protein for no more than ten days. [22]
For a correct stent-graft deployment the proximal and distal necks length must be at least 20 mm. The proximal neck length can be increased by covering the origin of the left subclavian artery with stent-graft leading margin between the left carotid and subclavian arteries.
The potential for ischemia of the left arm may be predicted by preliminary occlusive balloon inflation for 20 min in the left subclavian artery with symptomatic monitoring to assess the integrity of the collateral circulation. Anticipated problems may be overcome performing a left common carotid to left subclavian arterial by-pass graft.
Moreover if the primary entry tear is located at the level of the aortic arch a preliminary revascularization of the left carotid artery with carotid-to-carotid bypass and left carotid-subclavian by-pass with proximal ligation of the left common carotid and left subclavian arteries can be performed. [23]
On the contrary there are no easy management strategies to deal with a short distal neck above the celiac trunk. Intentional coverage of the celiac is not an innocuous tactic despite a coexisting normal superior mesenteric artery capable of supporting an apparently normal network of collateral flow.
Dake reported four cases of death following intentional stent-graft coverage of the celiac artery during treatment of thoracic aortic aneurysms with short distal neck. Two patients died for liver failure and two for sepsis with splenic and pancreatic infarction respectively. [8]
One of the most important technical challenges in stent-graft implantation is represented by the optimal method to select the correct diameter and length of the prosthesis. Since the true lumen is a fraction of the overall trans-aortic diameter and rarely cylindrical in shape, choosing the correct device dimension is a real dilemma. Most authors base their selection on more than one measurement. In our experience the most compelling is the diameter of the non dissected aorta immediately proximal to the entry tear and distally at the level of the landing zone evaluated with multidetector spiral CT angiography. This measurement plus an oversize factor of 20% to ensure secure anchoring and a tight circumferential seal, is the approximative device size more frequently used in current practice.
Obviously, if there is a retrograde proximal extension of the dissection from the entry site, other planning steps must be considered. These include: calculation of the mean true lumen diameter from measurements of the maximum and minimum true lumen dimensions and selection of an arbitrary diameter corresponding to a value larger than the true lumen but smaller than the overall aortic diameter. [1]
In terms of the device length, most investigators implant devices that are clearly longer than the entry tear and usually range from 10 to 15 cm in length. [8,24,25] After implantation this added length confers to the aortic morphology an appearance that is more normal, especially in the arch, than that observed following placement of a shorter device. In addition, the longer device promotes a more rapid formation of thrombus within the proximal thoracic aortic false lumen but an extension in the distal-third of the descending aorta should be avoided to reduce any possible risk of spinal cord ischemia.
Another technical challenging in the percutaneous treatment of aortic dissection is the use of multiple devices. If more than one device is required for anatomical characteristics of the primary entry tear or for a diameter mismatch (greater than 4 mm) between the proximal and distal necks, the smallest diameter device is deployed first, irrespective of its location. Subsequently, the larger diameter device is coaxially placed with at least 3-cm overlap to enhance the interference seal between the grafts.
If the anticipated diameters of multiple grafts are equal, the proximal device is usually deployed first with additional coaxial devices placed successively distal.
Another concern that still requires attention is the large delivery profile of current devices relative to the iliac-femoral arteries. Injuries to conduit arteries and arterial access complications are common and the clinical sequelae of these complications are often significant. Indeed, the frequency of these events and the more alarming reports of strokes, due in part to manipulation of large, bulky, and semi-rigid delivery systems within the aortic arch, mandate immediate development of smaller, less traumatic devices.
Complications including paraplegia, rupture, extension of the dissection into the ascending aorta has been reported in the early experience of endovascular acute dissection treatments. [26,27]
One major problem related to type-B dissection repair is represented by spinal cord ischemia, recorded particularly after surgery. [15] The effect of endoluminal repair on the spinal cord is sill unknown but the absence of aortic clamping, which may cause left-sided heart failures and spinal cord ischemia, may reduce the incidence of paraplegia (<3%).[14,15]
Endoleak represent the most common complication following endovascular treatment of aortic dissection with a rate ranging from 4 to 24%.[25] Leakage is classified according to the site of origin in proximal, distal or middle graft. The causes of proximal or distal endoleak are incomplete fixation of the stent-graft to the aortic wall (type 1), while middle-graft leak is consequent to retrograde blood flow (type 2) or graft defects (type 4). Endoleaks can also originate from an incorrect overlap of stent-grafts (type 3) when more then one devices are implanted. [1,8,25]
Generally the prognosis for type 1 endoleaks is more serious and aggressive endovascular or surgical intervention is recommended when type 1 endoleaks are documented more than 2-4 weeks after stent-graft implantation.
As the endovascular treatment of aortic dissection a new technique, an accurate follow-up protocol is mandatory to evaluate the configuration of the stent-graft, the origin and cause of endoleak, the modification of true and false lumen, and the distal blood flow. In our experience follow-up is performed with multidetector spiral CTA performed within 4-5 days after stent-graft placement, after 3-6-12 months and then after every year. Only in case of severe complications a DSA is also performed.
The placement of a stent-graft across the primary entry tear prove to be a more effective single-step treatment than the traditional surgical procedures, which are technically complex and have significant morbidity and mortality.
However, thoracic aortic endovascular procedures must be performed by an expert team composed of interventional radiologists and cardiovascular surgeons with the aid of excellent imaging facilities since the result mainly lies on the exact localization of brachiocephalic vessels for the correct deployment of the stent.
Future application of these evolving techniques may also allow the percutaneous treatment of selected patients with type A dissection.

Special Session
Endoluminal Treatment of Thoracic Aneurysms

10.3

Problems and solutions in endoluminal treatment of thoracic disease

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Introduction:
Endoluminal treatment of diseases of the thoracic aorta is rapidly becoming established in clinical practice. However, increasing experi-

ence is also uncovering some serious problems associated with the procedure. This presentation is about the problems associated with thoracic aortic endoluminal procedures and some solutions to these problems. The problems can be divided into those related to access, neurological complications, device related problems and those specifically related to dissections.

Access:

The large size of the introducer sheaths can lead to damage to the access arteries. Rupture of the external iliac artery can be caused on insertion, and the external iliac can be avulsed from the common iliac on removing a sheath which is too large for the recipient artery. If the guide wire is left in, occlusion balloons can be deployed to prevent haemorrhage. This can be followed by either open surgical repair or endovascular repair with covered stents. Imaging of the abdominal aorta, iliac and femoral arteries is essential to predict problems with access. Diseased vessels can be bypassed with grafts sutured to proximal arteries.

Neurological complications:

Manipulation of the guide wire in the aortic arch can cause strokes related to embolisation of atheromatous debris. Sudden unexplained increases in the systemic blood pressure may be the first sign of a stroke. Fortunately these are often small and patients can make a good recovery. However, permanent deficits may occur. The only solution is to keep manipulation of guidewires and devices in the ascending aorta to a minimum.

Paraplegia is one of the most serious complications associated with thoracic endografting. This can be readily recognised during or at the end of the procedure if local or regional anaesthesia is used. Insertion of a cerebrospinal fluid drain may completely reverse the neurological deficit. The drain should be left in for 3 days after which it can be clamped for four hours prior to removal if no further neurological complications occur.

Device related complications:

The definitive stent graft has not been manufactured as yet, and all the current devices have strengths and weaknesses. Fractures of the metal frame has been reported with both the Talent and Gore Excluder devices. The Talent stent graft originally was manufactured with a strong connecting bar which straightened it. This made the treatment of tortuous aneurysms difficult, and modular disconnection has been reported. The Endofit device has poor column strength and tends to move distally on deployment. Reports have also detailed puncture of the Endofit graft material by the metallic stent.

Dissections:

Endoluminal treatment of dissections requires different techniques to aneurysms. Balloon dilatation is to be avoided as it may convert a type B dissection into a more serious type A with lethal consequences. Bare metal stents should not be used for the same reason. Rigid sheaths and devices may also tear the aorta in acute dissection causing more proximal dissections.

Conclusions:

The treatment of thoracic aortic pathology with endoluminal devices is in its infancy. The design of the devices will continue to improve with a consequent decrease in device related complications.

Special Session
Endoluminal Treatment of Abdominal Aortic Aneurysms

13.1

What have thirteen years of endovascular aortic aneurysm repair taught us?

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Introduction

Since its first description in 1991, the placement of aortic stent grafts has become a routine treatment for abdominal and thoracic aortic aneurysms and it is estimated that around 25,000 patients worldwide have been treated with the technique. There have been continuing technical refinements with the advent of better devices and improved case selection, but controversies persist.

Patient and device selection

• Multislice computed tomography (CT) and Magnetic Resonance Imaging (MRI) with three dimensional reconstruction have superseded calibrating angiography in the work-up of patients for aortic stent graft insertion. Both are non-invasive, enable accurate measurement in multiple planes and show the entire aneurysm, not merely the lumen.

• The proportion of aneurysms suitable for endovascular repair has steadily increased with experience of the technique and technical refinements of the devices. Around 70% of abdominal aortic aneurysms can currently be stented. The use of bare metal supra-renal fixation to allow deployment in shorter necked aneurysms has become established and does not appear to be detrimental to later renal function.

• Bifurcated devices are generally accepted as the preferred option in most patients as they more closely mimic normal vascular anatomy. Early experience with tube grafts showed that they were only suitable for around 5% of patients and that the incidence of distal type I endoleaks was unacceptably high. Adequate sealing between graft and aortic wall is best achieved in segments of non-diseased vessel and bifurcated grafts extending into the distal common iliac arteries are most likely to achieve this.

• The size at which aneurysms merit endovascular treatment remains controversial. Initial data from the UK small aneurysm study[1] suggested that surgery should be reserved for those aneurysms greater than 5.5cm and most centres currently use this criterion both for open and endovascular repair. However, outside of the strict setting of a clinical trial this threshold is felt by many to be too high when considering intervention for abdominal aortic aneurysms in women. It may indeed be that the correct threshold for endovascular repair will prove to be lower, particularly as endovascular repair of smaller aneurysms appears to be associated with fewer complications [2].

Complications

The management of complications following endovascular aneurysm repair is a continuing challenge. Type I, II and III endoleaks, limb kinks and limb occlusions can usually be managed with radiological techniques although adjuvant surgical procedures such as femoro-femoral crossover grafting and aortic banding have an important role.

• Type I proximal endoleaks are associated with a high incidence of continuing enlargement of the aneurysm sac and require urgent repair. Primary type I endoleaks should be repaired on the same hospital admission. Distal type I endoleaks have a less malignant course, probably because of the presence of an outflow tract.

• Type II endoleaks rarely require treatment. Primary type II endoleaks resolve spontaneously in at least 75% of cases and secondary type II endoleaks are both rare and seldom associated with increasing aneurysm sac size or rupture.

• There appears to be a group of treated aneurysms that fail to reduce in volume or diameter over the longer term despite apparently successful endovascular exclusion. This phenomenon has been called 'endotension' and may simply represent the occurence of endoleak that is currently invisible to the imaging techniques used by most centres on follow up. In addition, this group includes a cohort treated with ePTFE grafts, in whom a form of 'hygroma' has been reported. This is thought to be related to selective permeability of the graft material to certain protein molecules which results in the accumulation of a jelly like substance within the sac. Unfortunately, despite the lack of a visible endoleak, this situation has been known to lead to rupture[3]. Because of the lack of change (or even an increase) in sac size many of these cases will lead to late conversions.

Future developments

The application of endovascular repair to ruptured aortic aneurysms is an exciting new horizon, but owing to the substantial infrastructure required has only become established in a few centres to date. One case series[4] reports a remarkable 12% 30-day mortality from stent graft placement whereas the pooled operative 30-day mortality is around 40% [5].

Partnership with industry has produced continuing technological advances. This includes improvements in the design of grafts and delivery systems from early "homemade" devices, via custom made commercial systems to "off the shelf" modular stent grafts allowing a precise fit in most patients. Many commercial systems now allow a precise fit in most patients from a small range of standard sized components. There is much interest in the developement of fenestrated or branched grafts to allow suprarenal aneurysms to be treated without compromising branch vessels, and also to treat aneurysms extending into the iliac segments. There is a continuing search for devices that may be more suitable for use in sharply angulated necks and for introduction systems that remove completely the need for a surgical cut down.

Current evidence

At present there is no level 1 evidence to support the use of endovascu-

lar aneurysm repair (EVAR) versus open repair in patients with abdominal aortic aneurysm although a wealth of level two and other data is available[6]. Several national randomised-controlled trials are underway and the first of these is expected to begin reporting in late 2004. In elective patients, analyses of current level-two data show short-term (30day) mortality is equivalent to open repair but blood loss, peri-operative morbidity and hospital stay are improved[6]. The Zurich group have shown significantly improved early morbidity by using local anaesthetic technique[7] with no operative mortality in 60 patients. In the longer term firm conclusions cannot yet be drawn but it is believed that intervention-free survival is poorer with EVAR and that overall costs are higher, buoyed by the initial cost of the device and the burden of follow up and re-intervention. However the majority of re-interventions are percutaneous and durability appears better with newer devices.

Conclusion

Perhaps the next major development in endovascular aortic aneurysm repair will be the publication of favourable level 1 data. Newer devices will mean more aneurysms will be technically treatable by endovascular means and the use of endovascular repair for acutely ruptured aneurysms is likely to become more widespread.

13.3

Endoluminal Treatment of Ruptured Abdominal Aortic Aneurysms

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The most feared complication of an abdominal aortic aneurysm is rupture, occurring in 35-63% (1). Ruptured abdominal aortic aneurysms (rAAA) are associated with excessively high mortality rates, with a prehospital mortality ranging up to 62% (2) Until recently, standard therapy of a rAAA consisted of laparatomy and repair with an aortic graft in general anesthesia. Despite advances in surgery, anesthesia, and critical care the operative mortality rates of rAAA's have not dramatically improved and are around 40% (3) (4).

Retrospective studies have shown that spiral CT scanning in patients with suspicion of a rAAA was feasible on arrival at the emergency unit in the majority of patients as they were sufficiently stable(5, 6). Obviously, it is important, that the shockroom, the CT scanner and the operating room with a fluoroscopy unit are located nearby. Having screened the patient with a rAAA with CT, a decision will be made towards open or endovascular repair.

At our center, all those patients being stable enough to undergo CT scanning will be directed towards endoluminal repair, whenever the aneurysmal neck anatomy and the iliac access vessels are suitable, and an appropriate device is on the shelf. The anatomical selection criteria are the same as for elective endovascular aneurysm repair. Since our first rAAA treated with a stent-graft in 1998 50% of the patients admitted with a rAAA underwent endovascular repair.

Fluid resuscitation is restricted as long as systolic systemic pressure remains above 60 mm Hg in order to facilitate hypotensive hemostasis. The procedure can be performed in general or local anesthesia (7-9). Local anesthesia bears the advantage of maintaining the abdominal wall tone with its tamponading effect. In addition, at least in elective AAA repairs the hemodynamics were more stable and less fluid substitution was needed with local than with general anesthesia (10). However, pain and patient discomfort control is more demanding in rAAAs. Therefore, the higher doses of sedatives and analgesics required may additionally hamper oxygenation in these patient with restricted lung volumes due to elevated intraabdominal pressure. In our experience, conversion to general anesthesia during the intervention was required in a fourth of the patients, most of them because of respiratory distress(8). Conversely, if treatment with an aortounililiac device combined with a femoro-femoral bypass or a retroperitoneal iliac access is chosen, general anesthesia will be necessary.

The first account of a rAAA treated endoluminally dates back to 1994(11). A number of centers have reported their experience since (7, 8, 12-14). These non-randomized series emcompass 20 to 36 patients, each. The perioperative mortalities range between 10 and 45 %, with an average mortality of 18%. In these centers, commercially available aorto-uniiliac stent-grafts, bifurcated stent-grafts or both were implanted. Besides the mortality reduction of stent-grafting in comparison to open repair a shortening of ICU and hospital stay is observed. CTA imaging follow-up as after elective aneurysm repair is mandatory. In our experience an additional completion CTA has proven to be helpful as a baseline comparison CT, whenever postoperative problems relating to the abdominal compartment syndrome appear(15). This syndrome may occur after endovascular repair of rAAA and represents a potentially fatal consequence of increased intra-abdominal pressure due to retro- and intraperitoneal hemorrhage. A 4% incidence of the abdominal comparment syndrome has been reported after open rAAA repair with primary closure (16). However, it may be even more frequent after endovascular repair. Clinically it is manifested by lower extremity venous stasis, oligo-anuria, pulmonary compromise, cardiac failure and shock. In our experience, evacuation of the retroperitoneal hematoma is rarely needed, but some patients will require temporary hemofiltration and prolonged mechanical ventilation.

At our hospital, the rate of early postoperative reinterventions for perigraft leaks is higher for rAAA than for elective AAA repairs. As expected, type II endoleaks occur at a similar frequency in ruptured and non-ruptured aneurysms after endovascular repair. They can be considered as innocuous in the acute setting. At mid-term follow-up re-rupture can be prevented by endovascular treatment of rAAA (Hechelhammer L., oral communication, CIRSE 2004).

In conclusion, patients with a rAAA will benefit most from an endovascular aneurysm repair as the perioperative mortality can be reduced by 50% compared to open repair. As an experienced team of vascular surgeons, interventional radiologists and anesthesiologists is required 24 hours-a-day, in addition to a stock of "off-the-shelf"-stent-grafts as well as fast spiral CT access, this procedure will probably be practicable just in the larger hospitals.

Special Session
Current and Future Strategics in Treatment of Peripheral Vascular Diseases

14.2

Current and Future Strategies in Treatment of Peripheral Vascular Diseases: Covered and Coated Stents

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Introduction

Due to its small lumen size and the often diffuse type of disease the femoropopliteal artery is extremely difficult to treat effectively, i.e. to remain long-term patency [1]. The common problem after percutanous transluminal angioplasty (PTA) is restenosis due to elastic recoil, late negative vessel remodelling and neointimal hyperplasia. Stents may help overcome the first two forms of reobstruction, however, they are not actually able to prevent restenosis since reactive tissue ingrowth seems to be triggered by the implanted device itself [2,3]. Also the superficial femoral artery (SFA) is subject to a variety of stresses including flexion at the popliteal level and muscle compression in the adductor channel which is challenging for any material implanted into this territory and which represents another factor that can limit long-term success. Covered stent-designs seem to have advantages over conventional stents, but long-term success still needs to be proven by larger randomized multicenter trials. If drug-eluting stents are a breakthrough will not be shown before large amount of long-term data becomes available. This lecture gives a short overview on current developments in modern stent technology. The value of these new techniques for the daily clinical practice of percutaneous SFA-treatment will be discussed.

Covered Stents

While the basic principles of percutaneous interventions for infrainguinal lesions have not changed much since the first techniques used by Dotter and Judkins in 1964 [4], there was an enormous evolution of catheters, guide wires and stents with significant improvements in flexibility, profile and mechanical resistance. In contrast to variations of the two basic types of vascular stents available today - the classic balloon-expandable systems and the newer generations of thermal-expanding and self-expanding cobalt- or nickel-titanum alloy (nitinol) stents - covered stents incorporate the hypothetical advantage to reduce tissue ingrowth at the treatment site and thereby to improve patency. While results of early studies dealing with stent-grafts for the SFA were not convincing, recent data show that modern ePTFE covered self-expanding stents like the Viabahn device (formerly Hemobahn) offer promising mid- and long term patency rates even for long-segment lesions of the SFA [5-12]. Last year we reported immediate and mid-term results of the Hemobahn self-expanding stent-graft for percutaneous interven-

tional treatment in patients with long-segment high-grade stenoses and occlusions of the femoropopliteal artery [8]. Overall, in our series, a prospective non-randomized 3-center trial, re-obstructions were observed in 25% (13/52) of the patients (reocclusions: 19,2% [10/52], restenoses: 5,8% [3/52]). For both, stenoses and occlusions the primary patency rates were 78,4% and 74,1% at 12 and 24 months, respectively. Primary assisted patency was 82,4% at 12 months and 80,3% at 24 months. Secondary patency rates for 12 and 24 months were 88,3% and 83,2% respectively, results which were comparable to the first prospective Multicenter study published by Lammer et al. in 2000 [9]. We concluded that endovascular placement of the Hemobahn stent-graft for SFA disease is a safe procedure with excellent initial success rates and promising mid-term results. Follow-up imaging studies indicated that the graft cover actually had the potential to reduce neointimal ingrowth through the supporting stent, and thus to enhance long-term patency. Our assumption was based on the fact that cases of reobstructions were associated with plaque progression and neointima formation only in the genuine artery near the stent-ostia while neointimal hyperplasia inside the stent-graft was not detected at any time. However, long-term success of ePTFE stent grafts for infrainguinal stenting needs to be proven by larger randomized multicenter trials. Also prospective randomized studies comparing ePTFE covered stents with the newer generations of self-expanding nitinol stents are not yet available.

Coated Stents

According to Garasic et al. stent design and geometry can significantly affect neointimal thickness and plays an important role in restenosis prevention [13]. However, modern strategies under intensive scientific evaluation today focus more on the biophysical characteristics of the stent surface. To prevent corrosion different coatings such as chromium, titanium, gold, and platinum have been used [14]. Other modifications include the use of ceramics, polymers and antithrombogenic agents such as heparin or hirudin [15-19]. The potential merit of local drug delivery is that it enables one to direct an agent to a target tissue in potentially higher concentrations, thus potentiating desired effects without systemic side effects. Today there is still global excitement about drug-eluting stents since numerous publications of coronary trial results have clearly shown that there is some significant clinical benefit compared to bare stents. The Cordis CYPHER sirolimus-eluting stent is already on the market and the Boston Scientific TAXUS paclitaxel-eluting stent will soon to be available in the US. For Superficial Femoral Artery disease, drug-eluting stents will need to be proven to be comparable or superior to surgical and current endovascular results. In the sirolimus-coated Cordis SMART nitinol self-expandable stent for the treatment of obstructive SFA disease trial (SIROCCO), performed by one Canadian and five European hospitals, 18 months binary restenosis rate was 0 % in the slow release and 33 % in fast release group versus 30% in the control group [20,21], thus the uncoated stents performed unexpectedly well. The results of the SIROCCO I trial also sheds light on the importance of drug release kinetics. Virmani et al. believe that the difference in animal and human studies represent accelerated healing in normal arteries of relatively young animals and delayed healing in humans secondary to a more advanced age and underlying atherosclerotic plaque [22]. Healing responses in humans might just be delayed and drug-eluting stents that reduce neointima at 12 months do not neccessarily have to show a long-term effect. Previous experimental work has already shown that polymer-coated stents are capable of inducing a proliferative inflammatory response, which is as a key component of restenosis itself and thus might influence long term patency [23] In this context it has to be considered that once drug eluting stents have lost all their active metabolite they might start to aggravate restenosis development. This was also stressed by Richter et al. at last years CIRSE meeting when he presented a new nanocoating (Poly-Tri-Fluorethoxy-Polyphosphazene) for nitinol stents and concluded that future research should focus more on improving the technology of drug coatings rather than on drugs [24].

Take-home points:

Due to the relatively small size of the femoropopliteal artery in combination with an often diffuse type of disease the long-term success of percutaneous treatment in the infrainguinal region is limited. Although great improvements have been achieved in stent technology over the last years, stenting of the SFA is still not indicated as a primary approach for the treatment of intermittent claudication. The Viabahn (Hemobahn) ePTFE-covered stent seems to actually limit tissue ingrowth into the treatment site and thus enhance patency, however, long-term superiority over PTA alone and/or newer generations of uncovered self-expanding nitinol stents has to be proven by larger randomized studies. Stent-coatings are potential mediators for the local application of drugs, radiation, gene-carrying vectors or other antirestenotic substances and modalities. The available data on sirolimus-eluting stents are consistent among most of the studies and presently demonstrate the best results in terms of restenosis prevention. However, as far as the stent-coating matrix is concerned, more research is needed to determine the biophysical behaviour of the drug carrying polymers. A critical issue when dealing with new technology for the treatment of peripheral vascular disease is the question of reimbursement. Depending on the health-sytem of the country at interest it is more or less difficult to introduce sophisticated new techniques into clinical practise even if animal and clinical studies are convincing. In the end the cost of a new treatment strategy will probably determine most which approach for restenosis prevention will finally be accepted.

Special Session
Endoluminal Treatments for Neurovascular Diseases

20.1

GP IIb/IIIa Receptor Antagonists in IR and INR

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Thrombembolic complications frequently occur during and after endovascular procedures because of associated arterial injury and thrombotic characteristics of implanted devices such as stents. New strategies in platelet aggregation inhibition are now available blocking the final and common pathway of platelet aggregation, the glycoprotein IIb/IIIa receptor. This treatment modality seems to be more effective for prophylaxis and prevention of thrombembolic complications than standard antiplatelet therapy. Most of the data provided for glycoprotein IIb/IIIa receptor blockade are derived from studies of coronary interventions. Glycoprotein IIb/IIIa antagonists as an adjunct to angioplasty and stent placement have been shown to reduce ischemic complications in patients with coronary artery disease. Three different compounds (abciximab - a monoclonal antibody fragment; eptifibatide and tirofiban - small molecules) have been approved in this field. Nevertheless data for non-coronary administration are limited to date. In peripheral vascular disease there may be a benefit during interventional treatment both in acute and chronic occlusions. There is considerable evidence that contemporary methods of thrombolysis are suboptimal. Beyond fibrin, which is the target of thrombolytic agents, thrombus associated with peripheral artery occlusion is composed of different elements including thrombin and activated platelets. Several studies have shown that thrombolytic therapy is associated with platelet activation, and increased thrombin activity. Additionally, as fibrinolysis proceeds, platelets tend to reaccumulate at the clot surface. It follows that inhibition of platelet accumulation may render the clot increasingly susceptible to thrombolysis. With standard fibrinolytic regimens, therapy is mainly aimed at fibrin, while current standard adjunctive thrombolytics include aspirin which is only a relatively weak platelet inhibitor. The combination of fibrinolytics and abciximab has shown to be safe (PROMPT and RELAX trial). Interestingly even in a combination of fibrinolysis with GP IIb/IIIa blockade the incidence of intracranial beeding events was not increased. For acute peripheral arterial occlusions the adjunctive use of abciximab reduced the time of thrombolysis and the number of amputations. In the past there was also increasing interest to use GP IIb/IIIa antagonists during interventions at high risk of subacute thrombosis such as long occlusions with interventional recanalization. Currently in the RIO-trial 420 patients with chronic occlusions (>5cm) of the SFA and poplital artery are randomised to receive placebo or abciximab before interventional treatment. Currently (May/04) 230 patients were already treated within the RIO-trial. The mean occlusion length was 16.4 cm. First insides of this study will be available for this presentation.

Wallace et al. described a case of successful treatment with platelet GP IIb/IIIa receptor inhibitor in basilar artery rethrombosis. Abciximab was use to prevent rethrombosis of the basilar artery after transluminal angioplasty. A patient with vertebral basilar insufficiency and acute occlusion of the basilar artery underwent revascularization with urokinase and angioplasty. Despite the repeat use of urokinase and angioplasty under anticoagulation with heparin, the basilar artery immediately rethrombosed. In an attempt to prevent rethrombosis, abciximab was administered before the final angioplasty, resulting in a widely patent basilar artery and no rethrombosis. There may be even a benefit of GP IIb/IIIa

inhibition in neurovascular disease without interventional procedures. In the first randomized, placebo-controlled study of GP IIb/IIIa inhibition 74 patients were treated as late as 24 hour after stroke onset. Patients received either placebo or an escalation dose of abciximab. Although the rate of asymtomatic parenchymal hemorrhage was higher in abciximab patients (19% vs. 5% with placebo) and higher in high-dose abciximab, abciximab was associated with a slight improvement in functional outcome. Only recently a 400 patient multicenter phase II pilot safety study with abciximab for acute ischemic stroke (AbESTT) has been completed. The AbESTT trial demonstrated acceptable safety and trends for efficacy for the use of abciximab in the treatment of acute ischemic stroke in a patient population predominantly treated 3 - 6 hours after stroke onset. On the basis of these data a much bigger study is planed.
It is uncommon in medicine for emerging data to completely transform a field, particularly in such a common disease state as atherosclerotic vascular disease. Only recently considerable attention has shifted away from the epicardial arteries to the microvasculature. New evidence from multiple fronts has underscored the frequency and prognostic importance of atherosclerotic embolization in microvasculature. Until recently, we have limited access to diagnose microvasculature in living patients. With the availability of imaging technology that includes magnetic resonance, myocardial contrast echocardiography, and transcerebral or transcranial Doppler, microvasculture obstruction has been documented in a far greater proportion of patients than ever conceived. The linkage between microvascular obstruction and unfavourable long-term clinical prognosis has been established in many series. Combination therapy with the GP IIb/IIIa antagonist abciximab and reduced-dose tPA improved myocardial (microvascular) reperfusion, as reflected in greater ST-segment resolution, in addition to epicardial flow. The authors conclude that this finding may translate into improved clinical outcomes by enhancing myocardial salvage.
Supporting the importance of microvascular obstructions, there are several pharmacological agents that have provided strong evidence of clinical benefit. While it is likely, that some benefit is mediated through effects at the epicardial large artery (e.g., peripheral artery) level, the microcirculation must play a pivotal role. Several examples provide evidence for this assertion. In a randomised trial by Neumann at al., 200 patients with acute MI who were undergoing primary stenting and reperfusion were randomly assigned to abciximab or heparin. Coronary blood flow was substantially improved in the infarct zone for abciximab-assigned patients assessed by Doppler with adenosine provocation. Along with this finding there was a significant improvement in regional and global ejection fraction. This study is flanked by several clinical trials with GP IIb/IIIa inhibitors. Other therapeutic agents have shown in microcirculatory perfusion like verapamil.
The data on the clinical use of GPIIb/IIIa receptor antagonists support the role of a highly potent antiplatelet therapy in the early phase of injury to the vessel wall. Possible indications are high-risk interventions in non-coronary arteries e.g. carotid artery, renal artery, and peripheral arteries and with fibrinolytic therapy. It is still too early to recommend GP IIb/IIIa receptor antagonists for such interventions, but preliminary data are encouraging and further studies are urgently needed in this area.

20.2

Carotid dissection: Diagnosis and management

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Arterial dissection is a disease of the vessel wall. The layers of the vessel wall split with formation of haematoma within the divided layers. If there is communication with the vessel lumen with both entry and exit tears then flow may establish within true and false lumen.
Clinical consequences vary from a benign presentation with neck pain and minor, or no neurological defect to devastating stroke.
Local symptoms of carotid dissection include headache, neck pain, particularly on swallowing, and consequences of local neural injury to the Vagus nerve and sympathetic chain. It is unclear whether local neural injury is the result if ischaemic nerve damage to the vasa nervosa or simply compression of the neural structures by the enlarged and rigid carotid wall. Vagal injury may result in hoarseness of the voice and damage of the sympathetic chain can result in Horners syndrome.
The intramural haematoma may limit carotid flow. If intracranial collateralisation via the circle of Willis or extracranial collateralisation via the external carotid and reversed flow in the ophthalmic artery are insufficient hemispheric hypoperfusion or infarction will occur.
A second, and more frequent cause of acute neurological defect is vessel to vessel embolisation. This may occur from the native lumen, from the site of arterial injury or from false aneurysms that develop at the origin or exit of the dissection.
Some arterial dissections are clearly the result of direct neck trauma though these are a small minority. The substantial majority of patients can associate the onset of symptoms with minor neck movement or effort. We have seen patients present with acute onset of symptoms during theme park rides, "headbanging" to heavy metal music, playing the Cello (vigorously!) and shouting at children.
A significant number of carotid dissections occur after upper respiratory tract infection leading to speculation that the wall of the carotid is involved in the inflammatory process somehow weakening it. Others believe coughing is in itself sufficient effort to initiate dissection in an otherwise normal vessel.
Arterial dissection occurs it increased frequency in fibromuscular dysplasia, cystic medial disease, Ehlers-Danlos and Marfan syndromes
The point of origin of the dissection is usually unclear and is usually irrelevant. The vast majority are contained intramural haematoma that propagate proximally to the carotid bifurcation and distally to the petrosal carotid segment though there is not infrequently intracranial propagation. The intracranial carotid artery has a thinner wall than the extracranial vessel and dissection to this section frequently results in false aneurysm formation. If these originate distal to the ophthalmic artery rupture can result in subarachnoid haemorrhage.
Arterial dissection is the underlying stroke mechanism in approximately 2.5% of all strokes but with a far higher cause rate in young stroke patients. It is the second leading cause of stroke in patients younger than 45 years.
Establishing the diagnosis of arterial dissection classically utilised angiography. The characteristic "String sign" of a narrowed vessel or "Flame shaped" tapering of an occluded vessel are well described. Angiography is now however only required rarely. Duplex Doppler ultrasound can be used to confirm the diagnosis but when the configuration of the neck is unfavourable or when the dissection only involves the highest segment of the study will be unsuccessful. Magnetic resonance imaging is now the investigation preferred to demonstrate the primary lesion and any intracranial complications. Magnetic resonance angiography may show occluded or severely narrowed vessels but the imaging sequence that best demonstrates the intramural haematoma is an axial T1 weighted study with fat suppression covering the carotid from the bifurcation to its intracranial termination. This will show the classical features of an enlarged vessel wall, a crescent or circle of hyperintense intramural haematoma and compressed lumen - a bright ring or crescent with an incorporated dark dot. A thrombosed, non-dissected vessel will not be enlarged, will be hyperintense and will not have a dark dot.
When the diagnosis is established treatment will be directed at the consequence of the dissection and only rarely at the diseased vessel. Stroke is treated conventionally, no benefit has been shown when anticoagulation is compared to conventional antiplatelet therapy. There is a slight excess of haemorrhage in patients treated with anticoagulants when combined with antiplatelet agents.
When a patient presents within the first few hours of onset of stroke then more aggressive treatment with thrombolysis may be considered. Data specifically relating to strokes caused by arterial dissection is not available. Broadly speaking patients with severe disability are more likely to have less disability after thrombolysis but with an increased risk of death.
Rarely direct recanalisation of the dissected vessel may be successful. There are reports of successful stenting of the involved vessel combined with intracranial thrombolysis though medical anecdotes of failure are rarely encountered. Concerns regarding this form of intervention are centred on the possibility of promoting embolisation from the recanalised vessel, haemorrhagic transformation of the stroke or hyperperfusion syndromes.
The substantial majority of dissected arteries heal to normality within six weeks. Occluded vessels frequently reopen and mural haematoma reabsorbs. Some vessels will remain abnormal particularly with underlying fibromuscular disease, these may benefit from angioplasty or stenting if the vessel continues to act as a source of embolism. There are no data available to support this though occasional anecdotal cases are described.
Surgery plays little role in acute cases though extracranial to intracranial bypass grafts find occasional place in hypoperfused hemispheric syndromes. Surgery for late complications such as false aneurysms may be treated by resection and vascular reconstruction though these techniques are being replaced by endovascularly placed covered stent grafts.

It is important to demonstrate the other extracranial vessels because synchronous dissection is not uncommon. Fibromuscular disease not infrequently involves several of the extracranial vessels in addition to visceral vessels. These changes may well adequately demonstrated by contrast enhanced MRA. If other vessels are shown to be involved then consideration should be given the treating these prophylacticaly to prevent later occlusion.
Involvement in the diagnosis and treatment of patients suspected of having dissection of extracranial vessels has produced challenges and rewards to radiologists and clinicians. New interventional techniques are finding their place in the management of acute stroke and these may prove to be particularly useful in the treatment of arterial dissections. The coming years hold the allure of challenging cases and continuously improving technology to overcome shortcomings in current devices and techniques.

Special Session
Venous Disease

22.1

Clinical Application of Retrievable IVC Filters

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Caval filtration is not a primary preventive technique against pulmonary embolism (PE), but is resorted to when heparinization fails to prevent recurrent embolism or when heparinization is contraindicated after a major event of PE.
Vena caval filters offer a mechanical protection against pulmonary embolism and may be life-saving, but do not provide an absolute protection against PE. Permanent filters have been in clinical use for more than 30 years. In view of the potential complications the general indications for permanent filter implantation should be very strict and limited to: 1.) recurrent PE despite adequate anticoagulation, 2.) PE if anticoagulation is contraindicated, 3.) free-floating femoral, iliac or caval thrombi, and 4.) PE in high-risk patients. Prophylactic permanent filter placement in patients at risk for PE but without having sustained an embolic event is controversial. In pediatric and young patients the indications should be even more carefully considered.
There are temporary, optional (retrievable) and permanent filters in various configurations and with different embolus capturing effectiveness. Temporary and optional filters belong to the category of non-permanent devices. Temporary filters are attached to a catheter and may be applied for protection during fibrinolysis in free-floating thrombi in the lower extremities and have been used with moderate results. The problems with those filters arise once they are filled with thrombi as a result of successful caval filtration.
In view of the long-term side-effects of permanent filters like chronic venous insufficiency (2) and the non-satisfying short-term results of temporary filters there is currently a trend towards retrievable filters with the option of permanent placement once they are filled with emboli or filter removal if they are free from emboli. The advantage of filter removal is that long-term side-effects of IVC filters can be avoided. For most filters the recommended dwell time for retrievable filters is 10-14 days after implantation. Since the anchoring struts are gradually incorporated into the caval wall as shown in animal experiments it was thought that filter retrieval after that time was too risky. In recent animal experiments and preliminary clinical series, however, it was shown that retrieval is possible with certain filter types even after that period of time. So, there a trend towards an increased time window for removal far beyond the originally recommended 10-14 days after filter implantation. Retrievable filters include the Günther Tulip (5,6), the Recovery and the OptEase filters. There are reports in the literature on filter removal after a mean implantation period of up to 53 days (1). Prolongation of filter implantation time and thus prolonged protection can also be achieved by repositioning of the filter in the IVC 10-12 days after implantation and leaving the filter in place for another 14 days or even longer until removal (4,8). There are also reports on removal of titanium Greenfield filter on the basis of an off-label use.
The indications for retrievable filters are essentially the same as for any permanent filters. The rules may be applied, however, in a more liberal way and the indications might be extended to prophylactic implantation in patients at high risk of sustaining pulmonary embolism, the indication of which is controversial when using permanent filters.
Filter removal is performed using a transjugular or transfemoral approach depending on the filter type; the Tulip and Recovery filters from above, the OptEase filter from below. A special retrieval sheath or catheter of 10-12F provided for each filter type is used for extraction. Once the hook at the apex of the filter is captured with a snare, the most critical step during retrieval is the disengagement of the anchoring struts form the IVC wall. The filter is collapsed by advancing the outer sheath rather than by pulling the filter back. The filter must not pulled back until it is completely collapsed, disengaged and within the sheath. Entrapment of the guide wire in the filter struts during the procedure may be a problem with some filters. 2000-3000 IU of heparin are administered during the procedure. After cavography shows no evidence of bleeding a total dose of 5000 IU can be given intravenously.
Filters should not be retrieved if they are completely filled with large emboli. If small trapped emboli are present filling only one third or half of the filter, removal can be performed, particularly since the thrombi in the filter will be fragmented during the procedure. Prior to that, the presence of an atrial septal defect or a.v. fistulas of the lung, however, should be ruled out under these circumstances. In case of large captured emboli it would make sense to re-study the patient after about10 days, since emboli may lyse spontaneously and decrease in size so that retrieval can be done under more favourable conditions.
The registry of the Canadian Interventional Radiology Association is the largest series presenting the experience with the retrievable Günther Tulip filter (5). Retrieval was successful in 52 of 53 filters after implantation periods of 2-25 days (mean 9 days). One failure was due to the filter hook being in contact with the caval wall so that it could not be snared. There were no complications.
Asch (2002) reported on successful retrieval of the Recovery nitinol filter in all 24 patients after a mean implantation time of 53 days (range 5-134 days) without complications. Reekers et al. (7) demonstrated the successful retrieval of 20 OptEase filters in animal experiments 12, 14 and 18 days after implantation. There were no signs of caval wall perforation or rupture.
By repositioning the Tulip filter after a mean of 13.8 days de Gregorio et al. (4) were able to prolong the mean dwell time of the filter to 34.8 days in 23 patients. There were no major complications.
In conclusion, in the prevention of pulmonary embolism retrievable caval filters have proved to be an attractive alternative to permanent and temporary filters. There were no serious complications in the series reported up to now. The maximum implantation period of the different devices, the reliabililty of retrieval after a given period of time and the safety of retrieval have to be determined in larger series.

22.2

Venous Thrombolysis

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Venous thrombolysis is an integral part of the daily practice of Interventional Radiology. The subject can be divided into three clinically distinct entities: deep venous thrombosis of the lower extremities, upper extremity venous thrombosis, and mesenteric venous thrombosis. The latter is addressed elsewhere in this syllabus and will not be discussed here. The first two are similar in definition in that they involve thrombosis of the systemic deep veins, but are met with very different treatment strategies. Lower extremity DVT is usually spontaneous (with the exception of filter-induced DVT), is readily treated with thrombolysis, yet referral for the procedure is one of the greatest hurdles to its widespread use. Conversely, upper extremity DVT is most commonly iatrogenic, with the exception of primary axillosubclavian thrombosis (PAST), and in most instances (PAST excepted) thrombolysis, though often requested, is not appropriate, with certain exceptions.
Lower extremity venous thrombosis
Deep vein thrombosis affects more than 2 million people annually (1) and venous insufficiency develops in up to 2/3 of these patients after DVT (2). Only a subset of patients with DVT are candidates for percutaneous management, according to current literature: phlegmasia cerulea dolens, iliofemoral thrombosis, isolated iliac disease, young patients, and those with thrombosed caval filters; this represents about 20% of all DVT but these patients may be at highest risk for post phlebitic syndrome (3). Despite the potentially huge patient base, and the fact that DVT thrombolysis has been available for decades (4-9), with good evidence basis, only a small percent of these patients receive lysis. While there are many potential reasons for this, as I outlined in the CIRSE 2003 syllabus, the most important one, at least in the US, remains the lack of prospective randomized trials of catheter-directed lysis, possibly

combined with a fear of catastrophic complications (ie cerebral hemorrhage) in a young and otherwise healthy group of patients. There are some technical reasons as well, as borne out by the DVT registry (6): relatively long procedure times and high doses of lytics that are inconsistent with the cost-effective outpatient management of DVT using low molecular weight heparin currently practiced in the US. However, it has been shown that by combining mechanical devices with lytic agents, procedure time and drug dose can be greatly reduced compared to the Venous Registry (10).

There is no question in the minds of any IR physician that lysis is superior to anticoagulation (AC) alone, yet there are precious few studies to support this contention (8, 11). It is incumbent on the IR community and lytic drug manufacturers to prove that DVT lysis is superior to AC, and this will take prospective, randomized trials with large numbers of patients and long term follow-up, with direct comparison to AC. These trials are very slow to get started. The most ambitious, the TOLEDO trial (Thrombolysis of Lower Extremity Deep vein thrombosis or Oral anticoagulation), will compare anticoagulation to thrombolysis, enrollment is scheduled to be 150 patients in a 2:1 lysis to AC ratio. Primary endpoints will be patency at 5 days and quality of life at 12 months, and secondary endpoints will be recurrent DVT, valve function, clinical disease severity score and cost benefit analysis. This trial is not yet underway at the time of this writing.

Existing studies show DVT lysis to be reasonably safe and effective. In the Venous Registry, 303 limbs in 287 patients yielded complete thrombolysis in 31% and partial (ie >50%) lysis in 52%, with 1 year primary patency of 80%. Valvular reflux was less with complete lysis (28% reflux) compared to 58% for the entire group (6). UK dose averaged 7.8 million units. Bjarnason et al reported 70% technical success, 63% 1 year primary patency (78% secondary) for iliac veins and 40% primary (51% secondary) patency at one year for femoral veins in a series of 87 limbs in 77 patients (9). Quality of life was evaluated by Comerota et al who showed better QOL for lysis compared to AC at 16 months (8). Several smaller series have reported similar results. To my knowledge only one prospective randomized trial exists comparing lysis to AC (11). This small series (n=35) reported 72% 6 month patency compared to 12% for AC ($p<0.001$). Venous reflux was worse with AC (41% vs 11%, $p=0.04$). Despite these favorable results, lysis is not in widespread use as the primary therapy for iliofemoral DVT.

Since the reintroduction of urokinase, there has been much said and written about choice of agent. A recent manuscript may help shed some light on this issue. Grunwald and Hoffman (12) reported a retrospective study of lysis in 82 limbs in 74 patients, using UK (n=38), t-PA (n=32), and r-PA (n=12). They showed no differences in success rates (97%,97%,100%), infusion times (41,31,24 hours), major (5.3%, 3.1%, 8.3%) or minor (10.5%, 12.5%, 16.7%). They did show that UK costs were higher than tPA ($p<0.001$) or rPA ($p<0.01$). While they acknowledge use of additional interventions including mechanical devices in most patients, they do no specifically state how often devices were used; under-use of devices might explain the longer infusion times, especially for UK, compared with the above-mentioned study in which lytic devices were combined with lytic agents (10). Most importantly, they did not have any deaths or intracranial hemorrhage with any agent. This is welcome news, and may relate to low-dose infusion and subtherapeutic heparinization in the t-PA and r-PA groups.

In summary, while mechanical devices have helped improve acceptance of DVT lysis, the future of this procedure rests heavily on prospective, randomized trials which are in planning or about to start. Pending the results of such studies, IR physicians should make every effort to increase awareness of the procedure in their area, through educational meetings as well as direct outreach to patients through the web and other avenues. While individual practices will vary as to choice of agent and use of mechanical devices, IR practitioners should be familiar with the most up-to-date techniques in order to optimize outcomes.

Upper Extremity Venous Thrombosis

In contrast to the above-described situation with lower extremity DVT, IR physicians are often asked to treat patients with upper extremity DVT, despite much narrower indications. Upper extremity DVT is readily divided into the distinct clinical entity of primary axillosubclavian thrombosis (PAST), in which lysis is the undisputed standard of care, and iatrogenic or secondary DVT, almost always due to central venous access devices and usually treated with anticoagulation alone due to high costs and poor outcomes associated with thrombolysis.

Primary Axillosubclavian Thrombosis

PAST, also known as effort thrombosis and Paget-Schroetter syndrome, typically occurs in young individuals and is often, though not exclusively, associated with exertion of the affected extremity. Swimmers and weight lifters are classically affected; though a broad variety of activities and occupations have been associated with PAST. In addition, some patients present without any obvious inciting cause. The underlying anatomic abnormality common to all those affected with PAST is compression of the subclavian vein as it passes between the first rib and clavicle, in association with varying degrees of ligamentous and muscular compression, resulting in thrombosis of the subclavian and portions of the axillary vein. Patients with PAST may present with arm swelling, venous claudication, or a heavy sensation in the arm; physical examination may reveal distended collaterals about the shoulder in addition to arm swelling and discoloration. Diagnosis is easily made with ultrasound or venography. In a large series of PAST, 18 of 294 patients presented with bilateral symptoms; 62 of 312 affected extremities were associated with cervical ribs (13).

For over a decade, since the description of the staged, multimodality approach by Machleder (14), thrombolysis has been the undisputed first line therapy for PAST, followed by definitive treatment of the offending anatomical abnormality with first rib resection, via either a transaxillary or infraclavicular approach. Importantly, there is little role for angioplasty or stent placement, except when surgical decompression fails due to residual venous stenosis. Most operators use an ipsilateral arm vein approach, with US guided puncture of the basilic or brachial vein, diagnostic venography followed by placement of a multisidehole infusion catheters, and infusion of the thrombolytic agent of their choice. Some operators choose to use a small diameter (eg, 6-8 mm) balloon to create a channel for flow to assist with lysis, but there is little evidence to support this technique. In our practice, we often use mechanical devices (Arrow-Trerotola PTA, AngioJet) to rapidly reduce clot burden, particularly when lysis appears to be reaching a state of diminishing returns. In the rare instance of rethrombosis immediately after surgery, we use mechanical devices exclusively. It is essential to resist the temptation to do large-diameter PTA and in particular stent placement before rib resection. Stents placed in this location without decompression are subject to fracture (15) and yield poor results (16); in addition it is undesirable to place stents in young, otherwise healthy patients, particularly given the results of surgical decompression. Using the approach of lysis followed by several weeks of anticoagulation, then surgical decompression, reserving PTA and/or stent placement only if needed; excellent results have been reported (14, 17). Only the timing of surgical intervention has remained controversial, and presently most surgeons with large experience in PAST feel early surgical intervention yields the best results, ideally within a few days of successful thrombolysis. One large series reported 189/199 "good to excellent results" with this approach (13), compared to 32/36 with delayed surgery. These authors concluded that early diagnosis and treatment associated with "prompt" first rib resection yield the best results.

In the very rare setting of restenosis after surgical decompression, PTA is used liberally, and stents may be considered as a last resort. In our practice, we will do everything possible to avoid stent placement in this young population. IR's principal role in PAST is rapid diagnosis and initiation of lysis; educational efforts directed toward caregivers likely to see these patients initially (ER physicians, sports medicine physicians, etc.) are essential to get patients treated early enough to achieve the excellent results of the multidisciplinary approach.

Secondary Axillosubclavian Thrombosis

By far the most common cause of upper extremity DVT is central venous access devices (CVADs). Depending upon the population studied, venous thrombosis may be associated with CVADs in up to 70% of patients, particularly those with malignancies. We now know that subclavian access is associated with a higher rate of symptomatic thrombosis (18) than internal jugular access; and that peripheral access is associated with higher thrombosis rates than central (jugular) access for ports (15). Use of the jugular vein for central access limits venous thrombosis, but does not eliminate it entirely. Indeed, thrombosis of a jugular access vein still occurs with regularity (26% in a recent series) (19), but is less likely to be symptomatic as the neck is well collateralized. Pulmonary emboli are common from upper extremity sources, but it is not known whether thrombosis associated with jugular catheters is less likely to result in PE than that associated with subclavian catheters. In spite of all efforts to reduce venous thrombosis, such as by minimizing catheter diameter and using jugular access, a sizeable percentage of patients will develop symptomatic venous thrombosis and even more will develop asymptomatic venous thrombosis. Despite excellent results obtained with thrombolysis of lower extremity DVT and PAST, lysis is of limited utility in secondary upper extremity DVD. Studies of thrombolysis,

whether catheter-directed or systemic, in the setting of an indwelling catheter have shown high costs (20) and poor results (21, 22). Thrombolysis should be reserved for very selected clinical situations, based on the following algorithm:
1) All patients with secondary upper extremity DVT need anticoagulation to prevent PE; anticoagulation will often render them asymptomatic in a few days even with the catheter in place (provided it is well-positioned). Leaving the catheter in place allows continued venous access without putting another access site at risk, and removing the catheter does not obviate the need for anticoagulation.
2) Patients with a contraindication to anticoagulation may need the catheter removed; a superior vena cava filter may be considered.
3) Patients with SVC syndrome need urgent treatment using thrombolysis, mechanical thrombectomy, angioplasty and stents as indicated. In many instances, with isolated SCV occlusion, the catheter tip may be repositioned to a subclavian vein during recanalization, then replaced after the SVC has been reopened.
4) The small percentage of patients whose symptoms of arm swelling do not subside after a few days of anticoagulation should have their catheters removed. Nearly all patients will become asymptomatic after removal, but the few that remain symptomatic may benefit from catheter-directed thrombolysis.
In patients in whom, according to the above algorithm, thrombolysis is indicated, it is performed similarly to that for PAST above, but often with more aggressive use of mechanical thrombectomy and stents. Since most patients with secondary upper extremity DVT are older, and many have substantial comorbidity, concerns about stent use are much less in this population. It is my preference after successful lysis to eliminate the catheter from the affected vein altogether, moving it to the other side or to the IVC; however, as noted above, good results can be achieved in the case of SVC thrombosis by replacing the catheter into the recanalized SVC. Postoperatively, all patients should be on long-term anticoagulation.
In summary, upper extremity DVT is common, but only a minority of those affected will benefit from thrombolysis, specifically those with PAST and selected patients with secondary DVT. With respect to catheter-related DVT, prevention though use of the jugular access route and the smallest possible catheter diameter is the best form of "management".

22.3

Endovascular Treatment of Massive Pulmonary Embolism

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Patients with massive pulmonary embolism are at serious risk of death due to right ventricular failure. 50-70% of the lethal courses occur within the first 3 hours after onset of symptoms. Therefore, survival depends on rapid recanalization of the pulmonary arterial occlusion and consecutive reduction of the right ventricular afterload.
Standard treatment option for hemodynamically unstable patients with massive pulmonary embolism is thrombolysis. Thrombolysis is indicated, if there are echocardiographic signs of increased right venticular afterload. According to studies, which assessed the reduction of the angiographic score after administration of full-dose rt-Pa and urokinase, the mean degree of recanalization by thrombolysis is about 20% after 2 hours and 30% after 12 hours. This explains that in severe cases even high-dose thrombolytic therapy may fail to prevent a fatal outcome. Surgical embolectomy as the current alternative treatment in extensive pulmonary arterial occlusion (or if thrombolysis is foreseeable to fail) is accompanied by a high mortality rate.
Percutaneous catheter treatment represents a new, up to date widely underused, therapeutic option for these patients. Catheter devices include standard diagnostic catheters, balloon catheters, suction catheters (Greenfield vacuum cup catheter), rotating pigtail catheter, hydrodynamic thrombectomy catheter, and high-speed rotating tip catheters, as the Amplatz clot buster or the Rotarex catheter. The principles employed are compression, fragmentation, aspiration, and extraction of the embolic material.
There some reports in the literature, which describe successful application of thrombectomy catheters, primarily designed for peripheral arterial recanalization, in pulmonary arterial occlusion, like the Amplatz clot buster, the Hydrolyser or the Angiojet catheter. Most of these reports are case studies or include small numbers of patients. In summary, all of these devices proved to have a somewhat beneficial effect in experienced hands, but recanalization efficacy is limited by a device operation diameter, which is too small for pulmonary arteries. While there are relevant occlusion diameters of 5-6 mm in femoral thrombectomy, thrombosed vessel diameters of 25 mm and more are encountered in occluded central pulmonary arteries.
Among the basic principles of recanalization of massive pulmonary embolism by catheter devices, embolus fragmentation is one of the most promising. Firstly, fragmentation of central emboli and displacement of the fragments to the periphery result in a relative gain of non-obstructed cross-sectional area, because the sum of the peripheral pulmonary artery cross sections is two- to threefold larger than that of the central portion. A second effect is that fragmentation increases the total surface area of thrombotic material and, therefore, accelerates the efficacy of an accompanying thrombolysis or of spontaneous intrinsic pulmonary lytic activity.
A fragmentation catheter, dedicated for percutaneous therapy of massive pulmonary embolism, is the Pigtail Rotation Catheter (Cook Europe). In a multicenter trial, including 20 patients with severe pulmonary embolism (average bilateral pulmonary arterial occlusion of 69%), pulmonary placement and navigation of the device proved to be straightforward and rapid, regardless, if a femoral or a jugular access was chosen. In 15 patients, the effect of fragmentation was assessed without interference of previous or concomitant thrombolysis. Sixteen of 20 patients survived and recovered to complete restitution (success rate of 80%). Mean fragmentation time was 17 minutes. Post-fragmentation control angiography revealed an average recanalization rate of about one third of the pulmonary embolic occlusion. Shock index and mean pulmonary artery pressure were significantly reduced by fragmentation, however, reduction of the latter one was only incremental. Complications as perforation, wall damage, and bleeding did not occur. The only complication observed concerned one case of embolus displacement from the right intermediate artery into an initially partly perfused upper lobe artery, which was then completely occluded. Continuation of the fragmentation therapy was able to remedy this event and provided for a considerable final recanalization also in this case.
Acute massive pulmonary embolism is an emergency procedure, requiring a catheter system, which features ease of handling, rapid placement and good steerability in the pulmonary arteries. The pigtail rotation catheter meets these criteria. We consider the fragmentation technique as a precious tool for treatment of acute pulmonary embolism in hemodynamically unstable patients, facilitating rapid partial reperfusion. Pigtail rotation catheter fragmentation provides for an almost instantaneous average recanalization of one third of the occlusion. The procedure is especially useful in high-risk patients to accelerate thrombolysis and as an alternative to surgical embolectomy. Embolus fragmentation extends the critical time frame for further recanalization by thrombolysis.
Indications for fragmentation therapy are massive pulmonary embolism in an hemodynamically unstable patient (hypotension, shock), with echocardiographic signs of right ventricular dysfunction and afterload stress. Further indications are unsuccessful previous thrombolysis or absolute contraindication to thrombolysis. In these cases, fragmentation therapy represents a new, minimal-invasive alternative to surgical embolectomy, which should be included into the therapeutic armamentarium. Furthermore, fragmentation may reduce the dose of thrombolytic agent in cases with relative contraindications to thrombolysis, e.g. in patients with trauma or previous surgical intervention. In our experience, fragmentation combined with or followed by subsequent thrombolysis, even with markedly reduced dose (e.g. 30 mg of rt-Pa for an occluded main pulmonary artery), may lead to complete restitution in the follow-up.
Regarding the question, wether to administer the thrombolytic agent via intravenous cannula or selectively, via pulmonary catheter, there is a paper from Verstraete et al. (1988), well known under cardiologists, stating that there is no difference in efficacy between both application modes. We performed experimental investigations in order to verify or refute this hypothesis (Schmitz-Rode et al. 1998). Simulation of an occluded main pulmonary artery in a flow model revealed that there is a strong vortex formation at the proximal edge of the occluding embolus, leading to a fast wash-out of thrombolytic agent to the non-occluded contralateral side and, consecutively, into the systemic circulation. This is true for a catheter tip positioned close to the leading edge of the embolus and, at first glance, supports the results of the Verstraete study. However, additional animal experimental trials revealed that if the catheter tip is positioned within the occluded segment (thrombus infiltration), or, if an embolus fragmentation was going ahead, selective

injection of thrombolytics via catheter is superior to intravenous administration.
Current research activities in percutaneous catheter therapy of massive pulmonary embolism include also other functional modes of action, like aspiration, extraction or compression. Examples are a dedicated pulmonary version of the Hydrolyser, also featuring a pigtail tip, and a pulmonary version of the Rotarex catheter with a reverse rotating tip. Other approaches, designed in our Aachen laboratory and currently under investigation, are an expandable catheter-based pulmonary embolus extraction device and a temporary pulmonary stent for embolus compression.

Special Session
Percutaneous and Endovascular Procedures in Transplant Patients

23.4

Percutaneous Treatment of Nonvascular Complications of Kidney Transplantation

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Urological complications after renal transplantation are relatively uncommon. They predominantly consist of urinary leaks and ureteral obstruction. Reported incidence of urological complications ranges from 1 - 10 % (1, 2, 3). They can be divided into early (within 3 months after transplantation) and late complications. Leaks tend to occur early, although obstruction may occur at any post-transplant period. These complications must be diagnosed without delay, because late diagnosis can result in the loss of transplanted kidney as well as increased patient morbidity and mortality. Prompt diagnosis and interventional treatment can either help to avoid surgery or to stabilize the patient, allowing definitive, usually surgical, therapy to be performed on a less urgent basis. The most commonly performed interventional procedure in the renal transplant patient is percutaneous antegrade nephrostomy usually followed by other endurologic procedures (balloon dilation, stent deployment).
Urinary obstruction:
Urinary tract obstruction can occur early or late after renal transplantation and is observed in 1 - 8 % (1, 2). Patients with obstruction are usually asymptomatic, and the diagnosis is based on a rise of serum creatinine level and is confirmed by ultrasound examination showing dilatation of the graft collecting system. The most common causes of obstruction are ureteral strictures or kinking (accounting for more than 50 % of obstructions) usually located in the distal third of the ureter and caused by ureteral ischemia secondary to devascularization of the ureter during graft harvesting (2), ureteral blood clot, and ureteral compression from lymphocele. Less common etiologies of obstruction include edema or narrowing at the ureteroneocystostomy, surgical technical error, pelvic fibrosis, chronic rejection, fungal debris, "de novo" stone or compression from an extrinsic mass such as adjacent hematoma or lymphoadenopathy. Occasionally, obstruction can occur years after transplantation, most often in patients, who have undergone multiple surgical procedures, and it is believed to be related to retroperitoneal fibrosis (4).
More than 90 % of ureteric stenoses occur within the distal third of the ureter. Once obstruction is suggested by ultrasound, a thin needle antegrade pyelography can be performed to confirm the diagnosis, to provide detailed anatomic definition of the type and level of the obstruction, and to serve as an access route for percutaneous management. Interventional radiology treatment of urinary tract obstruction consists of percutaneous nephrostomy, balloon dilatation, insertion of external - internal or internal plastic stents, metal stent placement, or correction of the source of extrinsic compression of the collecting system, such as a lymphocele. If obstruction is secondary to ureteroneocystostomy edema or ureteral blood clot, external diversion through a percutaneous nephrostomy catheter often provides temporary relief of obstruction until the edema subsides or the clot has dissolved or passed spontaneously. The nephrostomy is removed only after an antegrade nephrostogram has confirmed that the urinary tract is unobstructed (1).
The first choice interventional procedure is percutaneous nephrostomy. Initial puncture is usually performed under sonographic guidance (or with a help of previously performed antegrade pyelography). When the diagnosis of urinary tract obstruction is confirmed the calyx most suitable for nephrostomy insertion and/or further treatment is selected. Catheter placement and further endurological manipulations are performed under fluoroscopy. During the procedure we must not "overfill" kidney collecting system to avoid calyceo - parenchymal reflux with risk of urosepsis. Nephrostomy immediately provides relief of obstruction and restores kidney function. In the case of ureteral stricture, balloon dilation with subsequent placement of external-internal stent or internal "double J" stent can be employed. Small series reporting the results of balloon dilation of ureteral strictures describe success rate (long lasting relief of urinary obstruction) of 70 - 80 % (3, 5, 6). If the balloon dilatation fails a metal stent can be implanted but the long-term results are unpredictable (7, 8).
Renal calculi are rare cause of transplanted kidney urinary tract obstruction. The calculi may either develop as de novo stones related to underlying metabolic abnormalities or exceptionally may be transplanted together with the donor kidney. Percutaneous techniques may be used to remove the calculi using either baskets or lithotripsy; extracorporeal shock wave lithotripsy is occasionally employed as well (9, 10, 11).
Urinary leak:
Because of immunosuppressive therapy of renal transplant patients the risk of infection is higher and urinary leakage is a potentially life threatening complication of transplantation. The leaks are generally seen within 1 - 2 weeks after surgery, its incidence is reported to be 1 - 5 % of renal transplant patients (1, 2, 12) and if untreated, mortality may be close to 50 % (4). Ureteral leak producing urinoma can be caused by graft rejection, ureteral necrosis due to ischemia, or inadequate surgical technique. Most urine leaks occur at the ureteroneocystostomy, possibly due to vascular insufficiency (4), or along the anterolateral surface of the bladder where the ureteroneocystostomy has been performed. Leaks may also occur from the proximal ureter, renal pelvis, or calyces secondary to distal ureteral obstruction, renal infarction (occlusion of accessory renal artery during surgery, peripheral embolization), or percutaneous renal biopsy. Diagnosis is usually made by ultrasound revealing perirenal fluid collections that is relatively anechoic but may contain septations. Initial management should include percutaneous aspiration and fluid analysis: an elevated creatinine level can help to distinguish urinoma from lymphocele or other perirenal collections. Nephrostomy technique is the same as in urinary tract obstruction treatment, but as the collecting system is usually not dilated it can be technically more demanding. External diversion or external - internal drainage lasting 2 to 3 months can be effective in urine leaks management (12, 13, 14), but reported series present low numbers of patients and in some patients the healing of the leak site may result in a stricture requiring further therapy. In case of surgical therapy, nephrostomy is important preliminary procedure. Urinary diversion restores kidney function, "cleans" operation field and allows surgery to be performed as non-urgent procedure (15).
Nephrostomy complications:
Clinically significant complications are infrequent. The most common complications are mild hematuria persisting 1 - 2 days after procedure and perirenal hematomas, which usually are self - limiting. Rarely urinomas have developed after nephrostomy tube removal. Sepsis can be prevented in most cases by the use of preprocedure antibiotics and by avoiding of overdistention of the collecting system.

Special Session
Management of Portal Hypertension

24.1

TIPS in Budd-Chiari Syndrome

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Budd-Chiari Syndrome (BCS) is an uncommon disorder of the liver caused by hepatic venous outflow obstruction and characterized by clinical triad of tense ascites, hepatomegaly and abdominal pain. The inability of blood to drain from the liver leads to post-sinusoidal portal hypertension, ischemia and congestive necrosis of liver parenchyma and congestion of the entire gut. The obstruction can develop at any level of hepatic venous outflow and usually is associated with other uncommon disorders. In a rare veno-occlusive disease (VOD) caused by hepatotoxic

chemicals, the obstructions are at levels of hepatic sinusoids and venules. The hepatic vein thrombosis (HVT) that is associated with hypercoagulopathic conditions involves the mid and large size hepatic veins. HVT is the most often cause of BCS in European and American countries. BCS also develops with obstructions of hepatic vein orifices or suprahepatic portion of the inferior vena cava (IVC) by a congenital web-like membrane, which is most often seen in Asian and South African countries. Tumor compression or direct tumor invasion into intra and suprahepatic portion of IVC or large hepatic veins may also lead to BCS. In some patients, however, no cause of BCS can be identified.

The clinical course of BCS depends on the extent of involvement and rapidity of development and progression of venous occlusion. A rapidly progressing VOD or HVT involving most of the hepatic venous system may have a fulminant course and lead to acute liver failure. In most patients with HVT or membranous IVC web, however, BCS has a subacute or chronic course as only some hepatic veins are involved and a membranous web only partially obstructs IVC. These patients usually complain of mild abdominal pain from liver swelling and have chronic signs of portal hypertension, mainly refractory ascites and gastroesophageal variceal bleeding similar to liver cirrhosis. This presentation will concentrate mainly on diagnosis and treatment of HVT.

Diagnosis of HVT

Imaging techniques including ultrasonography, CT or MR imaging, and hepatic and IVC venography help to confirm clinical suspicion on HVT.

In HTV, the ultrasonography reveals no flow signal in large hepatic veins with hyperechoic thrombus replacing the veins. There can be a reversed or turbulent flow in hepatic veins and large intrahepatic venous and subcapsular collaterals especially in the vicinity of hepatic vein ostia corresponding with a spider web venous network.

CT or MR imaging demonstrates a lack of visualization of hepatic veins, hypertrophy of caudate lobe, which is often the only part of the liver parenchyma properly perfused due to its separate venous drainage and compression and narrowing of IVC. On contrast, enhanced CT during acute and subacute phases of the disease, the enlarged caudate lobe becomes significantly opacified, while the remaining liver parenchyma appears patchy due to lack of perfusion and necrosis. Extrahepatic collateral formation reflecting portal hypertension is similar to that in chronic liver cirrhosis.

Hepatic and IVC venography are done by femoral or jugular vein approach. The transhepatic approach should be reserved only for patients where local thrombolysis or balloon angioplasty of the obstructed veins is planned. Hepatic venography may identify stenosis or thrombus in hepatic veins, but more often demonstrates the classic spider web pattern of collateral veins and lymphatics with absence of sinusoidal filling. The IVC venography demonstrates intrahepatic IVC narrowing by enlarged caudate lobe. IVC pressure gradients need to be measured, particularly if a surgical shunt is considered.

Liver biopsy if needed can help to differentiate chronic cirrhotic type of HVT from cirrhosis of other origins. HVT is characterized by congestion, liver cell loss, and fibrosis in the centrilobular area.

In differential diagnosis of HVT, congestion due to heart failure and constrictive pericarditis should be considered.

Treatment of HVT

HVT is a manifestation of one or several underlying hypercoaguable conditions including myeloproliferative disorders (polycythemia vera and essential thrombocytopenia), use of oral contraceptives, paroxysmal nocturnal hemoglobinuria, Behcet´s disease, lupus anticoagulant, antithrombin III deficiency, and protein C deficiency. HVT treatment usually starts with systemic anticoagulation, which may improve the outcome of non-bleeding patients as heparinization facilitates spontaneous recanalization of thrombosed hepatic veins. Diuretics and paracentesis are used for control of ascites.

The surgical treatment modalities include portocaval or mesoatrial shunting and liver transplantation. The side-to-side portocaval shunt, which transforms the portal vein into outflow tract have been mostly recommended. However, early mortality rates of surgical portocaval shunting average 25% and early shunt thrombosis occurs in approximately 25% of patients. An increased pressure in the IVC exceeding 20 mm Hg also precludes shunting procedure unless the pressure gradient across the intrahepatic IVC is corrected by a stent implantation or a cavoatrial shunt placement. Survival of surgically shunted patients was not proved to be longer as compared with patients treated only by medical therapy (Zeitoun 1999). The liver transplant for the treatment of HVT should be reserved for patients with severe cirrhosis or with fulminant liver failure as its prognosis is not as good as for other indications (Ruckert 1999).

Restoration of hepatic outflow is, thus, attempted mainly by interventional techniques including local thrombolysis, recanalization of obstructed vein(s) by balloon angioplasty and stent placement, and by TIPS. Local thrombolysis and dilation of the obstructed hepatic vein can be done by the retrograde approach when the involved vein(s) can be catheterized. A stent placement was reported to improve long-term results of dilation. When retrograde approach is not feasible, the transhepatic approach can be used for local thrombolysis and angioplasty. The transhepatic tract, however, must be embolized in this case to reduce risk of hemorrhage.

TIPS has become an alternative to surgical shunting as it avoids the laparotomy and can be performed in more acutely ill patients with a lower morbidity and mortality than surgery. Furthermore, TIPS drains the portal venous system to the suprahepatic part of the IVC and, thus, bypasses the frequent intrahepatic IVC stenosis by caudal lobe compression.

Technique of TIPS in HVT

The TIPS procedure in patients with the HVT is technically more difficult because of distorted liver anatomy.

Catheterization of the right or middle hepatic vein may be occasionally possible with acute or subacute HVT form when venous thrombus is still soft. With chronic fibrotic venous obstruction when only residual venous stumps remain, the catheter is wedged into a stump for the portal vein puncture. In cases without any hepatic vein stump, the direct puncture from IVC is necessary. In such cases, puncture should be started as close as possible to presumed location of the hepatic venous confluence to avoid the frequent intrahepatic IVC stenosis.

Portal vein localization and its puncture may be difficult because of present hepatomegaly, enlargement of the caudate lobe and small size and low flow in the intrahepatic portal branches. We have been using the Rösch-Uchida portal access set. The curved metallic cannula is buried into the liver parenchyma and the puncture is performed with a flexible trocar covered with a tapered 5F Teflon catheter. The manually bended cannula keeps direction of the puncture.

A PTFE covered stent-graft should be used for creation of TIPS as it avoids or decreases formation of pseudointimal hyperplasia and thrombotic shunt occlusion. However, care has to be taken not to extend the covered parts of the stent-graft into the portal vein and the IVC, which could impair the flow. Precise measurement of stent-graft length is, therefore, necessary and sometimes the combination of two overlapped stent grafts is preferred, also because the intrahepatic channel is often longer than in other patients. Addition of an expandable stent placement into the stenosed IVC will improve general venous circulation.

Complications of the TIPS HVT

Associated hypercoagulability and longer shunts created with bare stents have contributed to poor long-term patency of the TIPS reported in this group of treated patients. The TIPS dysfunction requiring revision was reported in about 70 % of cases in 6 months in spite of aggressive anticoagulant therapy. Sepsis has been a rare complication after TIPS and its higher incidence reported by Cejna (the cause of death in 16 % patients) might have been related to immunologic impairment in hematologic diseases. Increased rate of sepsis has not been reported by others. Another complication of TIPS reported only in patients with the HVT is delayed development of the intrahepatic hematoma at 7-14 days after shunt creation. This is also our experience. This is probably due to a combination of anticoagulation therapy, venous congestion and potential injury during TIPS creation.

Results of TIPS in HVT

The technical success rate of TIPS in patients with HVT averages 95%. However, long-term patency of TIPS created with bare stents in patients with associated hypercoagulable conditions has been poor and in spite of aggressive anti-coagulation therapy many shunts occluded. Some patients (38% - Perello 2002), however, remain asymptomatic and without portal hypertension despite significant shunt stenosis or even occlusion. It seems that using TIPS, they gain time to develop sufficient venous collateral network. Recent experience indicates that use of PTFE stent-grafts will change these poor results. A randomized study showed that use of PTFE stent-grafts in non-BCS patients significantly improves TIPS patency and decreases the rate of clinical relapses and need for reinterventions. The up-to-date experience revealed better patency with use of these dedicated stent-grafts in combination with anticoagulation therapy in the HVT group of patients as well.

TIPS should be the first choice of treatment for HVT uncontrolled by medical therapy. In some patients, predominantly with liver failure, TIPS may serve as a bridge to elective liver transplantation.

24.2

Percutaneous treatment of portal vein occlusion

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Portal (and mesenteric vein) thrombosis (PVT) is a relatively uncommon multifactorial condition but which is known to complicate a wide variety of conditions from neonatal omphalitis to hepatocellular carcinoma. There is no one correct way to manage this condition but a number of factors need to be taken into account when planning endovascular treatment. These include

- Duration and severity of symptoms
- The extent of the venous thrombosis
- Presence of cirrhosis and portal hypertension
- Pro-thrombotic conditions, inherited or acquired
- Underlying obstructing lesion whether benign or malignant and the presence of intra abdominal sepsis
- Availability of equipment.

PVT will usually be diagnosed first by ultrasound. The extent of the thrombus is better assessed by CT (and MR). The use of multislice scanners has allowed excellent multiplanar reconstructions, which are very useful in planning intervention. In addition the extent and degree of bowel involvement can be seen. Arterioportograhy may be used as a prelude to intervention and to examine the dynamics of the collateral venous flow.

The chronicity of the PVT will determine how a patient presents. A young adult with no known liver disease may present with gastro-oesophageal variceal bleeding following PVT as a complication of appendicitis in childhood. Clearly the thrombus will be old and peri-portal collaterals will have developed ("cavernous transformation"). In these cases of extrahepatic portal hypertension the bleeding can be severe but it is less commonly fatal than in patients with established cirrhosis and portal hypertension. A surgical portosystemic shunt may be the best option. Orloff et al have reported the long-term outcome following surgical portosystemic shunts in 200 children and adults with extrahepatic portal hypertension. Actuarial 5-year, 10-year, and 15-year survival rates were 99%, 97%, and 95%, respectively [1].

On the other hand patients with acute thrombosis may present with non-specific symptoms such as pain, bloating, diarrhoea and eventually peritonitis. Venous thrombosis is extensive and secondary arterial insufficiency ensues. In these circumstances surgery and bowel resection may be the only option. In this group the mortality rate is as high as 76%[2]. Where symptoms are less severe there may be time to re-establish venous outflow and thus preserve bowel. A number of approaches have been employed. Simple anticoagulation may limit the extent of the thrombus and allow development of collateral flow as well as recanalisation of thrombosed segments by the body's own thrombolytic mechanisms. Intravenous unfractionated and subcutaneous low molecular weight heparins, followed by oral anticoagulation have been used [3, 4]. This approach is most likely to succeed in those who have no underlying liver disease or anatomical reason for PVT. Clinical success rates of up to 80% have been claimed [5]. However transmural infarction may still occur in 18% and extrahepatic portal hypertension may develop in 25%. These patients should be investigated for pro-thrombotic conditions such as factor V Leiden and factor II prothrombin mutations and deficiencies of antithrombin and proteins S and C [6].

If a non-invasive strategy does not work, more direct means of clot clearance will be necessary. Intra-arterial thrombolysis via the superior mesenteric artery can be attempted. A number of case reports, primarily using urokinase, have demonstrated some success despite incomplete lysis of the thrombosis. Prolonged therapy, up to 4 days, clinical condition permitting, may be necessary thus increasing the systemic risks of thrombolysis [7-11]. Intravenous thrombolysis is unlikely to be helpful.

There are reasons why direct access to the portal venous system may be desirable. These include

- Improved efficacy of thrombolysis or thrombectomy
- Dilatation and stenting of underlying stenoses and resistant clot
- Formation of a transhepatic portosystemic shunt.

There are two commonly used approaches, percutaneous and transjugular. Access via both approaches may be necessary. The advantage of a percutaneous transhepatic route is that a small portal vein branch can be catheterised under ultrasound guidance. A fine gauge needle, eg 21G Chiba, is ideal. This will accommodate an 0.018 " wire over which a larger catheter can be introduced. Portal vein occlusions will often be negotiated using a hydrophilic wire even in the presence of cavernous transformation. The occlusion can then be dealt with and usually a stent will be needed. The extent of the portal vein occlusion will determine whether re-establishing flow into the liver alone is sufficient. When there is pre-existing portal hypertension or extensive intrahepatic portal vein involvement it will be necessary to perform an additional transjugular intrahepatic portosystemic shunt (TIPS) to provide sufficient outflow. This may even be the case in the absence of pre-existing liver disease, since forming a TIPS when thrombolysis has produced incomplete portal venous recanalisation may lead to a continued improvement in portal flow [7] over the longer term. It is possible to leave the proximal end of the percutaneously placed stent within an occluded intrahepatic segment and then complete the shunt with a transjugular approach. The first transhepatic stent acts as a target for the transjugular needle. A number of stents are often needed extending from the superior mesenteric vein or splenic vein to the hepatic vein junction with the inferior vena cava. Self-expanding stents are usually preferred; the stainless steel Wallstent or a nitinol stent can be equally effective in this situation. As with a standard TIPS, shunt stenoses can be expected and surveillance will be necessary. Many centres now use a stent-graft (Viatorr, Gore) for primary TIPS in the absence of portal vein obstruction and hope that this will reduce the incidence of shunt dysfunction [12]. When the portal vein is occluded because of malignant invasion, although life expectancy is generally very limited, the use of a covered stent may confer an additional advantage. The main disadvantage of the additional transhepatic approach is the potential risk of intraperitoneal bleeding. The presence of ascites, portal hypertension and coagulopathy will exacerbate this risk. Therefore the transhepatic track must be embolised on withdrawing the sheath.

When using a transjugular approach alone, a standard technique may still be successful. Pre-operative CT and procedural wedged hepatic venography, particularly using carbon dioxide, help to work out the portal venous anatomy and aid successful puncture. Small injections of contrast into the parenchyma may outline the portal veins to provide a target. Many operators have also used ultrasound to direct the needle. Alternatively wires or even coils can be placed percutaneously into or adjacent to the target vein. Also, a balloon has been used to target the intrahepatic portal vein branch and access gained by puncturing the balloon with a Colapinto needle [13]. Citron describes using a percutaneous transplenic approach in a child [14]. After successful transjugular catheterisation of a portal vein branch, a chronic PVT could not be crossed but a collateral vein was used from the antegrade access. Catheterisation of the superior mesenteric vein at mini-laparotomy is also described [15].

Whatever approach to the portal vein is employed, there seems little doubt that when indirect transarterial thrombolysis has been inadequate more effective thrombolysis and thrombectomy can be achieved with direct portal venous access. Case series have described the use of catheter directed thrombolysis and mechanical thrombectomy using hydrolytic catheters eg Angiojet and Oasis and mechanical devices eg Amplatz Thrombectomy Device and Arrow-Trerotola [16-21]. Over the wire devices may have the advantage of easier selective catheterisation of vessels and fresh thrombus is generally easier to remove than a chronic obstruction. A combination of mechanical debulking of clot with adjunctive drug thrombolysis may offer the best chance of success. Technical success rates of 70 - 100% for restoring portal venous flow have been quoted [18][21]. However it is difficult to draw any meaningful conclusions from these relatively small case series each containing a heterogeneous group of patients, many of whom have chronic venous occlusions. Long-term survival, as for patients undergoing conventional TIPS, is dependant on the underlying disease process.

Special Session
Radiological Methods for the Diagnosis of Cardiovascular Diseases

29.1

The diagnosis of cardiac diseases:the radiologist's perspective

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Heart disease is the leading cause of morbidity and mortality in industrialized countries. Imaging plays an important role at its diagnosis. Methods such as chest X-Ray, cine-angiography, ultrasound and scintigraphy have been widespread and long established.Newer methods such as Magnetic Resonance (MR)and Multi Detector Computed Tomography (MDCT) have a great potential to expand the information that we currently can get from pathology (anatomy and function) and provide a global examination of the heart.

All the modalities mentioned above are traditionally managed by radiologists. However, this is not the case when coming to the heart. When imaging expanded beyond the limits of the chest X-Ray and information was not simply morphological any more but, also, quantitative and provided the basis for risk stratification and objective assessment of the effects of medical or surgical treatment, cardiologists demanded easy and quick access to all these modalities. In case their radiology colleagues were not able or willing to perform those examinations on the spot, they were replaced by cardiologists. Soon, even in hospitals with strong cardiac radiology departments, cardiologists were not willing any more to leave their patients to other specialty's hands and, nowadays, cine-angiography , echo-cardiography and scintigraphy are performed by them.Self-referral augmented their workload and funds were diverged from the radiology to cardiology departments.Consequently, research started flourishing and more and more cardiologists were dedicated to imaging than to the practice of every day cardiology.

Nevertheless, advances in CT and MR imaging has brought a new excitement in diagnosis of heart disease and radiologists have starting realizing the potentials of their role once more. In order to stand good chances in regaining part of the cardiac patient's work up, radiologists have to understand the clinical problem of the patient and acquire the ability to perform the appropriate imaging procedures. Unfortunately, very few radiology departments provide cardiac imaging sections in their residency training programs and even fewer have dedicated cardiac radiologists either for the every day service or for the training of the juniors. As a result, cardiologists have started gaining grounds in CT and MR, as well. However, as these modalities may provide information beyond the cardiovascular system, which cardiologists are not able to interpret,as they are not as globally trained as radiologists, the role of the radiologists has been upgraded. On these grounds, radiology societies on cardiac imaging have been introduced on both sides of the Atlantic with education on the latest advances of newer and older generations of radiologists being their primary scope.

Fields where radiologists may play a significant role in the diagnosis but, also, in te research of the cardiovascular disease are:

· Congenital heart disease
· Thoracic aortic disease
· Valvular heart disease
· Ischaemic heart disease
· Myocarditis
· Cardiomyopathy

Points on the role of various imaging methods at the diagnosis of each entity will be given briefly and will be discussed during the presentation.

CONGENITAL HEART DISEASE

Chest X-Ray remains an important tool at the assessment of pulmonary vascularity and heart size, both before and after operation.

Although echocardiography is the udeniable major diagnostic modality, MR provide such a bulk of information that, despite its long examination times rarely patients are operated anymore without a previous MR examination.

THORACIC AORTIC DISEASE

During the last decade CT an MR angiography have gained their place as gold standard examinations in the diagnosis and monitoring of any type of wall pathology

· Plaque formation and progression
· Arterial thrombosis
· Mural haematoma
· Dissection

CT and MR angiography are routinely used for preoperative assessment of either acute or chronic aortic disease, postoperative monitoring and has greatly contributed in early diagnosis and treatment of these entities.

Transoesophageal Us and IVUS (IntraVascular UltraSound) are two other modalities used in the work up of aortic disease. Advantages and disadvantages of all four methods , together with the appropriate use of each one will be discussed extensively.

VALVULAR HEART DISEASE

Echocardiography is a long established, gold standard method in the diagnosis, assessment of severity and monitoring of valvular heart disease pre and post operatively. However, its more severe limitation, the good window makes a percentage as high as 10% of the population unadequate for accurate examination. Nowadays,technical developments on MR and better acquisition times in the cine-MR indicate that this modality will have an important role to play in the workup of more complicated cases.

ISCHAEMIC HEART DISEASE

The tremendous pace on developments in management of ishaemic heart disease has pushed diagnostic methods uphill, as well. Imaging of the coronary lumen withprecise definition of the plaque, assessement of the atherosclerotic plaque, quantification of the coronary reserve,identification of the presence and extend of myocardial ischaemia and myocardial function (morphology, hypokinesia, viability) can all be carried out with several techniques. However, MR techniques and, also, MDCT may offer a more complete and thorough answer to all the questions raised after the clinical onset of an infarct . Advantages and disadvantages of the two methods when compared to the gold standards exams will be discussed.

MYOCARDITIS

Although biopsy is still the gold standard in the diagnosis of this entity, it carries the main disadvantage of poor results due to the piecemeal spread of the pathological foci. A method with capabilities of global tissue characterization and non-invasive at the same time would be the ideal. At the moment, such a method seems to realize with MR

CARDIOMYOPATHIES

Here again, echocardiography has replaced cardiac angiography of the 70's and has remained the gold standard examination since in both diagnosis and monitoring of the disease. However, during the recent years MR has been recognized as the most accurate method for monitoring left ventricular mass regression and precisely defining the distribution of hypertrophy in the left ventricle, so playing a major role in the evaluation of the response to new drugs.

The field of cardiac imaging has definitely expanded and it is on the radiologists to regain a major role in the management of the cardiac patients once again.To a chieve that, a substantial number of well trained and dedicated radiologists with a sole interest in the cardiovascular system is needed.

29.2

Integration of Peripheral Vascular and Cardiac Imaging

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Introduction

Cardiovascular disease is the leading cause of mortality worldwide[1] 28% of deaths are attributable to cardiovascular disease. Worldwide, the incidence of cardiovascular disease is increasing, especially in developing countries. In one recent report, ischemic heart disease and cerebrovascular disease were the leading causes of death in a survey of eight major world regions: established market economies; formerly socialist economies of Europe; India; China; other Asia and Islands; sub-Saharan Africa; Latin America and the Caribbean; and middle eastern crescent.

Of the estimated 50,467,000 people worldwide who died in 1990, the leading cause of death was atherothrombosis at 28%. Infectious diseases caused 18% of deaths globally, followed by pulmonary disease at 14%, cancer at 12%, violent deaths at 11%, and AIDS totalling 6%.

Different manifestations of atherosclerotic disease commonly co-exist in the same patient. A study of 1,886 patients in a long-term health care facility in the USA who were investigated for the presence of coronary artery disease, peripheral arterial disease and atherothrombotic brain infarction showed that overall, 63% of patients had evidence of atherosclerotic disease, most commonly coronary artery disease. [2,]

The annual direct cost in the USA of coronary disease was $55.2 billion in 2000 with much higher costs projected if a larger number of patients are treated . For example as a result of the Heart Protection Study, all patients with CHD, peripheral vascular disease, cerebral vascular disease, and diabetes are candidates for statin therapy and are expected to derive major clinical benefits from such therapy (in the absence of contraindications or intolerance). As such, there are an estimated 38,200,000 American adults eligible for statin treatment for secondary prevention. As study after study has shown, the majority of these patients are not currently receiving treatment, representing a major public health issue. Because statins lower the risk of major cardiovascular events by 24-42%, a significant proportion of the cardiovascular events in this country could be prevented by improving this one component of care.

In the USA the annual incidence of myocardial infarction is 350/100,000, the annual incidence of stroke is 170/100,000[3]. The incidence of myocardial infarction varies from country to country in France the annual incidence of myocardial infarction is 150/100,000 with a similar incidence of stroke[4]. In the UK the incidence of myocardial infarction is 250/100,00 and stroke 180/100,000[5]. Ischemic heart disease (including MI) and cerebrovascular disease (including hemorrhagic stroke) cause ~27-30% of all deaths annually in North America and Europe. As estimated from data taken from 17 Western European countries[6,7] The combination of this spectrum of cardiovascular disease has been termed atherothrombosis, this is a very prevalent and deadly disease. Manifestations of atherothrombosis, including heart disease and ischemic stroke (IS), constitute the leading cause of death in developed countries of the world, causing nearly a third of all deaths annually in North America and Europe.

The annual incidence of myocardial infarction (MI) in the United States and the European Union is 2.1 million; the incidence of ischemic stroke, 1.75 million.

The risk of a second vascular event is quite high after the occurrence of an initial myocardial infarction (MI), stroke, or severe leg ischemia. Besides an elevated risk of a second event affecting the same vascular territory as the first, patients are also at an increased risk of events at a new location.

Patients who have experienced an MI, for example, have a very high risk of a second MI. Within 6 years after an MI, men have a 23% risk of a second infarction; women, a 31% risk. There is also a substantial risk of stroke after MI: 9% of men and 18% of women have a stroke within 6 years of an MI.1 Most alarming is the risk of death within 1 year of an MI: 27% of men and 44% of women will not survive a year after an MI.1

Stroke patients also are at increased risk of both a second stroke and MI. The risk of a recurrent stroke within one year of an initial stroke is approximately 12%[8]; 7% of stroke patients will have an MI within one year.[8] The risk of death within a year of a stroke is approximately 31%.[9]

Materials and Methods

We followed up a series of patients who underwent peripheral angioplasty in our institution. 176 patients undergoing peripheral angioplasty were followed for two years.

We recorded the incidence of coronary disease and cerebrovascular disease as well as the cholesterol level and whether the patient received treatment for high cholesterol and lipids.

We also recorded the incidence of recurrence of peripheral stenotic or occlusive disease.

In a further subset of patients who had undergone peripheral angioplasty and stenting we recorded the incidence of restenosis within the stent and also the mortality, over a five year period.

Results

In the two year follow up of patients who had underwent peripheral angioplasty

35% had significant cardiac disease 14% cerebrovascular disease 10% had a Myocardial infarction.

81 patients had raised cholesterol (46%) of these 81 patients 42 were treated (52%)

The restenosis rate of aorto-iliac stenting was 48% at five years. There was a significant correlation between raised cholesterol and restenosis or recurrent disease after angioplasty.

The survival rate of patients with aorto-iliac stents after 7 years was 52%.

Discussion

Although the initial morbidity and mortality associated with peripheral arterial disease (PAD) is not as great as with MI or stroke, severe leg ischemia is indicative of an increased risk of both MI and stroke. In addition to an approximate 25% risk of worsening claudication over a period of 5 years,[10] a patient with severe leg ischemia has a risk of MI or stroke that has been estimated at 5-29%.[11] (This range is a function of the definitions of PAD used in studies with a follow-up of up to 13 years.) The risk of death within 1 year of a severe episode of leg ischemia is between 15% and 25%. The mortality associated with an episode of critical limb ischaemia is between 40-70% at five years. There is some evidence that the incidence of acute cardiac events of critical limb ischaemia (ACE) is better when it is treated by angioplasty as opposed to surgery non-invasive methods(16% ACE) as opposed to surgery (46% ACE,).But the late incidence of ACE is the same (44-51% at 18/12)[12]

There is also evidence that amputees have a shorter survival (55% at one year) than patients who have been successfully treated with reconstruction either by surgery or angioplasty (85% at one year).Peripheral vascular disease is an important factor in the incidence of complications after cardiac surgery, the incidence of cardiac events in patients with peripheral vascular disease after cardiac surgery is 20.7% patients without peripheral vascular disease have a 2.8% incidence. This adverse effect of peripheral vascular disease is also reflected in an increased 5 year mortality after cardiac surgery [12]

2871consecutive patients after CABG the 5 year mortality in patients with co-existent PVD was 20% (n=755) the 5 year mortality for patients without PVD was 8% (n=2116). The hazard ratio for survival with PVD was 2.77

Patients with claudication have a more benign prognosis but still have a reduced life expectancy the Speedwell heart study calculated that the risk of death for patients with claudication was 3.8 times that the population without claudication.

There is also a relationship in diabetic patients between peripheral and coronary disease which decreases when patients are treated with statins. 274 diabetics and 386 non diabetics with PVD investigated for new coronary events. In patients treated with statins new events occurred in 73% of diabetics with prior MI, 57% in diabetics with no prior CAD, 37% in nondiabetics with prior MI and 27% in non diabetics with no prior MI.

In the group not treated with statins 91% in diabetics with prior MI,82% in diabetics with no prior MI 72% in non diabetics with prior MI,52% in non diabetics with no prior MI[13]

A recent study of over 10,000 patients recruited to a trial of Orbofiban in patients with unstable coronary syndromes demonstrated that patients who had evidence of non coronary vascular disease had a higher incidence of more severe coronary disease, and worse outcomes than those without peripheral or cerebrovascular disease and also were less likely to be appropriately treated[14]. The severity of coronary artery disease in patients with peripheral vascular disease was born out in and angiographic study which demonstrated a higher prevalence of left main coronary disease and 3 and 4 vessel coronary disease in patients who had co-existent peripheral vascular disease when subjected to coronary angiography[15]

Conclusion

There appears to be a consistent picture that peripheral arterial disease is a significant marker for severe coronary disease, poor prognosis and these patients are less likely to be adequately treated. These issues should be born in mind in investigating and treating peripheral vascular disease. Closer attention should be paid to the cardiovascular risk status and coronary artery status of these patients. Appropriate cardiac investigations and treatment of peripheral vascular disease patients is recommended.

A number of new modalities are now available to aid the radiologist in carrying this out. Cardiac CT and cardiac MRI techniques can be combined with peripheral vascular MRI and CT techniques to facilitate the holistic approach to the patient. MRI can be used to gain perfusion information as well as anatomical information in the heart. These new techniques complement the use of conventional imaging and stress techniques in the heart.

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29.3

Diagnosis of Cardiac Muscle Disease

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Nowadays several cardiac imaging techniques have been developped. Echocardiography (ECO) is the most frequently employed in a clinical setting, because of the availability of the equipment, the relatively simple use and the low cost. ECO potential is directed to a morpho-functional analysis, but is strongly limited on the evaluation of some sectors (apex, right ventricle) and in patients with poor acustic window. Moreover, ECO provides few elements for tissue characterization.
Nuclear medicine (NM) offers good opportunities for the evaluation of volumes, kinetics and myocardial perfusion. Nevertheless, NM has poor temporal and spatial resolution and it does not offer elements for tissue characterization.
Cardiac gated multislice computed tomography (msCT) provides much higher quality morpho-functional studies than the previous techniques, but its contribution to the tissue characterization is limited. Moreover, msCT requires elevated x-rays doses and potentially nephrotoxic iodinate contrast agent.
Magnetic resonance imaging (MRI) actually represents the most advanced technique for the cardiac muscle evaluation. Subtle anatomical details and morphological parameters can be assessed through MRI more accurately than with any other technique, thanks to its elevated contrast and spatial resolution. The only field where MRI is less accurate is the study of the coronary arteries, infact msCT appears to be the best alternative to coronary angiography. MRI is the gold standard for a non-invasive and accurate tissutal characterization, and its potential clearly exceeds the other techniques.
MRI peculiarities are well known since many years and have been used for the study of the cardiac neoplastic pathologies. In this field MRI offers multiple semeiological elements, allowing an in-vivo differential diagnosis between several histotypes. Infact, a diagnosis of mixoma, the most frequent cardiac neoplasm, can be easily performed for its site, usually the left atrium, and for the disomogeneous signal intensity. This signal is due to the mixoyd component and to the haemosiderin, almost always present in this tumour. Lipoma is extremely hyperintense on T1-weighted sequences, because of its fatty component, while fibroma appears iso-hypointense compared to the surrounding myocardium. Vascular lesions, such as angiomas, can be characterized for the contrast agent dynamics, likewise to angiomas localized in other organs. Neoangiogenesis characteristics study can help in the differential diagnosis between primitive and secondary neoplasms, moreover it provides information about the myocardial infiltration level. Furthermore, contrast enhancement characteristics are useful for the assessment of cardiac lymphomas, infact an early contrast enhancement helps distinguishing between active residual disease and fibrotic involution.
Ischemic heart disease is usually evaluated with ECO, but msCT and MRI role is growing. These techniques can assess the cardiac function but only MRI has the potential for defining cardiac perfusion and viability thanks to the use of contrast agent and ultra-fast sequences. The standard technique comprises dynamic acquisitions during contrast agent first pass and after an interval (usually 15 minutes). Low perfused areas do not enhances during contrast first pass, so they can be differentiate from normal enhancing myocardium, moreover it is possible to distinguish if the perfusion deficit is subendocardial or transmural.
After a recent myocardial infarction, there are two main enhancement abnormalities: on first-pass images in the center of the affected myocardium there is often a core of tissue that does not enhance, because of obstruction of flow due to microvascular damage. The surrounding zone, however, often shows large areas of enhancement that persists on delayed images.
The study of the delayed acquisition is very useful because the evidence of "late enhancement" of the ischemic areas is related to poor outcome because of the high incidence of cardiac remodeling that leads to poor ventricular function.
Cardiomyopathies are usually assessed with ECO, that can provide good diagnostic elements and is often enough for a definitive diagnosis. Nevertheless, MRI is fundamental in many cases, when a precise diagnosis can not be achieved only with ECO, expecially in hypertrophic and restrictive cardiomyopathies, or when te detection a secondary form of cardiomyopathy is necessary. Moreover, MRI is very useful in the integrated diagnosis of arrhythmogenic right ventricular cardiomyopathy (ARVD).
MRI standard acquisition techniques (black blood and cine-MR sequences) can provide a morpho-functional charactrization useful to identify the different forms of cardiomyopathies, but they are sometimes unable to distinguish between primary and specific cardiomyopaties.
In the case of hypertrophic cardiomyopathy, the typical elements are myocyte hypertrophy and disarray surrounding areas of increased loose connective tissue. Such aspects are partially detectable by means of T1 and T2 relaxing time analysis, but the low signal to noise ratio makes very difficult a qualitative approach. To overcome this problem, is possible to use contrast-enhanced perfusion imaging acquisition techniques and to analyse the late(or delayed) enhancement through an approach well estabilished for ischemic heart disease study. By this way, they can evaluate possible contrast agent wash-out alterations, due to transmembrane transport deficit and contrast entrapment in the fibrous tissue. Those mechanisms could coexist in focal hypertrophic sectors, in relation to the presence of ischemic areas due to a microvascular damage in the site of the hypertrophy, that can be identified as patchy areas. Moreover, zones of subtle interstitial fibrosis could be identified for a faint contrast enhancement. The presence and the amount of late enhancement could be related to a poor ventricular function and the risk of sudden death. MRI provides also the opportunity of a very detailed and accurate analysis of the regional cardiac function assessing the degree of wall thickening with the tagging tehnique, that allows the evaluation of the contractility after having divided the myocardium in small subunits. In this way, MRI can analyse single wall units and show the activity of myocyte groups. Standard cine-MR sequences are not able to identify the activity of the fiber layers, that are arranged by different directions from the epicardium to the endocardium, while tagging can emphasize the focal disfunction observed in the hypertrophic cardiomyopathy. It has been observed that tagging can demonstrate not only systolic but also diastolic dysfunctions in patient with familiar hypertrophic cardiomyopaty.
Similar considerations can concern dilated cardiomyopathy. In this case, MRI can show the degree of systolic dysfunction and the globous remodeling, usually associated to this disease, more accurately than other techniques. Infact, MRI offers the possibility to assess the volumes, mass and ejection fraction by performing an analysis of a series of cylinders representing the whole ventricular volume in a tridimensional way. With this approach the geometrical models used with ECO

are not necessary and the evaluation is always accurate despite the degree of remodeling. MRI with perfusion assessment can also provide a diferential diagnosis between idiopathic dilated cardiomyopathy and ischemic cardiomyopathy. In the former the delayed enhancement is often absent, while the latter is usually associated to no-reflow areas characterized by a delayed enhancement pattern. Moreover, in dilative cardiomyopaty when the late enhancement is present, it has a distribution pattern characterized by patchy areas or longitudinal stripes. In the ischemic disease it is subendocardial or transmural.
An other interesting possibility is to differentiate dilative cardiomyopathies between primitive and secondary to myocarditis. In case of myocarditis T2-weighted sequences can show edema related focal hyperintensity in the early acute phase, in the following 2-3 weeks the hyperintensity becomes diffuse and then it disappears. Contrast enhanced T1-weighted sequences can be more sensitive in the acute phase, because they show the membrane transport dysfunction, and also in the sub-acute phase because they can show late enhancement due to fibrous involution.
In the study of restrictive cardiomyopathy, MRI can provide information about the atrial and vena cava dilation and shows functional abnormalities. Myocardial signal intensity has not usually specific aspects in the familial form, but the secondary forms can be identified. Sometimes restrictive cardiomyopaty can not be easily distincted from constrictive pericarditis, because both produce the same haemodynamic alterations and a diagnosis with ECO is usally difficult. In this case, MRI can accurately show irregularly thickened pericardium with areas exceeding 4 mm of pericardial thickness.
In cardiac amyloidosis the most specific finding is the presence of infiltrative amyloid protein nodules, characterized by disomogeneous low signal intensity on T1 and T2-weighted sequences: this element is very useful for a differential diagnosis versus hypertrophic or restrictive cardiomyopathies. An other condition that can involve the myocardium is hemochromatosis. In this case the functional pattern can be dilative or restrictive but the iron superparamagnetic effect is the reason of low signal intensity on T1 and T2-weighted sequences.
An other systemic diseas that can sometimes affect the cardiac muscle is sarcoidosis. Cardiac involvement is usually segmentarious and the most typical finging is the presence of granulomas associated to kinetic alterations.
Imaging techniques are very useful for the study of arrythmogenic right ventricular cardiomyopathy, the diagnosis of this disease is very challenging, because of the wide clinical, electrocardiographic and morphological patterns. Nevertheless, diagnosing this condition is very useful, because it is associated to high risk of sudden death in young people, expecially in young athletes, and an antiarrythmic therapy can often prevent symptoms. The most typical aspect of this pathology is the presence of regions of fibro-fatty infiltration that are associated to kinetic alterations, from hypokinetics to bulgings. Moreover, right ventricular dilation and focal thinning of the ventricular wall are often observed.
Several imaging techniques (ECO, angiography, myocardial perfusion scintigraphy, msCT and MRI) may detect right ventricular structural and functional abnormalities in arrythmogenic right ventricular cardiomyopathy. These range from small ventricular wall aneurysms with localized wall motion abnormalities to marked chamber dilatation with diffuse hypokinesia. ECO is the front-line imaging but its sensitivity and specificity are low particularly in patients with suboptimal image quality and limited abnormalities, because of the known difficlties in the echocardiographic study of the right ventricle. Angiography can detect several functional abnormalities: diffuse or localized dilations, diastolic bulgings and wall motion abnormalities, but it can not show the fatty substitution, it is invasive and there is need for contrast media and x ray exposure: therefore angiography is nowadays seldom performed. Fat demonstration at myocardial biopsy is considered specific but not sensitive since biopsy results depend on the ability to collect significant samples and small, localized fibro-fatty areas of substitution may be missed. Electron beam CT and msCT have also been used to detect and evaluate this pathology. These techniques may provide direct evidence of fatty replacement, kinetic alterations and chamber dilatation. Compared to EBCT, multislice CT may provide higher spatial resolution and reduced motion artefacts. These techniques have not been widely applied so a clear knowledge about their diagnostic accuracy is still lacking. It should be pointed out however that both techniques require the use of contrast media and x-ray exposure thus being suboptimal for follow-up purposes. At the moment, MRI is considered the gold standard for the diagnosis of arrythmogenic right ventricular cardiomyopathy because of the potential for showing the whole spectrum of kinetics abnormalities and the fatty substitution.
The evidence of fibro-fatty substitution has been considered as specific, however at this moment this aspect must be considered as one of the many findings contributing to the diagnosis. The limits of this element are that fatty substitution can be also found in normal hearts and some cases without evidence of substitution can exist, even because the fibrous component is much more than the fatty one. Other limits are technical, infact the fatty sbutitution can be simulated by subepicardial fat related artifacts, by phantom artifacts due to the subcutaneous fat, by motion artifacts resulting from poor gating when ectopic beats occur. Therefore, intra and interobserver variability is not optimal and to limit the imaging study to the assessment of fat related high signal leads to high incidence of false positives and false negatives, even if fat saturated sequences could slightly improve the diagnostic accurancy. To overcome this limits, the importance of evaluating other findings has been emphatized. Infact, MRI has elevated specificity for arrythmogenic right ventricular cardiomyopathy diagnosis when regional kinetic abnormalities and chamber dilation are present in the same site of the fatty substitution. Recently, some researches have been focused on the assessment of myocardial perfusion in these patients, infact the presence of a variable amount of fibrotic tissue in the site of the abnormality can be associated to microvascular obstruction. This damage can be observed on MRI perfusion sequences for the presence of late enhancemente on the affected areas. At the moment there is no evidence late enhancement has an impact on the prognosis, however it can be an additional useful diagnostic tool.
In conclusion, non invasive imaging techniques are helpful for the tissue characterization of many cardiac diseases. MRI must be considered as the gold standard for this purpose, even if ECO is always the first diagnostic step. The role of msCT is at this moment still poorly defined, but this technique seems to be the best alternative to conventional angiography for coronary artery assessment.

Special Session
Interventions in Pediatric Patients

31.2

Interventions in Pediatric Patients - Liver Interventions

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Imaging studies and intervention are now key components in the investigation and treatment of infants and children with liver disease. Our understanding of the pathogenesis and natural history of these disorders has been parallelled by the development and introduction of these techniques into clinical practice. Today, advances in ultrasound, computed tomography, and magnetic resonance allow depiction of parenchymal, vascular and biliary anatomy to a level of conspicuity that the requirement for invasive diagnostic techniques is reducing whilst the demand for the more challenging interventional techniques is increasing. This therefore results in a steep learning curve for any radiologist that is training or developing a service in interventional hepatobiliary radiology. Many of the techniques of biliary and hepatic vascular intervention have developed from adult practice and therefore the indications, principles of access, and equipment used are the same or modifications of established adult techniques. For example the indications for TIPSS is essentially the same as in the adult population, commonly as a bridge to transplantation with uncontrolled variceal haemorrhage and refractory ascites providing the predominant indications. However, there are significant differences in approach.
First, and most importantly is the issue of consent. For the interventional radiologist, obtaining informed consent from the childs parents is demanding and requires full discussion and an appropriate period of reflection for them. Committing your own child to a procedure with a high morbidity and potential mortality is often more difficult than consenting yourself as an adult to the procedure. Information systems available on the internet and elsewhere are often read and analysed by parents and although providing data, this may be imbalanced particularly if the disorders are rare and the institutional experience is not presented. This will be a particularly difficult decision for a third party if the child is currently thriving but has a recognised developmental anomaly that if not corrected at an early stage in infancy will carry a high morbidity in childhood. For instance if a baby has a developmental arterio-portal shunt, the optimum period for intervention and closure of

the communication is before the portal venous system has become arterialised and portal hypertension has developed. Equally biliary strictures and choledochal cysts although asymptomatic in infancy may lead to secondary biliary cirrhosis in childhood or adult life if untreated.
A second important principle is to avoid the deployment of implantable devices of unproven long term viability. Every interventional technique completed should ensure that it will not adversely impact on the childs potential for a normal adolescence and adult life by the requirement for repeated intervention of an inappropriately placed device. Therefore, although placement of a stent into the portal venous system or hepatic veins may provide an attractive and less invasive option to a surgical approach in the short term, due consideration needs to be given to the potential long term results of both the procedure and the device. Inevitably there will be a significant group of patients that it is entirely appropriate to place stents. These include rescueTIPSS for the treatment of variceal haemorrhage and also the treatment of some of the caval and portal vein complications that occurr following liver transplantation where retransplantation may be the only surgical option.
Finally, the prevalence of the disorders requiring diagnosis and intervention differs from the adult population with a significant number of developmental disorders of the biliary tree and hepatic vasculature with or without benign liver tumours requiring diagnosis and treatment. Disorders such as biliary atresia, inspissated bile plug syndromes and choledochal cysts often requiring percutaneous cholangiography for confirmatory diagnosis or transhepatic dilatation to treat recurrent strictures following biliary reconstructive surgery. Furthermore the developmental anomalies of the bile ducts, particularly extrahepatic biliary atresia, may form part of a more complex developmental anomaly of the foregut. The association of biliary atresia with anomalies such as polysplenia, situs inversus, malrotation and absent inferior vena cava with or without azygous continuation, cardiac defects, portal vein hypoplasia or preduodenal portal vein is well recognised in approximately 20% of cases. The importance of these anomalies is that they may mitigate against prolonged survival following a Kasai portoenterostomy or transplantation or may demand a modification of surgical approach at liver transplantation.
This presentation will cover the main developmental and acquired hepatobiliary disorders, defining the important patient selection criteria based on ultrasound and axial imaging, the technical approach and outcome measures from our experience at Kings College Hospital. This is a tertiary referral centre for paediatric liver disorders and transplantation. The following disease categories will be presented;

Biliary

These are diseases that may require invasive radiology either to establish a diagnosis or treat the complications of stricture and stone formation that may occurr as the disease progresses or consequent to surgical reconstruction

[i] Developmental and acquired disorders of the biliary tract in infancy
–biliary atresia
-choledochal cysts
-spontaneous bile duct perforation
-benign strictures
-Caroli malformation
[ii] Acquired cholangiopathies of the biliary tract in infancy and childhood
[iii] Tumors of the bile duct

Liver Tumors

[i] Haemangiomas and other vascular anomalies
Haemangioendotheliomas may develop within the liver as part of a generalised mesenchymal disorder and may result in a high flow arterio-hepatic venous shunt precipitating cardiac failure in infancy. Although these lesions may spontaneously regress or respond to medical therapy, arterial embolisation may be necessary to reduce the shunt in the short term.
[ii] Malignant tumors;hepatoblastoma and hepatoma
[iii] Benign tumors; adenoma and focal nodular hyperplasia

Anomalies of Portal Venous Anatomy and Portal Hypertension

Many rare anomalies of the portal vein are described, some of which are an anatomical observation requiring no intervention. However, those associated with severe portal hypertension or that present a long term risk of encephalopathy, liver atrophy or pulmonary arterial hypertension secondary to porto-pulmonary shunting. These include
[i] Pre-duodenal portal vein
[ii] Cavernoma of the portal vein
[iii]Anomalous portal venous drainage into the IVC, pulmonary venous system with or without intrahepatic portal vein atresia/hypoplasia
[iv] Duplication of the portal vein
[v] Arterio-portal shunts

Trauma

The indications for arterial intervention in children parallels those in adults with active arterial haemorrhage, pseudoaneurysms presenting the main indications for intervention particularly if there is continued haemodynamic instability following operative packing. The objectives are to achieve occlusion of the arterial haemorrhage whilst minimising ischaemia to the viable liver segments.

Vascular and Biliary complications following Liver Transplantation

Interventional radiology is a key specialty within a paediatric liver program contributing to both patient and graft survival. Improvement and modification of surgical techniques at harvesting and implantation have reduced the incidence of the more common vascular and biliary complications. However this is a dynamic field of evolving surgical technique and there has had to be a modification of radiological interpretation and interventional approach to match these various operations. A limiting factor in paediatric transplantation is the availability of suitable age and size-matched donor organs. the shortage of paediatric donor organs is worldwide and is most acute in the smallest and youngest children where the surgical window for cure is often the narrowest. Segmental reduction of adult livers was developed in order to increase the pool of donor organs for children. These techniques have extended to further segmental techniques of live-related and auxiliary grafts. Auxiliary grafts are implanted in an orthotopic site following resection of part of the native liver. this now has a role in two groups of patients. Firstly, in patients with potentially reversible acute liver failure for whom there is clinical expectation of delayed recovery of the native liver. In this instance the graft is used as a 'bridge' during recovery of the liver from an acute or toxic injury. The second group is made up of infants and children with non-cirrhotic liver-based inborn errors of metabolism. the aim is to replace the deficient enzyme or protein by the graft.
As programs introduce these more complex techniques, a higher vascular and biliary complication rate may occur and therefore their prompt recognition and treatment is mandatory if the best level of graft and patient survival is to be maitained.
The role of intervention in the management of arterial and venous stenoses, both hepatic and portal venous is established in adults and the same principles are applicable to infants and children although the technical challenges for the radiologist are greater. Equally, biliary strictures, both anastomotic and non-anastomotic are managed by percutaneous intervention in the first instance reserving surgical reconstruction for radiological failures.

Developments in Paediatric Intervention.

Programs are now established in **cell transplantation** and potentially provide a 'bridge' to auxiliary or segmental liver transplantation in neonates and infants with inborn errors of metabolism or acute liver failure. Neonatal liver transplantation is technically challenging and often requires a monosegment graft of a required volume. Implantation of hepatocytes into the liver provides the necessary enzyme or protein and transplantation may be deferred to allow growth of the infant and also provide evidence of reversibility of the metabolic sequels of the disorder with normal hepatocytes. Delivery of these hepatocytes requires access to the portal vein either by a transhepatic approach or following catheterisation of the portal vein through the umbilical vein.

Special Session
Interventions in Aorto-Iliac Segments

32.1

Should we treat bifurcation disease with kissing stents?

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Atherosclerotic occlusive disease involving the distal abdominal aorta and the common iliac arteries has traditionally been treated surgically using bypass. In spite of its well documented good results, it carries 3.3-4.6 % perioperative mortality and a 8.3-13.1 % major early complications including intestinal ischemia, ureteral damage and sexual dysfunction[1]. Because of this, during the last decade endovascular stenting has become a more attractive treatment modality due to its less traumatic nature. However, there is a controversy as to whether endovascular stenting in the aortic bifurcation is effecient enough to

justify its use. This relates specifically to the use of the so called kissing stent technique, which involves the placement of stents in the common iliac arteries and protruding a couple of mm up into the distal abdominal aorta. This form of reconstruction of the aortic bifurcation is used when the occlusive atherosclerotic disease is extensive, either unilateral or bilateral. The most common symptoms encountered in this group of patients is intermittent claudication, followed by distal emboli resulting in the so called blue toe syndrome, and occasionally critical limb ischemia when the disease is extensive and involves also the peripheral arteries in the legs. The kissing-stent technique has been developed as a further refinement of PTA for complex bilateral aortoiliac obstructions. It is well accepted that this technique is associated with considerably less trauma to the patients than open surgical bypass operations. Procedure-related mortality is virtually uniformly zero while 30-day mortality has been reported to be up to 4%[2-5]. The latter, however, has reflected the poor general state of the patients rather than being associated with the procedure itself. Furthermore, procedure-related morbidity has often been limited to puncture-site hematomas, which may sometimes cause pseudoaneurysms, or a few occasions of emboli requiring open surgical embolectomy. These complications have not exceeded 4 %[6]. Personal experience from 22 patients treated with kissing-stent technique for complex aortobiiliac lesions confirms the low traumatic nature of the procedure, with zero percent 30-day mortality and a few complications related to hematoma at the puncture site and an incidental occlusion of one renal artery.

Although there is good agreement on the less traumatic nature of the kissing-stent technique compared to open surgical bypass for treatment of atherosclerotic occlusive disease of the aortic bifurcation there continues to be a controversy on how these two treatment modalities compare in terms of long-term results. The accumulated experience from traditional open surgical bypass has been reported in meta-analysis to result in a five-year limb-based clinical patency of 91% for claudication and 87.5 % for limb ischemia[1]. There is no data on such a long-term follow-up after kissing-stent reconstruction of the aortic bifurcation. In addition, the reported series are limited to no more than 50 patients, the majority of which are treated for intermittent claudication[6]. Such a discrepancy hampers any comparison between these two treatment modalities. However, a two-year patency at 65 % following kissing-stent reconstruction of the aortic arch has been reported as clearly inferior to open surgery[7]. Possible explanations for these results included difficulties in achieving large enough diameters in complex calcified lesions at the level of the aortic bifurcation, as well as a hypothesized unfavourable flow effect at the level where the stents crossed each other in the newly created bifurcation, and finally extensive iliac occlusive disease which has not been addressed. In contrast, there are several other reports, according to which the patency rate following kissing-stent treatment is in the range of 96 % at 12-month follow-up and 87 % at 24-month follow-up, documented by repeated angiographies[2, 4, 8]. These good results are also seen among patients from personal experience in whom, at a median follow-up time of 11 months (range 1-69 mo), the cumulative patency rate was 89 %.

There are several technical aspects to how to place kissing stents, which may influence the long-term result. Normally, when isolated iliac artery lesions are stented, angiography as well as pressure gradient are valuable tools for evaluating the outcome. An angiographic stenosis of more than 30% and a mean pressure gradient of 10 mmHg are considered as indicators of failure. Such criteria cannot be readily applied in the aortic bifurcation, because excentric plaques are common and in addition any pressure gradient may be masked by the open interstices of the crossing stents. Angiography is also difficult to use in this particular area. Therefore, poorly placed stents in the aortic bifurcation have been shown to result in subsequent stenosis and occlusions[3]. It is critical to place the stents at least a centimetre higher than the occlusive lesions in the aorta, and also to achieve a symmetrical and widely open stent at least 8-10 mm in diameter. Usually, self-expandable stents are preferred in this location, and if necessary buttressing with balloon-expandable stents may also be used. Currently, the most suitable self-expandable stents are nitinol stents, not wallstents. The latter have a tendency towards an unequal expansion and possible collapse with time[7]. Overexpansion of the stents in the bifurcation may increase the risk for dissection[8]. However, this can be handled either by additional stenting or simply left untreated because it is not uncommon that these dissections do not have any hemodynamic importance, especially if no pressure gradient is measured across them. Another risk with overdistension of the arteries is rupture of the vessel. This may occur particularly in case of recanalization of occluded arteries, which often takes place in the subintimal space and particularly at the transition from the common iliac artery to the external iliac artery[4, 8]. If this happens, the rupture can be treated endoluminally using a stent-graft as a way of closing the perforation.

In conclusion, reconstruction of the aortic bifurcation in occlusive atherosclerotic disease using kissing-stent technique is well recognized to carry low mortality and morbidity. It therefore offers a valuable alternative to open surgical bypass. The results from kissing-stent reconstruction of the aortic bifurcation are dependent on a good technique in achieving large stent-lumen diameters. Any late restentosis can in the majority of cases be treated endoluminally. Open surgery is therefore reserved for the few failures of kissing-stent treatment.

Special Session
Embolization in Bleeding Patients

33.1

Indications an Techniques of Mesenteric Angiography: Embolization in bleeding patients

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GI-bleeding is one of the most common life threatening emergencies (approx.90 pts./100 000 inhabitants): Upper GI-Bleeding (UGIB) accounts for 85% of all cases including bleeding varices (1/3 of all UGIB). Lower GI bleeding (LGIB) affects mostly patients older than 60 years and represents the remaining 15% of all cases. The total mortality of all GI bleeding events is ranges between 10-20%. Emergency surgery performed in theses patients has a mortality of 15-40%. Hemorrhagic shock is encountered in approx. 35% of all UGIB and in 19% of LGIB. UGIB tends to be acute causing hypotension and a drop of hemoglobine whereas LGIB tends to be chronic with recurrent bleeding episodes.

It is widely accepted that endoscopy is the primary tool for investigation and therapy. However, 10-20% of all endoscopies performed are non diagnostic and 10% of all endoscopic therapies fail. Thus, alternative treatment options are important to improve diagnostic and therapeutic results and to reduce patient mortality.

Table 1 gives an overview of underlying causes of UGIB:

- 19% gastroesophageal Varices, **Mortality : 15-30%**
- approx. 50% Duodenal- bzw. gastric ulcers, **mortality: 10-20 %**
- 13% gastroduodenal erosions
- 10% Refluxesophagitis
- 7% Mallory-Weiss-Lesions
- 3% Tumors
- 1% Angiodysplasias etc.

LOGIB is most commonly caused by Meckels diverticulum, CIBD and polyps in younger patients whereas angiodysplsias, diverticular disease and neoplasias are more common in the elderly.

Initial work-up of patients with acute GI-bleeding should always include gastroscopy since patients with severe bleeding from an ulcer may present with rectal discharge of fresh blood. Recently, MD-CT has shown to be a valuable tool for demonstrating the site of acute bleeding. Due to its high contrast resolution and its threedimensional display of anatomical structures, even small extravasation of contrast material into the lumen of the intestinal tract can be easily detected. Thus, MD-CT may be used to evaluate patients with a negative gastroscopy. Alternatively, colonoscopy may be used. However, in patients with severe LGIB colonoscopy may be non-diagnostic due to fresh blood filling the entire colon. Blood pool scintigraphy is another option. However, localization of the bleeding site can be misleading due to the dispersion of the extravasated radionuclide in the gut. Angiography is,therefore, an important adjunct. Especially in LGIB angiography can reveal cause and site of bleeding followed by endovascular treatment. Angiographic work-up should include both mesenteric arteries including selective studies of the main branches of the SMA. Special attention has to be paid to include all parts of the lower GI tract including the rectum and both colonic flexures. DSA may be impaired by motion artifacts. Thus, application of a spasmolytic drug (for example glucagon) may be helpfull. Sometimes, unsubtracted views have to be used to detect subtle details such as a small aneurysm or contrast extravasation. Curved vessels may be easily mistaken as small aneurysms. Therefore, angled views have to be used to rule out"pseudo"aneurysm.

There are direct and indirect signs of bleeding such as extravasation of

contrast material, demonstration of an aneurysm or abnormal vessels or an avm. A localized vasospasm may also be a sign of acute intermittend bleeding. Hypervascularity and an early draining vein are not considered to be a reliable indicator of bleeding.
For a long time, embolotherapy was considered to be a high risk procedure for treatment of bleeding in the small and large bowel and was, therefore, not commonly used for treatment of LGIB. Following the introduction of highly flexible coaxial catheters and platinum microcoils for treatment of cerebral aneurysms, highly selective cathetrization in the mesenteric vasculature became also possible and was, therefore, used for treatment of GI bleeding. Data from the literature indicates that superselective catherization and the use of highly radioopaque embolization materials such as microcoils allow for a safe treatment of GIB. Embolotherapy is increasingly used for treatment of LGIB whereas treatment of bleeding ulcers, Mallory.Weiss tears and DieuLafoy Lesions is limited to cases in whom endoscopy fails and surgery is not an option. Thus, the role of angiography and embolotherapy in UGIB is limited but nevertheless life saving in selected cases.
Endovascular therapy can now be safely performed in all vascular territories including the celiac trunk and mesenteric arteries. Usually, 3F highly flexible coaxial catheters with steerable guide wires (0.0014") are used to catheterize the bleeding vessel. In some cases it may be helpfull to use a 6F guiding catheter instead of a 5F diagnostic catheter since guiding catheters allow for simultaneous contrast injections which may be helpfull for guiding catheterization and monitoring treatment. In order to avoid complications, embolization should be performed as close to the bleeding site as possible. Catheterization may be difficult and time consuming, especially if a hostile anatomy is encountered (elongated tortous vessels, SMA stenosis etc.). In such cases, the target vessel should be catheterized as close to the bleeding point as possible. Then, short and straight platinum wires or coils of appropriate size are injected which are carried by the blood stream to the bleeding site. Radioopaque solid embolization materials (no liquids!) should always be used which can be delivered precisely and can be anchored at the site of delivery. Microcoils are most commonly used. Embolization of the bleeding site rather than a feeding vessel prevents revascularization of the embolized vessel and, therefore, rebleeding. In cases of aneurysmal bleeding, embolization of the aneurysmal sac or the arterial segment carrying the aneurysm is the method of choice. Embolization is terminated once the lesion is occluded or contrast extravasation stopped. Angiography is again performed demonstrating all potential collateral pathways.
Although the intestinal mucosa is vulnerable to ischemia, bowel infarction complicated by perforation or sepsis is extremely rare following embolotherapy. Changes due to regional mucosal ischemia or segmental ischemic strictures may be seen during endoscopic follow up. However, these changes are rarely causing symptoms. Thus, embolization therapy of GI-bleeding is no longer considered to be a high risk procedure reserved for patients with no other treatment options. Failures of treatment are most commonly due to mistakes in localizing the bleeding site or revascularization of complex lesions or collateralization following an embolization too proximal of the bleeding site. In summary, embolotherapy is effective (97% technical success, approx. 85% clinical success) and safe (less than 5% clinical relevant complications).

33.3

Pulmonary Arteriovenous Malformation

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Pulmonary arteriovenous malformations are high flow, low pressure shunts, consisting of a single feeding artery connecting via an aneurysmal connection to a draining vein. The aneurysmal connection is referred to as an aneurysmal sac. The "filter capacity of the pulmonary capillaries is lost and results in predisposition to brain abscess, stroke and TIA and when multiple, dyspnea, because of right-to-left shunting and hypoxemia.1
PAVMs are markers of Hereditary Hemorrhagic Telangiectasia (HHT).1 Up to 30% of patients with HHT have PAVMs complicating their disorder. Recent literature suggests that 90% of patients with PAVMs have HHT and the remaining 10% of patients' PAVMs are sporadic.1, 2 Left untreated, 50% of patients with PAVMs, will develop disabling or fatal complications. In addition to stroke and TIA syndromes due to passage of paradoxical emboli through the PAVM, rupture of the aneurysmal sac, particularly in the 3rd trimester of pregnancy, can lead to fatal hemoptysis or hemothorax. Finally, brain abscess or more obscure musculoskeletal or spinal infections may be secondary to PAVM.1, 2
Up until 1997, thoracic surgeons advocated for thoracotomies and resection of large PAVMs. Successful outcome and long term results of embolotherapy were published that year for large PAVM, thus rendering thoracotomy with wedge resection or lobectomy obsolete.3 Continued surveillance of the treated patient is necessary as small PAVMs with feeding arteries less than the "threshold" diameter of 3 mm will grow with time, and may require therapy as the patient grows older.3, 4
DETECTION OF PAVM AND CONFIRMATION OF SIZE AND OUTCOME OF THERAPY
Prior to 1999, there were a large number of techniques used for diagnosing PAVMs. Since that time, 2 excellent papers have been published, suggesting that saline contrast transthoracic echocardiography, using a 4-chamber view of the heart, is the most sensitive technique as well as the least invasive for establishing the presence of a right-to-left intrapulmonary shunt.5, 6
In our clinic, we use this limited echo. technique for establishing presence of PAVMs. In order to size the feeding artery, we use unenhanced helical CT with 5 mm cuts. Helical CT without contrast material is also the primary method for determining successful outcome. By 6 months after the embolization, the CT should demonstrate disappearance of the "aneurysmal sac," with a residual scar. Persistence of the aneurysmal sac suggests "reperfusion," which can arise from recanalization of an occluded artery or a missed accessory artery from another segmental branch. Reperfusion has been demonstrated in approximately 10% of our patients, hence the importance follow-up 6 months after the procedure and continued surveillance of the treated patient for growth of small PAVMS every 5 years.2, 3
VALUE OF OUTPATIENT DIAGNOSTIC ANGIOGRAPHY AND APPROACH TO SEQUENCING TREATMENT
In patients with multiple PAVMs, outpatient pulmonary angiography is performed with oblique as well as AP and lateral views. This provides critical information about the diameter and shape of the feeding artery as it enters the aneurysmal sac and also provides a guide to the "safe" location within the feeding artery to perform the occlusion. "Safe" location for occluding the artery is defined as that portion of the artery with uniform diameter. An "unsafe" location is defined as an artery of varying diameter or very short length. Placement of coils or detachable balloons in an "unsafe" location predisposes them to forward slippage into the aneurysmal sac and "iatrogenic" paradoxical embolization of the occlusion device.
In patients with a solitary PAVM, which is large, we also favor outpatient pulmonary angiography. Unique techniques such as Vein of Galen approaches for occlusion of the aneurysmal sac are sometime required in large PAVMs with a short feeding artery and in general, precise diagnostic angiography is required prior to treatment of large PAVM with arteries exceeding 8 mm in diameter.
In patients with smaller single PAVM, we perform diagnostic angiography and embolotherapy on the same day but have no reservations about postponing the embolotherapy of the PAVM until the next day, if the anatomy or techniques are deemed uncertain. Since embolotherapy of PAVM is elective, we proceed with caution, even in our laboratory, which has experience in treating 600 patients over the past 10 years.
We only treat one lung at a time since 15% of patients will develop pleurisy 48 hrs. to 7 days after treatment. This is most probably due to thrombosis of the aneurysmal sac, abutting the visceral pleura. Up to 30% of patients with large PAVM, i.e. the group with greater than 8 mm diameter feeding arteries, develop pleurisy.3 It is far preferable to treat one lung at a time and follow with a second elective treatment of the contralateral side in 4-8 weeks.
GUIDING CATHETERS AND DEVICES
Since 1996, we have used a special coaxial guide catheter consisting of an 80 cm length 7 Fr guide catheter with inner 100 cm 5 Fr hydrophilic MPA shaped catheter with 0.038 endholes (Cook Inc. Bloomington Ind.). About 50% of the time we exchange the 5 Fr Cook inner catheter for a 5 Fr hydrophilic "glide catheter" (Terumo/Boston Scientific, Natick, MA). This latter catheter is slightly more hydrophilic than the 5 Fr from Cook. The coaxial guiding catheter has been the most striking advancement in our opinion in providing control, not previously available with the thin walled polyethylene "introducer catheters," used prior to 1996. Standard pushable fibered 0.035 stainless steel or Platinum coils are passed through the inner 5 Fr catheters. Detachable silicone balloons (DSB) (Target/Boston Scientific, Natick, MA), are no longer available. At the end of treatment of one lung a completion angiogram is obtained by passing a 5 Fr. Pigtail catheter through the 7 Fr Guide catheter.

We have not needed the more expensive detachable coil systems, favored for closing narrow neck aneurysms in the head or kidney. While some interventional radiologists use mechanical or electrolytic detachable coils for closing PAVMs, we do not think they are warranted at this time.7

Since 1996, we have treated 600 patients and have only needed microcatheters and microcoils in 14 patients. However, familiarity with microcatheters is essential for modern embolotherapy and they are certainly required for treating some patients with PAVM. Microcatheter techniques are absolutely required when the artery supplying the PAVM is less than 2.5 cm in length. In these instances we use a modified Vein of Galen technique for closing the aneurysmal sac.7

TECHNIQUES USING GUIDE CATHETERS AND STANDARD COILS

Using the view which best profiles the course and entry of the artery into the aneurysmal sac, the pigtail catheter is exchanged for the 7/5 Fr. guiding catheters. The 5 Fr. catheter is placed as close to the aneurysmal sac and distal occlusion of the PAVM is performed by Nesting coils into a tight coil mass. If the artery widens as it enters the aneurysmal sac, the coils are placed more proximal in a "safe" (uniform diameter) portion of the artery. Embolization of the artery to the PAVM should be accomplished as close to the aneurysmal sac as possible.

Currently, we are primarily using Nester coils (COOK, Inc. Bloomington, IN) for treating PAVMs. The first coil placed is usually 2 mm larger than the diameter of the artery and we often ANCHOR the first 2 cm of this 14 cm coil in a side branch of the artery. Then by stabilizing the 7 Fr. guide catheter in the proximal portion of the artery, we can withdraw the 5 Fr. catheter and with "to and fro" motion of the 5 Fr. catheter, we deploy the Nester coils into a tight coil nest. 2 to 4 coils are used for each PAVM, depending on the size of the feeding artery. With the current guide system, we can usually deposit these coils within a 2 cm length of the artery. Essentially, we are duplicating the cross sectional occlusion obtained with a detachable silicone balloon.

For large arteries with rapid flow, we often use high radial force Inconel or stainless steel coils, to form an "endoskeleton," so called Scaffold technique. Once the Scaffold or endoskeleton is in position, the remaining occlusion is performed with fibered platinum coils. We have determined that if cross sectional occlusion is obtained initially with pushable fibered coils, then long term occlusion is almost certain on follow up studies.

TECHNICAL ISSUES AND MANAGEMENT DURING FIRST WEEK AFTER EMBOLIZATION TECHNIQUE

1. Air filters are placed inline with IVs. Air introduced through standard IVs can cause TIA/stroke. After the procedure, when the patient is tolerating PO fluids well, we discontinue IVs, in order to avoid personnel on the in-patient floor FLUSHING CLOT OR AIR INADVERTENTLY.

2. Heparinization. During the embolotherapy, patients are heparinized at 100u/kg and 1000 u each hour. Like in interventional neuroradiology or cardiology, pericatheter thrombus can cause TIA or stroke during the procedure.

3. Avoidance of AIR when introducing coils. We are extremely careful to ALWAYS WITHDRAW GUIDEWIRES slowly under saline in a disposable cup and not create a vacuum. Even the slightest injection of air can lead to an anginal syndrome, which is frightening, but reversible as well as to TIA.

DISCHARGE INSTRUCTIONS AND FOLLOW-UP

1. All patients use an incentive spirometer while in the hospital and are instructed to continue use at home for 5 days following discharge. We believe this may minimize the pleurisy by avoiding atelectasis that occurs in some patients.

2. Patients call us every other day for the first week post embolization. If pleurisy develops we treat them with non steroidals including Ibuprofen. Most pleurisy syndromes last only 48-72 hours. We don't place patients on antibiotics routinely but if high fever develops, we would either see them in the clinic or when out of state coordinate care with local physician.

3. Since most of the patients with PAVM have HHT, there are other issues, including management of epistaxis, gastrointestinal bleeding, etc. Patients are provided with genetic counseling while in hospital and evaluation by our genetic counselor is important as part of the first visit (http://www.hht.org).

4. ALL PATIENTS UNDERGO unenhanced spiral CT of the lung either at their first follow-up visit with us after complete treatment of both lungs (4-6 months later) or in their home environment. We review these CTs to be sure that all treated PAVM HAVE INVOLUTED.

5. FOLLOW-UP SPIRAL CTs are obtained every 5 years since growth of small PAVM, below the threshold size of 3mm feeding artery, occurs gradually. Many patients will require additional therapy over the years as these PAVM grow.

6. Patients are instructed about the importance of antibiotic coverage 1 hour before dental cleaning since untreated small PAVM, still predispose them to brain abscess, associated with the bacteremia during dental work.

SUMMARY

There are other issues about treatment of PAVM, which are beyond the scope of this brief review such as management of diffuse PAVM which occur in 5% of patients with PAVM and management during pregnancy which are covered in several recent publications.10, 11

PAVM is a much more common manifestation of HHT than originally reported. We believe that PAVM, like low flow venous or high flow arteriovenous malformation, needs to be treated by a team of doctors with experience and commitment to obtain OUTCOME and follow-up. Each patient needs genetic counseling as well since PAVM is usually a manifestation of underlying HHT. (www.hht.org)

Special Session
Horizons

34.1

Islet Cell Transplantation

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Introduction: In July 2000 the results of Islet cell transplantation (ICT) in 7 patients with type 1 diabetes were published in the New England Journal of Medicine. All 7 patients attained insulin independence after two or three transplants with steroid free immunosupression and the authors concluded that 'islet transplantation can result in insulin independence with excellent metabolic control when glucocorticoid-free immunosuppression is combined with the infusion of an adequate islet mass' (1). Enormous interest in the technique followed with several centers striving to replicate these early results. Further published material from the Edmonton group has supported the early optimism with successful transplantation in 90 procedures with 80% of patients remaining insulin free at 1 year (2,3,4). More recently data from the University of Pennsylvania on 20 islet transplantation procedures in 11 patients resulted in 9 patients achieving insulin independence (5). Multiple international centres are now carrying out this new and exciting technique. The goal in ICT would appear at first sight to be independence from exogenous insulin, however more important is the optimizing of glycaemic control because this reduces the long term complications (6,7) and this is the primary goal in our centre at this time.

Patient selection: Due to the associated risks of ICT and long term immunosuppression, stringent selection criterion are recommended and the procedure should be performed in centres with the necessary expertise. In our centre patients with C-peptide negative Type 1 diabetes for greater than 5 years are eligible for inclusion based on poor glycaemic control complicated by recurrent hypoglycemia or metabolic lability despite compliance with optimal medical therapy. Pretransplant diabetes complications should be recorded with reference to nephropathy, retinopathy, neuropathy and vascular complications (2). Compliance with the immunosuppression regimen is essential as is long term follow up. The current 'Edmonton protocol' uses both long term sirolimus and low dose tacrolimus together with short term dacluzimab and avoidance of the use of cortico steroids.

Islet cell isolation: Isolation of an adequate islet cell mass is paramount to a successful procedure and recent advances have allowed isolation of 300-500,000 islet equivalents from a single donor pancreas with packed cell volumes of typically less than 5 mls (8,9,10). The Islets are harvested from brain dead donors using a combination of enzymatic and mechanical dissolution and are matched for blood group only.

Procedure: Many sites for possible ICT have been explored including subcapsular renal, omental pouch, subcutaneous delivery or celiac axis infusion, all with limited success (11,12,13.14). The most promising route appears to be portal vein embolization (15) either surgically via the omental vein or percutaneously. A right sided percutaneous approach is used and the point of hepatic puncture (anterior or mid axillary line) determined using fluoroscopy, ultrasound or a combination

thereof. The use of ultrasound may reduce procedural time, patient radiation exposure as well as reducing the number of capsular punctures (4). Combined CT and ultrasound has also been employed for portal vein access (16). Under asceptic conditions a 22 guage Chiba needle is advanced into a branch of the right portal vein. An 18 guage guide wire is then advanced into the portal vein and a stiffened micropuncture set (Cook Canada Inc, Stouffville, Ont) advanced over the guide wire into the portal vein and positioned just proximal to the portal confluence. Portal vein pressure measurement is recommended during the procedure, transient elevation is common with a significant rise in some patients (17). Portal pressure elevation may preclude infusion in some cases or may require curtailing of the procedure. Measurements in excess of 20mmhg and should caution the operator. Heparin is given (35 units per Kg of patients weight) to reduce the risk of portal vein occlusion, a published risk. (4,18).

Once the catheter is positioned a gravity based system is used for the islet infusion over approximately 15 - 30 minutes, following which the catheter is withdrawn. Embolization of the trans hepatic parenchymal track using coils, gelfoam, tissue adhesive or photo coagulation have all been attempted, the most durable and effective procedure remains to be seen. Occlusion or obliteration of the tract does however seem essential. Certainly the risk of severe hemorrhage exists and some authors have suggested a trans mesenteric approach to avoid this complication (19). Hemorrhage remains the most serious obstacle to percutaneous islet cell infusion but with aggressive tract embolization this seems to be reduced both in incidence and severity. Other reported complications include bile duct or gall bladder puncture and vaso-vagal reactions.

In the immediate post procedure period close observation is indicated with particular reference to portal vein occlusion or intra-abdominal hemorrhage. Ultrasound of the liver with Doppler interrogation of the portal vein is recommended within 24 hours of transplantation. Insulin is discontinued after the ICT and not resumed unless the plasma glucose rose above 10.0 mmol/L post prandially or above 8.0 mmol/L in the fasting state. Most patients are discharged from hospital the next day.

Follow up: The long term effects on the liver are unknown and detailed follow up is therefore essential. Liver enzymes do demonstrate elevation post procedure to greater than 2.5 times above the upper limit of normal in 50% of patients but then resolve (19,20). Hepatic steatosis following transplant is reported (21) and can be readily identified on MR and ultrasound. Other findings occur such as ovarian cysts, which are unexpectedly common when compared with the background population. The long term effects of immunosupression include worsening of renal function, elevation of serum cholesterol, depression in white blood cell count, increased incidence of infection, gastrointestinal tract ulceration, and as yet their impact on the overall programme remains to be seen

Conclusions: Islet cell transplantation is effective in resolving unstable type 1 diabetes and eliminates the need for exogenous insulin in the majority patients. Acute complications are at an acceptably low level with portal vein thrombosis and intra-abdominal hemorrhage reported, long-term complications are reported but further data is needed. The percutaneous radiological approach is safe, readily achievable by appropriately trained interventional radiologists, and is currently the optimal method for islet delivery.

34.2

Treating varicose veins

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Varicose veins are one of the commonest medical disorders and surgery for the treatment one of the commonest operations. Recently 3 new interventional radiological treatments for varicose veins have been introduced.

Ultrasound guided catheter based endovenous
Foam sclerotherapy
RF ablation
Laser ablation

All are showing great promise as alternatives to traditional surgery - long and short saphenous tying and stripping. These techniques combined with local stab avulsion or sclerotherapy can treat virtually all varicose veins non-surgically.

There is much principle and practice common to all 3 techniques. Firstly the patient needs to be adequately assessed. A relevant history and clinical examination is undertaken to include for example risks of heart disease, history of DVT, previous vein treatments and the presence of abdominal masses, skin changes, ulcers, etc.

Next a duplex ultrasound examination is undertaken of the superficial and deep veins of the affected leg. It is especially important to identify the highest point of reflux, the feeding veins, the presence of perforators, abnormal anatomy and state of the deep veins.

Indications for treatment by these means are symptomatic or cosmetically displeasing varicose veins with evidence of reflux in a major feeding vein. This is most commonly the great saphenous, but many other veins can be implicated, e.g. short saphenous or antero-lateral tributary of the thigh.

Contra-indications are few. RF should not be attempted in large veins (over 12mm) or very tortuous veins. Sclerotherapy should be avoided in those with known allergy to the proposed agent, diameters over 10mm , and the grossly obese. All 3 techniques should be used with caution in patients with severe bleeding diatheses, thrombogenic tendencies local infection, acute thrombosis and pregnancy.

All procedures can be undertaken in a normal clinical room rather than operating theatre. Facilities for resuscitation should be available as for any procedure involving local anaesthesia. A couch with a full tilting mechanism (i.e. the whole bed tilts rather than the feet and head separately) is ideal. Other environmental requirements are decent lighting and warmth. A cold room may be more comfortable for the operator but even large truncal veins can just disappear!

The commonest vein to be treated is the great saphenous vein. The patient lies on their back with the foot of the couch 20° down. The skin over the vein from groin to just above the knee is cleaned with warmed skin cleaner. Drapes are applied and 1% local anaesthetic (without adrenaline) is injected into the skin over the great saphenous vein just below the knee as directed with ultrasound.

For foam sclerotherapy a venflon type 18 gauge cannula is guided into the great saphenous vein. The first puncture is easiest using a transverse scanning plane, but once in the vein the probe is moved longitudinally and the cannula advanced deep into the vein and secured with micropore.

For laser and RF ablation a 19 gauge needle is placed in the great saphenous vein and a guidewire passed up to the sapheno-femoral junction. It is easy to see the J end of the wire under ultrasound as it advances up the vein. Occasionally the use of a Terumo wire is helpful when there is obstruction to passage of the J wire. Once the wire is in place at or beyond the sapheno-femoral junction a sheath provided with the RF or laser kit is advanced over it and using the J wrapped around the end of the sheath as a guide under ultrasound the tip of the sheath is positioned just below the SFJ. The wire is then removed and the ablative mechanism (bare-tipped laser fibre or RF probe) is passed up the sheath to the SFJ. Before applying the ablative energy, very dilute high volume (2% lignocaine with adrenalin 20mls diluted with normal saline to 180mls) local anaesthetic is injected carefully under ultrasound guidance in the fascial envelope immediately around the GSV. This serves 3 purposes:

1. It prevents pain from the ablation.
2. It reduces the chance of causing skin and nerve damage.
3. It compresses the vein, displacing blood within it, increasing the chance of permanent total ablation without re-cannalisation.

FOAM SCLEROTHERAPY

Foam sclerotherapy is not especially new - many traditional sclerotherapists have long realised that mixing sclerosant into a foam with air displaces blood rather than mixing with it and leads to more effective ablation with lower overall doses of sclerosant and less risk. The foam is made at the bedside by rapidly squirting STD solution back and forth from one syringe into another full of air through a partially open 3 way tap.

What is new is the use of duplex ultrasound scanning to guide the needle and follow the injection of sclerosant into specific sites within specific veins. This has allowed ablation of larger veins and deeper veins including both the GSV and SSV.

Foam sclerotherapy is usually undertaken in 3 sessions over 4 weeks. On the first occasion the highest point of reflux is tackled, e.g. the GSV. This is usually accomplished using 4mls of 3% STD foam injected into the lower GSV and massaged up the vein to the SFJ using the ultrasound probe both to see what's happening and to massage the vein. The foam is easily visible within the vein as an echogenic line of acoustic shadowing. The veins quickly go into spasm. On the second and third sessions smaller veins are tackled. As the veins get smaller they can be effectively treated with lower concentrations of sclerosant injected

through needles rather than cannulae. The injections are painless provided they are within the vein lumen.
Immediately after each session compression pads are applied to the injected veins and a limited stretch bandage and class 2 compression stocking applied. The bandage is left on for a week and the stocking for 2 weeks.

RF ABLATION

RF ablation is used almost exclusively for the GSV although it can be applied to the SSV. The RF probe comes in 2 sizes (6F and 8F). It is easily seen on ultrasound so once it has passed up the sheath it can be accurately positioned just below the SFJ.
After the local anaesthetic is applied the energy is switched on and constantly adjusted to maintain perfect temperatures/impedence as the probe is slowly withdrawn (3cm/min) down the vein until it is just about to leave the entrance point where it is switched off.
In addition to the compressive effect of the local anaesthetic, hand pressure is also applied to the upper end of the GSV to enhance the contact of the probe with the vessel wall and minimise blood clot formation.
The sheath and probe are removed and the leg bandaged with limited stretch bandages and a class 2 compression stocking applied. After 6 weeks the patients are reviewed and any residual varices injected under ultrasound guidance with an appropriate concentration of STD foam. Further bandages and stockings are used as per sclerotherapy.

LASER ABLATION

All operators wear laser safety spectacles. Once the laser fibre is positioned at the end of the sheath just below the SFJ (check with red aiming light) and the vein compressed with local anaesthetic the power is switched on and the fibre and sheath simultaneously slowly withdrawn down the vein at a rate of 3mm per second. Pulsed energy is used; on for a second off for a second and the fibre withdrawn 3mm in the off phase. The energy is switched off and the sheath and fibre withdrawn just before the sheath exits the vein puncture.
Patients often comment on a strange smell of cooking onions but feel little discomfort. The leg is wrapped with limited stretch bandage and a class 2 stocking. Follow up as for RF ablation.

RESULTS

Long term results are unknown but medium term results are impressive for all 3 techniques.
RF shows immediate closure of GSV in 90-100% and of these 90-98% remain closed at up to 2 years. One small RCT has shown less pain than surgical stripping. 95% are rendered symptom free and 94-100% are satisfied with the treatment. Skin burns occur in 2-7%, paraesthesiae in 0-15%, thrombophlebitis in 2-3% and DVT in 1%.
Laser shows initial closure rates of 95-100% and a recurrence rate of 0-7% at 2yrs. Patient satisfaction is over 90%. Complications include bruising which can be marked in 0-24% , pain in 0-67%, thrombophlebitis in 0-10%. No DVTs, skin burns, paraesthesiae or other major complications have been reported.
Foam sclero shows immediate closure rates of 88-93%, and 67-81% remain closed at up to 3 yrs. Complications occur in 8% overall and include allergic reactions , thrombophlebitis, DVT and migraine.

COMPARISON OF THE 3 TECHNIQUES

Both RF and laser give similar short and medium term results. Laser, however, has several small but significant advantages. It is cheaper. It is more flexible allowing a greater range of veins to be treated. It is quicker. On the down side, the set up for laser is more complicated with special permission usually being required to establish a laser centre and bureaucratic rules involving laser protection advisers etc.
Foam sclerotherapy is cheaper than either of the above. The results in large veins are not so good but it can be easily repeated. Recurrence rates are higher than laser and RF. Some patients are allergic to the sclerosant and inadvertent arterial injection although very unlikely using ultrasound guidance can be disastrous.
Each technique has its own proponents but I feel that a combination of laser for the major veins and foam sclerotherapy for the tidying up offers the best compromise.

DISCUSSION

Interventional radiological (image-guided minimally invasive) techniques have revolutionised and largely supplanted open surgery for most arterial vascular therapy. Given the rapid and dramatic advances in minimally invasive therapy in arterial disorders it is perhaps surprising that a similar revolution has not yet occurred in the treatment of by far the commonest vascular disorder, i.e. varicose veins.
Recent developments in particular ablative techniques using RF, laser and foam sclerotherapy but maybe more sophisticated systems still seem set to abandon surgery for varicose veins into the history books. The lack of good RCT evidence for the safety and efficacy of these techniques is restricting development to a degree but the change of attitudes and practice when it happens is likely to be sudden and dramatic. Patients are becoming more knowledgable, more demanding, more questioning and less accepting of 'doctor knows best'. Even if good clinical evidence is hard to find; from the patient's perspective which is more appetising - surgical operation with known problems of need for general anaesthesia, pain, scars, haematoma, infection, paraesthesia, recurrence and significant time off work and play or an outpatient non-operative procedure whilst fully awake, listening to their favourite music, with little pain, few complications and an immediate return to work and most other activities? When weighing up the options how many patients are going to be majorly concerned by theoretical unproven and as yet unseen risks and uncertain long term recurrence rates?
So the stage is set for a therapeutic revolution to match and exceed that seen with the introduction of laparoscopic cholecystectomy.
At present there are a few pioneering Interventional Radiologists developing these techniques but the majority of the players are vascular surgeons. This is both a surprise and a shame. Who could possibly be better prepared to take on this treatment than the Interventional Radiologist? Adequate accurate assessment of the anatomy and physiology of the patient with varicose veins depends crucially and almost entirely on duplex ultrasound examination which is usually carried out or supervised by an Interventional Radiologist. The treatments themselves depend upon ultrasound guidance of vessel needle puncture and guidewire/catheter/contrast guidance and manipulation ; the natural territory of interventional radiologists. Follow up is largely by patient self-perception and duplex scan.
Interventional Radiologists are at a critical point now with regard to minimal invasive treatment of varicose veins - if we grab the opportunities on offer we can establish ourselves as the natural therapists for this common problem. If we do not, then sure as eggs are eggs another Interventional Radiological technique will be taken from us.

Special Session
IR: Veni, Vidi, Vanished

35.2

Interventional Radiology and Diagnostic Radiology – Parallel lives

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Interventional radiology makes an important contribution to modern medicine. However, its very existence is occasionally denied. Many believe that percutaneous intervention should be incorporated in the training of all radiologists. However, in reality, certain procedures tend to be performed by individuals known as 'interventional radiologists'.
Interventional radiology has developed from the many practical techniques used in diagnostic radiology. It has become increasingly complex, with a concomitant rise in the risks involved. The development of interventional radiology has been gradual, making it difficult to draw a clear dividing line between it and diagnostic radiology. However, if a fine-needle aspiration biopsy of a large mass in an abdominal organ is compared to a complex insertion of metallic endoprostheses in a patient with a hilar cholangiocarcinoma, there is undoubtedly a difference.
Before guidelines can be devised for training and practice in a specialty, that specialty must be defined. For this purpose, interventional radiology may be defined 'the use of imaging guidance to effect treatment'. In general, therapeutic radiological techniques are more complex and carry greater risks than most diagnostic procedures. There are obvious exceptions, but not enough to invalidate the definition.
It should be remembered that relatively uncomplicated therapeutic procedures, such as abscess drainage, are taught to all radiologists. This should continue. There are, however, many therapeutic radiological techniques that should be carried out by appropriately trained individuals in order to increase the effectiveness of these methods and minimise the accompanying risks.
Interventional radiologists are the only medical specialists directly treating patients without usually assuming primary clinical responsibility for them. This must stop, partly because it reduces referrals but mainly because it reduces the quality of patient care. Interventional radiologists are in the best position to obtain informed consent, to treat complications and to follow-up patients in order to establish whether further treatment

is necessary. These tasks cannot be delegated to others without decreasing standards of care. Issues related to training and responsibility for patients should be addressed urgently by interventional radiologists everywhere if standards are to be maintained and enhanced.

SKILL DEVELOPMENT

The most important skill possessed by an interventional radiologist is the ability to interpret radiologic images. This skill is acquired over a long period and is based on a detailed knowledge of radiologic anatomy and pathology.

The complexity of the tasks involved should not be underestimated. The planning and performance of an intricate procedure, such as the percutaneous insertion of a biliary endoprosthesis for a hilar lesion, may involve the interpretation and use of ultrasound and CT scanning, as well as percutaneous cholangiography. Similarly, the insertion of a vascular stent-graft benefits from analysis of CT images and angiograms.

In Europe, the training of radiologists varies by country. In some cases, there are rigorous examinations, whereas in others a period of apprenticeship is deemed sufficient. In all cases, however, the emphasis is on diagnostic radiology, with relatively little attention being paid to the needs of interventionalists.

The gradual evolution of interventional radiology from the practical techniques used in diagnostic radiology makes this omission understandable. Looked at individually, each emerging interventional procedure was considered an extension of what had gone before and did not by itself justify the creation of a new system of training. If interventional techniques are looked at as a whole, however, it is obvious the absence of formal training in interventional radiology is no longer acceptable.

TRAINING COMPONENTS

What should formal training in interventional radiology consist of? It is, of course, necessary to learn about the indications, contraindications and potential complications of various procedures, as well as the actual techniques used. In such a technology-dependent specialty, it is essential to be familiar with the characteristics of the various catheters, guidewires and other instruments used for the various procedures. All these points might seem obvious, but they are often overlooked.

In Europe, individual countries will seek their own solutions to the problem of training in interventional radiology. Most European countries have their own societies or working groups of interventional radiology, and there is also the Cardiovascular and Interventional Radiological Society of Europe. These bodies are primarily concerned with providing a forum for presentation and discussion of scientific work, although they are increasingly becoming involved in providing guidelines for training and practice in interventional radiology.

Fellowships should be held in accredited training centres, with accreditation granted on the basis of the range and number of procedures carried out. Logbooks kept by trainees should be used to monitor the performance of training centres, as well as to demonstrate the achievement of training targets by the trainees themselves.

New training arrangements should not disenfranchise radiologists performing interventional techniques. The potential for interventional radiology has not been fully exploited, and this is largely because of the lack of appropriately trained practitioners. Therefore, it would be foolish to discourage or restrict the activities of those enthusiastic general radiologists currently practicing intervention. This point cannot be emphasized too strongly: it is in nobody's interest to stop either general radiologists or organ-based radiologists from performing the techniques that they carry out today. The aim is to improve training for the next generation. Furthermore, if future organ-based specialist radiologists should not be prevented from carrying out interventions, provided that they can perform the procedures safely and effectively.

ORGAN-BASED VS. GENERAL TRAINING

There is a debate among interventional radiologists about whether training in their field should be based on organ systems or be general. I believe that there is room for flexibility and adaptation to local circumstances and that there is no need for hard and fast rules.

It is necessary to be realistic about what is happening. Although there are diagnostic radiologists who has specialised in one organ system and are expert in interventional techniques, this is the exception. For every chest radiologist one is happy to embolize bronchial arteries and pulmonary arteriovenous malformations, there are dozens who prefer to ask their interventional radiologist colleagues to perform these techniques.

Neuroradiology is a special case because organ-based subspecialisation has been the rule in this field for a long time; some neuroradiologists are willing to undertake intervention, although the majority prefer to limit themselves to diagnostic techniques.

Organ-based specialisation is appropriate in diagnostic radiology because it is advantageous for the radiologist to share a common body of knowledge with the internist or surgeon to whom he or she provides a service. However, the knowledge necessary for the safe and effective practice of interventional radiology is different. For example, a large proportion of the work of interventionalists consists of dilating strictures. It is appropriate to have knowledge about the nature of stricturing and of the likely response to dilatation or stenting; this process has many similarities in organs belonging to different systems, including the ureter, bile ducts and oesophagus. The techniques used for dealing with ureteric, biliary and oesophageal strictures are similar. It is obviously better for an expert to use these techniques frequently to manage a similar process in three different organs than for three different people to use them occasionally because of an artificial separation based on historical concepts.

Interventional radiology is highly dependent on manual dexterity. The need for this skill is often underestimated because outcomes analysis has not yet been established firmly in European practice. Moreover, a successful end result may be defined differently depending on expectations in a particular hospital. For example, there is a major difference between usually being able to introduce an external catheter in a markedly dilated biliary tree in someone with malignant obstructive jaundice, and being able to introduce a biliary endoprosthesis in virtually all patients with this condition, irrespective of the degree of biliary dilatation.

It is time to discuss this subject openly and to set standards that are achievable, but not below what patients deserve. It should be recognised that not every person who enters the specialty of radiology is capable of becoming an interventional radiologist. The corollary of this argument is that it is better to have a skilled individual performing procedures across a range of organ systems than a less skilled person dealing with a limited range of conditions in a single organ system.

These realities are recognised in practice, and in most hospitals there are general interventional radiologists. Such specialisation as exists tends to take place in vascular and nonvascular intervention, with a healthy overlap between these disciplines. The number of interventional radiologists and the volume of procedures dictate that, at least initially, training in intervention should take place across a range of organ systems with appropriate specialisation being provided when required for particular purposes. Nevertheless, local circumstances must be taken into account when training programs are devised.

ACCESS TO PATIENTS

Interventional radiologists are the only medical practitioners directly administering treatment who do have direct access to patients. The main reasons for this are the historical evolution of interventional radiology from the service specialty of diagnostic radiology, the fact that interventional radiologists in Europe do not usually have resident junior staff, and the perception among many other medical practitioners that radiologists do not have sufficient clinical training and expertise to be in charge of patients. In the US, many interventional radiologists have patients referred to them directly by primary-care physicians. In Europe, this is the exception.

In some European countries, the degree of clinical expertise possessed by radiologists is indeed limited, and this problem would have to be rectified before direct patient access can be justified. In the UK, the great majority of radiologists possess a postgraduate medical or surgical qualification. These are not 'exit' examinations, but they cannot be acquired without a significant amount of clinical experience. Clinical training for at least two years after qualifying in medicine is a requirement for entry into radiologic training.

A doctor should possess sufficient clinical expertise to deal with situations commonly encountered in his or her own practice; the interventionalists should know, for example, that following the insertion of external biliary drainage, a large amount of bile may be lost, disturbing the fluid and electrolyte balance of the patient, and perhaps leading to renal failure if appropriate measures are not taken. Such knowledge would be expected of interventional radiologists because they are the ones most likely to encounter problems connected with the procedures they perform. It is illogical and inappropriate to relinquish the pre- and post-procedure care of patients to physicians or surgeons who are less familiar with the problems encountered in interventional radiology.

Some people accept these arguments but caution against direct patient access because it would upset the referring physicians or surgeons. This need not be the case. Interventional radiologists should continue to work in partnership with the appropriate medical or surgical teams, but the relationship should always be based on equality and mutual respect. Teamwork should not be a euphemism for the interventional radiologist assuming a subordinate role. Similarly, joint decisions should not be 'code-speak' for interventionalists being able to voice their opinion while

accepting that the ultimate decision regarding treatment will always be taken by someone else.
I have been fortunate never to have had a less than excellent relationship with the clinicians with whom I have worked, and my views have always received a courteous and sympathetic hearing. Nevertheless, interventionalists should recognise that under the current arrangements, ultimately they can only refuse to carry out a particular procedure if they consider it to be inappropriate; they cannot take a positive decision to treat a patient in a particular way unless their views are shared by the person in true charge of the patient.
One key issue is payment for time being spent seeing patients. Directors of radiology departments are much more likely to support the clinical role of their interventional colleagues if the departmental budget does not suffer as a result of their clinical activities.
Any changes in current practice have to be gradual, logical and realistic, but interventional radiologists should be able to argue from a position of equality for the use of a particular method of treatment that they believe to be in the best interests of the patient. For example, if a vascular surgeon simply does not believe in angioplasty - even for lesions that all vascular interventional radiologists would consider eminently suitable for this form of treatment - it should not be possible for the surgeon to simply decide that angioplasty may not be offered in a particular hospital. Direct access to patients by the interventionalists would create a situation in which both individuals would have to argue their case on the basis of the facts as they know them
CIRSE can play an important role in shaping the future of interventional radiology in European countries. It should support local initiatives to persuade governments , radiological societies and insurance companies to recognise the important clinical role of interventional radiologists in modern medicine.

Special Session
Endoluminal Techniques for Stenosis/Obstructions in Visceral Arteries

39.1

Treatment of Acute Mesenteric Thrombosis

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Occlusion of the mesenteric arteries, either due to emboli or thrombosis, accounts for 70-80% of all cases of arterial mesenteric ischemia, with nonocclusive mesenteric ischemia accounting for the remainder (1). Emboli are variously cited as accounting for one third to over half of arterial occlusive causes of mesenteric ischemia (1, 2). Mesenteric venous thrombosis accounts for 5-30% of all cases of mesenteric ischemia (1, 3). All forms of acute mesenteric ischemia are life-threatening; the mortality rate for embolic disease is 50%, for arterial thrombosis 97%, and 30% for mesenteric venous thrombosis (1). It is well beyond the scope of this brief review to discuss the pathophysiology of mesenteric ischemia; the reader is directed to several excellent reviews for a more in-depth discussion of the subject (1). Rather, this review will focus on treatment of acute occlusive diseases of the mesenteric arteries and veins.
Embolic mesenteric ischemia
It has been reported that 5% of all arterial emboli reach the superior mesenteric artery. An important set of figures when considering percutaneous options is the distribution of emboli within the SMA: 15% at the ostium, half beyond the proximal few branches, and 35% break up and lodge distally (1, 2). Most emboli originate in the heart, and in most patients atrial fibrillation will be present (2). Because there is generally no preexisting mesenteric arterial disease in these patients, symptoms are acute in onset and severe due to lack of collaterals. Abdominal pain, classically sudden in onset and out of proportion to the physical examination, is accompanied by bloody diarrhea. Vomiting was present in just over half of patients in one recent series (4). Peritonitis and shock are indications for emergent surgery, which is often too late. Traditional surgical dogma was to perform exploratory laparotomy in anyone suspected of acute mesenteric occlusion, as it is well recognized that delay in treatment of even a few hours may mean the difference between life and death. Indeed, Arteriography, although the acknowledged gold standard, was often bypassed due to the inherent delay in assembling a team to do the study. However, with widespread availability of multislice CT scanning, most patients can have the diagnosis rapidly established without any significant delay. Further, CT scanning, especially CTA, may be helpful in triaging those patients who may be candidates for percutaneous management. Surgical therapy consists of embolectomy, bowel resection and rarely arterial reconstruction, and is often followed by a second look laparotomy 24-48 hours after the initial surgery, though this is by no means standardized (1). Over the past decade, sporadic reports have described successful percutaneous management of embolic mesenteric ischemia with good results (2, 5-10). To date, no more than two patients have been described in any manuscript. Whether this represents underreporting, or whether series larger than case reports have had less than favorable results and have thus gone unpublished, is unclear. All reports of percutaneous management have a common thread: the treated embolus has always been beyond the first branches of the SMA. Indeed, to the extent that one can extrapolate from single reports, it would appear that one indication for considering thrombolysis is non-ostial location of the offending embolus. Lytic agents have included both streptokinase (SK) and urokinase (UK), the latter with both infusion and pulse-spray techniques. Patients have been followed more frequently than those with peripheral occlusive disease, generally with a 6 hour lysis check, and in some cases laparatomy and even second-look laparatomy has still been performed. There do not appear to be any reports in the literature at present of use of mechanical thrombectomy devices in embolic mesenteric occlusion, although one report did describe suction embolectomy in conjunction with thrombolysis (2).. Immediate outcomes have been good, and where reported, longer term outcomes have been good as well. Patients are maintained on anticoagulant therapy after treatment, and the source of the embolus is addressed as appropriate.
Based on the limited evidence available at present, it would appear that a stable patient without CT evidence of bowel infarction, with a non-ostial embolus (which account for the majority of emboli), and without contraindications can be considered as a candidate for thrombolysis. Close cooperation with surgical colleagues, intensive care unit observation, and a low threshold for proceeding to surgery in the event of a change in condition should be considered essential accompaniments to percutaneous management of mesenteric emboli.
Mesenteric Arterial Thrombosis
Unlike embolic disease, mesenteric arterial thrombosis usually occurs in the setting of existing underlying arterial disease, although hypercoagulable states, intrabdominal catastrophes, low flow states, vasculitides and inflammatory bowel disease may lead to thrombosis in the absence of underlying disease. The presence of underlying disease likely accounts for the higher mortality rate compared to embolic disease, as well as the relative paucity of reports of successful percutaneous management of this disorder. Indeed, review of the literature yields only a single manuscript describing thrombolysis in this setting (4), in which two of twenty patients with mesenteric arterial thrombosis were successfully treated percutaneously, without any laparotomy. The agent used was not reported; angioplasty was performed in addition to lysis in one patient, attesting to the underlying disease in this population. Symptoms of acute mesenteric arterial thrombosis tend to be worse than those of embolic disease as occlusion tends to extend to the origin of the SMA, but are otherwise identical to those of embolic disease. However, most patients will also report chromic symptoms, and have evidence of atherosclerotic disease elsewhere, which may be gleaned from the history and physical examination. Imaging evaluation should be directed to identifying the cause of symptoms as expeditiously as possible; CT scanning appears to be most valuable in this regard for reasons described above. However, one study reported that most imaging studies merely served to delay the diagnosis (4). It is unclear whether the centers involved in that study had access to multislice CT. Surgical management is similar to embolic disease, but infarction is more common and thus bowel resection tends to be more extensive. Arterial reconstruction or bypass is need more frequently than with embolic disease (1, 4). It is thus not surprising that mortality is higher with mesenteric thrombosis compared to embolic disease, and that reports of successful percutaneous management are fewer. Given the dearth of published evidence to support thrombolysis, it is difficult to make any recommendations. Similar to embolic disease, in the rare event that the thrombosis does not extend to the SMA origin, in the absence of bowel infarction and subject to the caveats above, thrombolysis may be considered with the full understanding that mortality in this population will be very high regardless of the treatment modality used.
Mesenteric Venous Thrombosis (MVT)
Unlike arterial mesenteric occlusions, which typically present acutely and with dramatic symptoms, MVT may be protean in its manifesta-

tions. A wide variety of clinical conditions may predispose to MVT, including cirrhosis, intrabdominal infections and inflammation, malignancy, hypercoagulable states (including oral contraceptive use), trauma, and intrabdominal surgery (recent or remote) among many others (1, 3). Also unlike arterial occlusion, bowel infarction is less common. In this regard, it may be useful to separate the "primary" causes of MVT, principally the hypercoagulable states, from the other or "secondary" causes, as the latter are more likely to progress to infarction and represent a true emergency while the former are more insidious in their onset (1). Symptoms of MVT may include abdominal pain, fever, nausea and vomiting, and in some cases hematemesis and hematochezia. While older series have still considered arterial portography the gold standard for diagnosis, nearly 10 years ago it was recognized that CT would supplant arteriography (1) in diagnosis MVT. Because of the subacute onset in many patients, MR venography may be equally useful in making the diagnosis of MVT.

Treatment depends on clinical presentation; anticoagulation and supportive care are given in the absence of infarction; the latter mandates surgical intervention with bowel resection and thrombectomy. Percutaneous management has been more well described in MVT than in arterial occlusion, and was recently exhaustively reviewed by Henao et al (3). Several different routes have been utilized, with no clear advantage of one versus the other, including systemic or transarterial (via the SMA) thrombolysis and direct portal vein puncture via the transabdominal and transjugular routes. With direct portal access, both chemical and mechanical techniques have been used individually or in combination. In the review cited above, 22 cases from 19 reports showed use of the transarterial route in 11, systemic lysis in 7, transjugular in 3, transhepatic in 2, and intraoperative lysis in 2. Thrombolytic agents have included urokinase, streptokinase and t-PA. Mechanical thrombectomy device have been reported as well, including successful use of the AngioJet (n=1)(11) in conjunction with intraarterial urokinase; one successful and one unsuccessful use of the Oasis device (12) and one successful use of the Arrow-Trerotola PTD without thrombolytic agents (12). The latter report is not included in the review cited above. Given the case-report nature of the available evidence, as well as the wide variety of techniques and routes used for treatment of MVT, it is difficult to draw conclusions or make recommendations, however a few points are worth making. First, if MVT occurs in the setting of portal hypertension and the patient is a candidate for a TIPS, the transjugular route is probably best as it allows treatment of MVT and shunt placement in the same sitting. In patients with primary causes of MVT, who typically will not have contraindications to thrombolysis, the large doses of lytic agent needed for successful transarterial lysis (approximately 10 million units of UK on average) may be acceptable, and many may consider the transarterial route less invasive. On the other hand, in patients with absolute or relative contraindications to thrombolysis, the transhepatic route may allow the most direct approach for use of mechanical devices with or without lower does of lytic agents. Regardless of the route and technique of treatment, percutaneous management of MVT should be considered as a viable option in the absence of bowel infarction.

Summary

Treatment of acute mesenteric thrombosis, whether arterial or venous, can be performed effectively in carefully selected patients, with apparently good results based on very limited evidence. Given the critically ill state of many of these patients, percutaneous options may eventually prove to be preferable to surgery when they are not contraindicated, but a substantially larger experience will be needed, ideally with prospective trials, before such a conclusion can be drawn.

Special Session
Teaching IR

41.1

The Educational Revolution in your Future: Simulation for Interventional Training

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The future of interventional training will lead the way in taking advantage of the symbiotic relationship between computers and educational curricula: we will learn our craft in ways unimagined to our mentors just a generation ago. [1] For the first time, we will be able to break the age-old tradition of "see one, do one, teach one" and change it to "see one, practice many, do one". We will be joined in this educational revolution by other medical specialties, some of whom have already begun this transformation: cardiology, orthopedics, surgery, obstetrics, and anesthesia. Plans are underway for the first use of simulations during board examinations in cardiology in 2006. In the United States, the Society for Interventional Radiology, the American Board of Radiology and the Radiologic Society of North America are all examining the role simulation could play in certification and lifelong maintenance of professional competence. The force that will drive this revolution is improved patient safety.

Motivation

Medical education faces two motivating factors and one significant driver as it considers how to address patient safety the 21st century: the motivation arises from the 1999 Institute of Medicine Report, "To Err Is Human" [2]. In this seminal report, medical errors are revealed as the eighth leading cause of death in the United States, exceeding the number of annual fatalities from breast cancer, AIDS, or motor vehicle accidents. More recently, at the annual clinical congress in 2002, the leadership of the American College of Surgeons offered a second motivating factor, recommending that the College "become the center of patient safety in the United States while enhancing the role of simulation in surgical education and training." [3]

But newer factors are now driving the patient safety issue. The Accreditation Council for Graduate Medical Education's newly mandated 80 hour work week in the United States created a conflict between the need for more and better training to improve patient safety while mandating for fewer contact hours, without a change in the length of residency programs. The situation here in the European Union is even more dire: a newly enacted European Work Time Directive mandates that medical personnel must work no more than 48 hours per week. Early reports from the British training programs where the law was first implemented indicate that fundamental and unforeseen far-reaching consequences have already resulted from this Directive.

We are faced with the problem of training physicians in less time, to do new procedures often not included in residencies even recently completed, to a higher standard of safety, using technologies with which they may not be familiar. We need a medical education revolution.

Simulation as a Disruptive Technology

Simulation represents a disruptive challenge to traditional Halstedian methods of training. Under the Halstedian system, residents are chosen on the basis of merit and pursue training for an arbitrarily chosen period, composed of both didactic training and graduated responsibility for patient care, concluding with a period of supervised practice. According to Christensen [4], disruptive technologies:

- bring different values than were previously available
- initially underperform existing technologies
- have features valued by fringe customers
- are frequently more convenient to use
- are typically commercialized in emerging markets
- the best customers don't want, and initially can't use, products based on disruptive technologies.

The best prima facie evidence that simulation is disruptive is that it will permit users to safely learn from complications. The defining essence of the revolution in education is that with simulation, we will be able to make mistakes without consequences, and learn from them. But unlike actual patient care, many students will be able to make the same mistake and learn the proper correction. With a patient, a mistake is usually made just once and the only person who fully learns how to avoid the error is the person who makes it.

Simulation as a Transformative Technology

As discussed in Brown [5], transformative technologies take knowledge as we know it and present unforeseen opportunities. Simulation is transformative because it allows the dissociation of training from time - it presents the opportunity for training to become asynchronous, where acquisition of skills is independent of the calendar. Procedural learning gained from a well-designed simulation may permit a young resident to demonstrate skills beyond the academic year stages of PGY-1, PGY-2, etc. By dissociating learning from time, we also free education from the laws of physics that demand that time only move in one direction, and thus anatomy can only be seen from one perspective. Because the information in a simulation is digital, we can suspend laws of physics and look at anatomy from any perspective that teaches us, suspending time and space to peer inside an organ and see what we're doing or to examine the relationship of tissues to each other.

Simulation is also transformative because it separates learning from hierarchy-it changes the current model of learning from a master in a

"How I do it" lecture or video library, to a "how did you do it?" opportunity. Peers can practice together and learn from each other, independently of the availability of a master, a patient, or a particular disease. This transformation exchanges a learning archive of one ("How I do it") to an infinite archive ("How did you do it?"), thereby enriching the learning experience.
Finally, by dissociating training from time and hierarchy, simulation transforms learning's place. No longer must learning occur in a hospital or clinic, it can occur wherever simulators and simulations exist. In the end, this may be an important response to how we train future physicians in an era of reduced patient contact time.
Despite its disruptive and transformative nature, for the conceivable future, simulation will be an adjunct to traditional Halstedian methods of training. Even visionaries cannot foresee a day when patient contact is replaced by simulation training. However, we may be shortsighted: in aviation, pilots are trained so proficiently in simulators that the first time they fly a new aircraft, it is full of passengers.
Conclusion
I am confident that both here in Europe and in America as well, our future training will rely on simulation because of three converging trends: growing restrictions on animal use; continued reduction in the length of stay in hospitals, with more care provided on an outpatient basis; and rising demands by patients that they not be used as training materials. With fewer patients in the hospital, and fewer animal models for learning, skills will need to be mastered and maintained over a lifetime of practice. Simulation offers the window of opportunity where we can acquire new skills and prove our abilities to certifying boards. It will allow us to sustain clinical excellence without putting our patients at risk. And in the end, this will be the strongest driver for this new revolution in medical education.

Special Session
Thrombolysis

42.3

Mechanical Thrombolysis Devices

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Introduction
Acute limb ischemia is a result of decreased arterial perfusion resulting in inadequate tissue perfusion. Various mechanical thrombolysis devices have been introduced for the purpose of percutaneous mechanical thrombectomy (PMT) for the treatment of acute arterial occlusion (1-8). These devices should concur with the gold-standard surgical method, the Fogarty balloon embolectomy and with local fibrinolysis therapy (9, 10). The latter therapeutic option is usually deemed too time-consuming, whereas the surgical intervention might cause severe intimal vessel wall damage. Currently available devices for PMT like hydrodynamic (11-18), rotational and ultrasound devices will be introduced (19-21); advantages, disadvantages and finally the clinical outcome of these devices will be presented, recognizing the accepted classifications for acute arterial occlusions.
The success of therapy using mechanical thrombolysis devices in patients presenting with acute peripheral arterial ischemia is evaluated using two major end points as limb salvage and patient survival. Limb salvage is mainly dependent on the severity and etiology (embolic or thrombotic) of ischemia, time from ischemia beginning and extent of thrombus especially when involving run-off vessels. Mortality is mainly dependent from patients medical condition (cardiac, pulmonary and renal disease). Due to complexity of the vascular pathology, an approach of different modalities involving endovascular specialists, as vascular surgeons and radiologists is necessary to obtain best results for patient care.
Mechanical Thrombolysis Devices
While catheter-directed thrombolysis is often lengthy and cumbersome procedure, prolongation of infusion time and increase of the thrombolytic agent dose are associated with increased systemic and local complications and mortality rates (22). Mechanical devices combined with the local application of fibrinolytics have been developed and are still under clinical evaluation (23).
Based on the working principle mechanical thrombolysis devices for infra-aortic arterial applications can be separated into the following groups:
Aspiration Devices
Today no specific aspiration devices are needed to perform an adequate percutaneous aspiration thrombembolectomy (PAT), however a vascular sheath with a removable hemostatic valve might be necessary to prevent retention of aspirated thrombus inside the sheath while retracting the catheter from the artery. While specific percutaneous aspiration catheters are still available in a variety of shape tip configurations conventional thin walled big lumen guiding catheters in different available shaft diameters may serve as a suitable device for aspiration of thromboembolic material. To achieve powerful suction, a 50cc syringe with a luer lock connector is needed. The procedure can be repeated several times to remove the entire thromboembolic material, but for complete thrombus removal adjunctive modalities like thrombolysis are frequently employed in case of large thrombus loads. The risk of antegrade dissection increases significantly when repeated advancement of the catheter is necessary (24).
Hydrodynamic Devices
- AngioJet™ rheolytic thrombectomy catheter (RTC)
The device uses the power of saline jets to break up and remove thrombus by exploiting the Venturi /Bernoulli effect. This effect is based on fast-flowing jets that are directed into the exhaust lumen, creating a pressure gradient with a resulting negative pressure within the catheter's lumen (11).
AngioJet™ catheters (Possis Medical; Minneapolis, MN) are available in different lengths and diameters (60cm and 100cm, 6F Xpeedior™; XVG™140cm, 5F; 135cm, 4FXMI™) are double-lumen catheters (Fig. 1). They are intented for breaking apart and removing thrombus from peripheral arteries, AV access conduits and veins. One lumen provides passageway for high pressure saline delivery to the catheter tip (40ml to 60ml/min, depending on catheter selected); the other larger lumen provides passageway for the guide wire as well as outflow of thrombus debris.
Saline jets directed into the exhaust lumen, provide the driving force to evacuate thrombus from the catheter. To achieve high pressure, a special drive unit with a pump is required (AngioJet™ 3000 A; Possis Medical, Minneapolis, MN). A roller pump on the drive unit (mode 1 or mode 3) controls the clot removal rate to balance it with the saline infusion rate of the jets. The catheters are steerable over an .035 inch (Xpeedior™) guide wire (or .014inch for XMI™ and XVG™). The guide wire passes through the same lumen used for effluent removal. The devices are suitable to treat vessels from 2mm to 12mm in diameter (2-5mm XMI™, 3-8mm XVG™, 4-12mm Xpeedior™).
Fragmentation Devices
- ATD™
The ATD (7Fr, 75cm to 120cm working length; Microvena, White Bear Lake, MN) is a mechanical thrombolysis system intended for mechanical dissolution of thrombus in cases of acute and subacute thromboembolism occluding native vessels and vascular grafts (1). The ATD is driven by high air pressure and mediates mechanical clot fragmentation. A rapidly spinning encapsulated impeller creates an aspirating vortex which agitates and pulls thrombus towards its distal tip (1). The thrombus is broken down to small particles of which 98,8%-99,2% are of less than 13µm size. The remaining particles measure 13µm - 1000µm (3).
- Rotarex™
The Straub Rotarex catheter (Straub Medical, Wangs, Switzerland) consists of a coated stainless steel spiral which glides over an .020inch guide wire and runs inside along the whole length of the 6F or 8F outer catheter. The spiral is fixed distally to the catheter head and proximally to a motor drive. The catheter head consists of two cylinders fitting over each other, the outer rotating cylinder is attached to the spiral, the stationary inner one to the catheter shaft. At the tip of the 8F catheter, the spiral communicates with the vessel lumen through two oval slits. When the catheter and motor drive are connected by a magnetic clutch, the motor rotates the spiral at 40,000r/min, resulting in 80,000cuts/min at the catheter head (negative pressure exerted: 5.8kPa = 43.5mmHg). The occlusion material is sucked through the cutting slits and the fragments are transported by the spiral to the proximal sideport and discharged into a plastic bag. The size of fragmented particles is supposed to range between 100µm and 500µm. A control unit regulates the speed of the motor and increases or decreases the power steered to the motor to obtain an optimum rotation speed of the catheter. The momentary rotational speed of the catheter head is indicated optically and acoustically to avoid overload.
Ultrasound Devices
Acolysis™: The 7F peripheral Acolysis™ probe (Angiosonics, Morrisville, NC) is supposed to facilitate rapidly thrombolysis in the lower limbs

using ultrasound energy (19). The catheter working length is 78cm. The device is compatible with a .018inch rapid exchange (monorail) guidewire. A specific transducer concerts electrical energy into ultrasound energy. Displacement of the probe (45kHz, 21Ws) causes some kind of vibration at the distal 1.6mm tip with a radius of 40µm to 50µm. Due to this mechanism, the formation of so-called cavitation bubbles is induced. The implosion of these bubbles should selectively break down the fibrin bridges between erythrocytes responsible for holding the clot together. Contraindications for the endovascular application of ultrasound have not been determined.

Resolution 360™ Therapeutic Wire: The resolution endovascular system (Omnisonics, Wilmington, MA) is also intended to restore flow in thrombosed peripheral blood vessels. Acoustic energy is delivered circumferentially (360°) around the distal tip of the device to reduce both fresh and organized thrombus to micro-fragments approximately the size of red blood cells while leaving healthy tissue unharmed (21, 25). The energy is delivered by a device specific generator. The maximum tip dimension is .030inch, the diameter of the wire itself varies from .015inch to .025inch. Clinical experiences using this kind of ultrasound device are limited.

Clinical Applications

Balloon embolectomy with the Fogarty catheter is the preferred surgical method for treatment of acute occlusions of native peripheral arteries and bypass grafts (26). Thromboembolectomy using the Fogarty catheter without fluoroscopic and angiographic guidance increases the risk of arterial wall damage with a complication rate ranging from 1 % to 20 % (27). Limb salvage rates of the procedure vary between 62 % and 95 % (28).

All newer therapies must be compared to open surgical revascularization. So far it is unlikely that a single therapeutic modality for mechanical thrombolysis would become the "golden standard" in the management of patients with acute limb-threatening ischemia. Therefore it is possible that optimal thrombus removal with least risk to the patient might be performed by the combination and incorporation of mechanical thrombolyis devices with fibrinolytic agents to reduce duration and dose of fibrinolytic therapy. Latest results using such a device will be presented from a multicenter trial.

Summary

This lecture should provide a comprehensive, current overview of tdevices and techniques available for mechanical thrombolysis. Efficacy of clot removal, procedure-related embolization rate, and mid-term primary patency, secondary patency, mortality and amputation free survival rates for these devices for treatment of acutely occluded infra-aortic native arteries, bypass grafts and veins are given if available. Further-more, the authors try to explain why mechanical thrombectomy is not widespread and established as routine tool in Europe and what changes are needed to get mechanical thrombolysis devices more accepted in the field of interventional radiology. However, the authors hope that less invasive treatment strategies for acute limb-threatening ischemia will be improved and finally accepted in the near future.

Special Session
Percutaneous Ablative Techniques for Non-Hepatique Tumors

43.2

Radiofrequency Ablation of Renal Tumours

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Introduction

In recent years radiofrequency ablation (RFA) has continued to evolve into an effective image-guided tool for the minimally invasive destruction of small volume, discrete tumours. Whilst the vast majority of experience has been gained in the treatment of hepato-cellular carcinoma and colorectal metastases in the liver recent attention has turned to renal tumours. Renal tumours represent some 2% of all human tumours. Despite considerable research into immunotherapy and other agents little advance has been achieved in the treatment of metastatic renal cell carcinoma and only 5-10% of patients will be alive at 5 years [1]. The incidence of renal cell carcinoma (RCC) has also continued to rise by 38% between 1974 and 1990 [2]. Against this background the 5-year survival rate from RCC has steadily improved from 37% in the 1960's to 58% between 1983 and 1989 [2]. Both increased incidence and improved survival are almost certainly attributable to the radiologic detection of early stage disease. In addition, despite other strategies, this detection is largely serendipitous at cross-sectional imaging studies for other symptomatology. Some recent series have suggested that up to 85% of all renal tumours are in fact detected incidentally [3]. The improved outcome from smaller volume tumours has in fact been recently acknowledged by the TNM classification system whereby the upper size limit for T1 tumours has been increased to 7cm in 1997.

An increasing body of opinion has acknowledged the morbidity and mortality of radical surgery for often small and probably low-grade tumours [4]. This has paved the way for nephron-sparing surgery or partial nephrectomy. However compared with standard nephrectomy, partial nephrectomy can be a more technically demanding procedure and carries its own, not insignificant, morbidity [5,6]. A minimally invasive technique that avoids the morbidity of even partial laparascopic nephrectomy would clearly represent a useful therapeutic option. This author would suggest that small (<4cm), rounded, retroperitoneal tumours such as early RCC represent an ideal target for RFA and are potentially curably primary malignancies.

Radiofrequency Ablation (RFA)

RFA is now an increasingly commonplace image-guided interventional tool. A small monopolar electrode induces a sphere of thermal injury around the un-insulated probe tip. This is induced by setting up an alternating current around a closed circuit established through the patient. Large dispersive grounding pads are usually attached to the patient's thighs and the concentration of current flux around the much smaller probe tip induces the thermal injury at temperatures of 55 and 110°C. Successful RFA requires the maintenance of cytotoxic temperatures throughout a 3-5cm sphere of perfused tissue for a number of minutes in order to induce irreversible cellular damage. However the technique is also reliant on gradual conductive tissue heating and induction of higher temperatures of 100-100°C is counterproductive as it causes carbonisation and vaporisation so limiting the volume of the treatment sphere. At our institution we use both perfusate-cooled cluster probes (Tyco Radionics, Boulder, CO) and expandable needle systems (RITA Medical Systems, Mountainview, CA).

Technique

Both patients with solitary kidneys and multifocal disease in addition to standard small volume tumours have been treated at our institution. A number of cases are referred for RFA due to co-morbidity and lack of fitness for traditional surgery. Our practice is to have the patients attend for outpatient assessment and a review of their recent cross-sectional radiology staging. The majority or renal tumours are still treated under ultrasound guidance and the tumours are assessed for sonographic visibility and ease of access. Only occasional treatments are then scheduled in the CT scanner where poor visibility or a critical relationship to adjacent structures is encountered. Most small volume cortical tumours lend themselves ideally to ultrasound-guided treatment in the prone oblique position. Occasionally anterior interpolar tumours are closely approximated to the colon and it has been our recent practice to improve the safety margin around the tumour using "hydrodissection" with 5% Dextrose.

RFA of retroperitoneal RCC also appears to be better tolerated than transperitoneal, hepatic procedures. Certainly slightly slower treatments operating at 100-150W generator outputs seem to cause less patient discomfort. At our hospital most of the RFA has been performed under conscious sedation although more recently we have shifted towards general anaesthesia for larger volume or multifocal treatments.

The treatment cycle varies between manufacturers but most tumours up to 4cm are adequately treated by up to 30 minutes of energy deposition. A "track ablation" is performed at the end of the treatment episode.

Follow-up assessment is by contrast-enhanced CT and treatment adequacy usually determined by the area of non-enhancement with respect to the tumour mass. Careful comparison must be made with the recent pre-procedural imaging and the extent of the RF lesion is usually better defined by CT at least 3-4 days after treatment.

Is a local, minimally invasive treatment adequate?

Some "radical nephrectomists" have raised the issue of tumour multicentricity, at between 5 and 10%, and the fact that morbidity is greater with partial than radical nephrectomy. However outstanding 5-year, tumour-specific survival for small renal tumours (<3.5cm) from partial nephrectomy makes the case for a minimally invasive therapy where preservation of ipsilateral renal parenchyma appears to have a significant impact on overall patient outcome [7,8]. Radical nephrectomy practise must also acknowledge that approximately 10% of resections reveal benign pathology such as angiomyolipoma or complex cyst.

Harmless adenomas?

Some commentators have implied that small renal tumours of less than 3cm in diameter are harmless "adenomas". Adenomas are in fact minute cortical foci of tubular / papillary epithelium usually of up to 3mm in diameter and rarely growing up to 1cm in size. These adenomas are commoner in scarred kidneys and lack the 3p chromosomal alteration of RCC. It now appears spurious to term sub-3cm solid nodules, adenomas, as even small clear cell carcinoma can demonstrate aggressive features with metastatic potential. In this respect the author believes the practice of RFA for small RCC can be likened to prophylactic polypectomy in the colon.

To Biopsy or not to Biopsy?

Imaging studies have been repeatedly shown to be more *accurate* than biopsy. Indeed a recent study by Dechet [9] found that intraoperative core biopsy against resected histology yielded a sensitivity of 81%, specificity of 67% and NPV of only 71%. It is our practice to only biopsy the lesion during the procedure, when a concurrent malignancy exists. There is however considerable controversy around this issue and many workers in the field would argue that we should strive to obtain tissue confirmation particularly for a non-extirpative technique such as renal RFA.

Results

To date most reported studies of RFA for RCC have been in terms of safety and local efficacy although patient outcomes, with moderate cohorts, out to the mid-term are now accruing. Gervais et al have reported on 42 renal tumours in 34 patients during a 42-month period with a mean follow-up of 13.2 months. They found all 29 exophytic tumours were completely ablated. Larger tumours (>3cm) with a renal sinus component was predictive of subtotal treatment. In the series by Mayo-Smith et al 26 of 32 tumours were completely ablated at one treatment session and 31 out of 32 following two re-treatments or less. They reported two perinephric haematomas and one 5mm skin metastasis which was resected without occurrence.

In our own experience (12, reported early experience) of 32 tumours in 28 patients, over a four and a half year period, measuring 12-64mm, we have experienced 5 subtotal treatments. In two elderly patients with thin residual crescents of viable tumour a clinical decision was made not to re-treat. In two others the residual tumour crescent was successfully ablated under CT guidance. One further patient is current (5cm tumour) with some remnant viable disease and a therapeutic decision is outstanding. Tumour size of >4.5cm and a lacunar or cystic component were predictive of treatment failure. In this series one profuse but self-limiting haematuria and one assymptomatic psoas burn were incurred.

Conclusion

Radiology has made a major contribution to the detection of early stage renal cell carcinoma and has thereby contributed to the improved outcome for this disease over recent decades.

Uro-oncological practice suggests there is a real place for a minimally invasive therapy for the treatment of small volume (<4cm) renal malignancy. Radiofrequency ablation under imaging guidance appears well suited to the task.

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9.1.1.

Infrapopliteal stenting with simple versus drug-eluting stents: preliminary experience

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Purpose: Drug-eluting stents have yielded exciting results in coronary stenting, but have not improved long-term results in the superficial femoral artery. Our aim was to investigate the efficacy and safety of infrapopliteal stenting with conventional versus sirolimus-eluting stents.
Materials/Methods: Forty consecutive patients (28 men, mean age 69 years), with stenoses of Rutherford Grade II category 4 and above, underwent infrapopliteal stenting, 24 with conventional and 16 with sirolimus-eluting stents. The total number of treated arteries was 32 and 27, respectively.
Results: Initial technical success rate was 100% in both groups. The mean ankle-brachial index before intervention was 0.81 for the conventional group and 0.72 for the sirolimus group, and rose to 1.02 and 0.98 respectively at hospital discharge. Periprocedural complications occurred in 8% and 6% respectively. At six months, the angiographic binary restenosis rate was 18.75% for conventional stents versus 3.70% for sirolimus-eluting stents (p=0.037), and the revascularization rate was 5% and 0% respectively. The cumulative limb salvage rate was 97% for the conventional group and 100% for the sirolimus group. Minor amputation was necessary in 4% of the conventional group.
Conclusion: Drug-eluting stents achieve significantly lower short-term restenosis than conventional stents; short-term limb salvage is similar in both groups.

9.1.2.

SIROCCO II Study: sirolimus coated SMART nitinol stents for the treatment of obstructive superficial femoral artery disease

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Purpose: To investigate further the safety and efficacy of self-expanding sirolimus-coated nitinol stents versus bare SMART stents in the superficial femoral artery (SFA).
Materials/Methods: This randomised, double-blind study involved 57 patients (29 in the sirolimus-eluting stent group and 28 in the bare stent group) with chronic limb ischemia and SFA occlusions (66.7%) or stenoses (average lesion length, 81.5 ±41.2 mm). The primary endpoint of the study was the in-stent percent mean diameter stenosis quantified via angiography at six months.
Results: There was no statistically significant difference in the primary endpoint of in-stent mean lumen diameter, as measured by quantitative angiography at 6 months, between treatment groups (4.94 ±0.69 and 4.76 ±0.54 mm for the sirolimus-eluting stent and the bare stent groups, respectively). The mean late loss values (0.38 ±0.64 and 0.68 ±0.97 for the sirolimus-eluting stent group, and the bare stent group, respectively), suggest that neointimal hyperplasia may have been inhibited in the sirolimus group. Duplex ultrasound at 9 months showed in-stent restenosis of 7.7% and 13% in the sirolimus arm and the control group, respectively. There was no significant difference in adverse events between treatments.
Conclusions: There is a trend for greater efficacy in the sirolimus-eluting SMART stent group.

9.1.3.

The effect of percutaneous transluminal angioplasty on patients' quality of life

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Purpose: Impact of PTA on quality of life (QoL) in patients with peripheral vascular disease (PVD).
Materials/Methods: Seventy-one patients (54% men, average age: 71yrs) underwent lower limb PTA, over 12 months. QoL data were obtained before angioplasty, at one and six months using the Short Form 36 questionnaire. Questions covered nine health indices [physical function (PhF), physical role (PhR), emotional role (ER), social functioning (SF), mental health (ME), energy/vitality (E/V), pain (P), general health perception (GHP), change in health, (CH)] using a well-defined scoring system. Indications were intermittent claudication (66%) and limb salvage (34%).
Results: Baseline QoL was below that quoted for normal Irish population. QoL average scores at baseline, one month and six months were: PhF: 40, 50, 52; PhR: 23, 36, 44; ER: 66, 54, 62; SF: 70, 71, 72; ME: 74, 75, 79; E/V: 49, 55, 56; P: 47, 64, 61; GHP: 61, 61, 58; CH: 38, 65, 69. Seven health domains improved at one and six months, being statistically significant in four (PhF, PhR, ME, E/V).
Conclusion: PTA results in improved QoL in patients as early as one month post-procedure and is maintained at six months. QoL assessment is useful in the clinical follow-up of PVD.

9.1.4.

Endovascular brachytherapy to prevent restenosis after femoropopliteal angioplasty

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Purpose: To evaluate safety and efficacy of endovascular brachytherapy (BT) for the prophylaxis of restenosis after femoropopliteal percutaneous transluminal angioplasty (PTA).
Materials/Methods: Thirty-three patients (20 men, 13 women, mean age 65.2 years, range 49-80) with 36 femoropopliteal lesions were included in this randomized double-blind study. Eighteen lesions (mean length 10.72 cm; range 5-15 cm) were treated with PTA+BT and 18 (mean length 10.04 cm; range 5-15 cm) with PTA and dummy BT. A dose of 14 Gy was applied by a gamma source (192 Iridium) to the adventitia. Follow-up was performed the day after and at one, three, six and 12 months, including measurement of the ankle-brachial index (ABI), colour duplex ultrasound, and angiography.
Results: No complications or side effects were observed. The cumulative patency rate after 12 months was 81.4% for PTA+BT and 43.9% for PTA+dummy BT. The recurrence stenosis rate was 16.7% (3/18) for PTA+BT and 44.4% (8/18) for PTA+dummy BT ($p<0.05$, χ^2-test).
Conclusion: BT with a dose of 14 Gy seems to be a safe and effective treatment for the prophylaxis of restenosis after femoropopliteal PTA. Further studies are needed to evaluate long-term results of BT.

9.1.5.

ReoPro and peripheral arterial intervention to improve clinical outcome in patients with peripheral arterial disease. A randomized prospective trial (RIO trial)

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Purpose: The RIO trial was designed to test the efficacy of GP IIb/IIIa blockade on subacute reocclusions in patients with interventional recanalization of chronic occlusions in superficial femoral and popliteal arteries.
Materials/Methods: A total of 420 patients will be randomly assigned to ReoPro or placebo. Infusion is started after passageof the guidewire. Patients will be eligible for randomization with occlusions longer than 5 cm. Doppler ultrasound follow-ups will be at 30 days, and after six and 12 months.
Results: A total of 154 patients are currently randomized in this multicenter trial. In Tuebingen, 4/73 patients had to be unblinded due to acute occlusions which could not be successfully treated with thrombolysis. All four patients were assigned to the placebo group and resolved without any surgery after bail out administration of ReoPro.
Conclusion: GP IIb/IIIa blockade may have its role during complex interventions. The RIO trial design and first insides will be discussed.

9.1.6.

Performance of distal protection filters during percutaneous interventions of peripheral arteries

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Purpose: Outflow filter devices are already employed for protection during coronary, carotid and renal endovascular procedures. The authors report their safety, filtering capability, and clinical outcome during peripheral interventions.
Materials/Methods: The study population included 25 patients, aged 47-74 (five stenoses, five acute peripheral occlusions, 11 subacute and four chronic). A Spider filter (EV3, USA) was utilized. Target lesions were treated using angioplasty and stenting. Angiojet rheolytic thrombectomy was reserved for acute thrombotic occlusions. Embolic material after filter recovery was analyzed histopathologically. One year of follow-up was planned.
Results: Twenty-six filter baskets were deployed distal to a total of 25 target lesions, with a mean length of 6.10±3.70 cm. No distal embolization occurred. Macroscopic debris was extracted from all filters, containing fresh thrombus, calcifications, cholesterol and fibrin. Mean diameter of the largest particle per filter specimen was 1,702.80±1,155.12 μm. Primary and secondary patency was 50% and 70% at one year, respectively, among ten patients. Limb salvage rate was 100% (10/10) at one year. One-year follow-up data for the other 15 patients will be presented.
Conclusion: In our experience outflow protection filters seem to be effective in hindering distal macroembolic complications and in safeguarding the microvascular bed from microemboli during endovascular therapy.

9.1.7.

External beam radiotherapy to prevent restenosis after femoropopliteal artery angioplasty

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Purpose: To evaluate the safety and efficacy of external beam irradiation to prevent restenosis after femoropopliteal percutaneous transluminal angioplasty(PTA).
Materials/Methods: After femoropopliteal PTA, 98 patients were randomly assigned to 0 Gy (placebo), 7 Gy, 10.5 Gy, or 14 Gy of external beam radiotherapy given to the PTA site, administered in one fraction 24 hours after PTA by a 6-MeV linear accelerator. Arteriography was performed before, immediately after, and 12 months following PTA.
Results: Ten patients were lost to follow-up. Among the 88 patients who completed the one year follow-up, arteriography demonstrated a mean minimal lumen diameter of 2.0, 1.6, 1,9 et 3.0 mm for the 0, 7, 10.5 and 14 Gy groups, respectively (0 versus 14 Gy p=0.01). Mean late loss were respectively of -25%, -30%, -23% and -10% (0 versus 14 Gy p=0.03). Restenosis rate of ≥50% were respectively of 50%, 65%, 48% and 20% (0 versus 14 Gy p=0.05). One patient had a reversible transient thigh myositis but relationship with radiotherapy is uncertain. Two other patients presented a transient thigh pain.
Conclusion: External beam radiotherapy after femoropopliteal PTA seems to be well-tolerated and the 14-Gy dose has a significant beneficial effect on restenosis one year after PTA.

9.1.8.

Use of aSpire stent for the treatment of superficial femoral artery disease

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Purpose: To report our experience with the use of the aSpire stent (a nitinol spiral-shaped stent fully encased inside a sleeve of ePTFE covering) for the endovascular treatment of superficial femoral artery disease.
Materials/Methods: Between May 2001 and September 2003, 29 patients (mean age 70±18, 17 men) with distal (26 patients) or proximal (three patients) superficial femoral artery disease were treated endovascularly with the use of an aSpire stent. The length of the lesions ranged between 6 and 30 mm; one-vessel run-off was present in 19 patients, two-vessel in nine patients and three-vessel in one patient. Prior to treatment the mean ankle-brachial index (ABI) was 0.57.
Results: After a mean of 11 months (1-20) primary and secondary patencies were 65.5% (19 patients) and 75.9% (22 patients) respectively with improvement of 35% in ABI (mean ABI 0.77). Seven patients (24.1%) developed complete occlusion of the treated vessel at 1-17 months after stenting. At 13 months one patient underwent foot amputation for severe ischemia unresponsive to other therapy.
Conclusion: Despite the limited number of patients and relatively short follow-up time, the results of our preliminary experience are encouraging.

9.1.9.

Endovascular brachytherapy for the prevention of restenosis after femoropopliteal angioplasty: results of the VARA trial

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Purpose: Endovascular brachytherapy (EBT) has been proposed as a method to prevent restenosis. A randomized trial to evaluate effectiveness of EBT was then performed.
Materials/Methods: Patients with symptomatic stenotic or occluding lesions in the femoropopliteal artery were randomized to be treated with PTA plus EBT or PTA alone. Follow-up examinations were planned after six and 12 months. The primary end-point was a significant restenosis at duplex ultrasound of the treated segment after 12 months.
Results: Fifty-one of the 61 patients could be studied. After 12 months, restenosis rates were 42% (10/24) in the control group versus 32% (7/22) in the PTA + EBT group (X^2 test, p=0.49). There was no significant difference in mandatory reintervention between the two groups. The impact of several lesion characteristics on restenosis was compared. Overall, EBT gave an absolute risk reduction of 10%, yet in occlusions this reduction was 28% versus 3% only of stenotic lesions.
Conclusion: The effect of EBT on restenosis seems modest in our study. This may be influenced by the relatively low restenosis rate in the control group.

9.2.1.

Image-guided radiofrequency ablation in the local treatment of small cortical renal tumors

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Purpose: To determine safety and efficacy of radiofrequency ablation (RFA) in the management of small cortical renal tumors.
Materials/Methods: From January 2001 to January 2004, 12 patients (aged 57-91 years) with 13 renal tumors underwent RFA under CT- or ultrasound-guidance. Tumor sizes were 16-36 mm. Four patients had a solitary kidney, one had bilateral tumors, and seven presented high surgical risk or severe renal failure. Two commercially available needle electrodes were used (three cooled-tips and ten hooked needles). RFA was performed under conscious sedation in 11 patients while one patient underwent RFA under general anesthesia during a surgical procedure for another pathology. During follow-up (22-715 days), patients underwent abdominal CT or MR at one, three, and six months, and every year thereafter.
Results: The treatment was well tolerated in all cases and no major complications occurred. Imaging follow-ups demonstrated a complete tumor necrosis in 11/13 lesions. One patient was lost at follow-up and another patient died for another pathology. A second successful RFA was done in one patient for a recurrence identified at six-month follow-up.
Conclusion: RFA of small renal tumors may be a safe and effective alternative for those patients with contraindications to surgery or with coexisting diseases.

9.2.2

Percutaneous radiologic gastrostomy. A simplified technique with ultrasonographic puncture and T-fastener control of the gastric wall during tract dilation

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Purpose: To evaluate the safety and efficacy of a new simplified technique for percutaneous radiologic gastrostomy (PRG).
Materials/Methods: Thirty-nine PRG procedures were performed in 34 patients (mean age 73, range 52-88 years). The indication for PRG was a neurological disorder in 33 patients and esophageal cancer in one. The stomach was filled with water via a nasogastric tube and punctured under ultrasonographic guidance. A T-fastener and a guidewire were introduced via the puncture needle. Under fluoroscopic guidance, dilation up to 16 F and insertion of a 14-F gastrostomy tube (silicon-balloon catheter) was performed while the gastric wall was held and fixed with the T-fastener. At the end of the procedure, the gastrostomy tube was gently pulled toward the abdominal wall (gastropexia) to avoid gastric spilling into the peritoneal cavity. The T-fastener was used only during the procedure/dilation.
Results: All the procedures were performed successfully. Thirty-day follow-up recorded two minor complications: a minor hemorrhage and an infectious peritonitis. No major complications were seen. Tube replacement was required in five patients because of inadvertent tube removal due to an early balloon rupture.
Conclusion: PRG with this simplified technique is highly efficient and feasible. Procedure-related complications seem to be unfrequent.

9.2.3.

***In vitro* and *in vivo* comparison of different sequences for the visualisation of laser-induced thermotherapy and radiofrequency applicators with 3-Tesla highfield MR**

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Purpose: The aims of this study were: 1. to quantify susceptibility artifacts produced by different laser-induced thermotherapy (LITT) and radiofrequerncy (RF) applicator systems using a MR system; and 2. to evaluate the feasibility of 3-Tesla MR-guided interventions.
Materials/Methods: *In vitro* MR imaging of different LITT and RF applicator systems (MeoMedical, Rita Medical Systems, Somatex, RadioTherapeutics, Radionics) was performed using a 3-Tesla MR. Pulsed sequences (T1w and T2w), suitable for image guided interventions, were performed. The size of induced artifacts was documented in transversal and longitudinal directions. Animal experiments were carried out in six rabbits with liver tumours by using those sequences evaluated *in vitro*.
Results: Among all applicator systems, solitary titanium needles of LITT applicators produced significantly smaller artifacts than multipart applicators for RF ablation. Induced artifacts were significantly smaller in T2w FSE and SE sequences. The diameter of the artifact was proportional to the angle of the applicator in correlation to the magnetic field B0. SSFSE sequences were advantageous for non-breathhold interventions in animal experiments.
Conclusion: Image-guided interventions with applicators for LITT and RF are safe and feasible in 3-Tesla highfield MR. Induced susceptibility artifacts can be minimised by using T2w FSE and SSFSE sequences.

9.2.4.

Radiofrequency ablation in patients with severe cancer pain

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Purpose: The relief of severe cancer pain in those patients with advanced cancer and the consequent improvement of their quality of life is a very important feature. In this study, the effectiveness and feasibility of radiofrequency ablation (RFA) in patients with severe cancer pain were assessed.
Materials/Methods: Eight patients with advanced cancer and severe pain were included (four rectal cancers, one uterine cancer, one lung cancer, one renal cell carcinoma, one hepatocellular carcinoma). There were ten metastatic lesions: in the iliac bone in three cases, in the acetabulum in two, in the sacrum in one; pelvic recurrences were three, and one lesion was a paraaortic lymph node metastasis. RFA was performed under computed tomography-fluoroscopy guidance. Pain relief was evaluated using the visual analogue scale (VAS) score and complications were also assessed.
Results: All the procedures were technically successful. Pain was relieved within two weeks in all the eight patients (100%). The mean VAS score significantly decreased from 8.0 ± 1.3 to 2.0 ± 1.4 ($p<0.01$). Opioid administration decreased in four patients. There were no major complications, although one patient with a pelvic recurrence of rectal cancer had transient dysuria.
Conclusion: RFA in the treatment of severe cancer pain is feasible and effective.

9.2.5.

Percutaneous US-guided radiofrequency ablation (RFA) of small renal cell carcinomas (RCCs)

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Purpose: To present our experience with RFA of small RCCs, initially performed in patients with contraindications to surgery and, later, as the treatment of choice.
Materials/Methods: Thirteen patients (seven with a single kidney, three with von Hippel-Lindau disease also) with 18 RCCs (15-35 mm, median: 24) were treated. One lesion was parahilar, one parahilar/parenchymal, the remaining parenchymal and/or exophytic. US-guided RFA feasibility, complications, results at imaging, and mid-term clinical usefulness were evaluated.
Results: RFA was always feasible under US-guidance, even via transperitoneal approaches (three cases: two transhepatic and one transcystic). Only one minor complication (minimal hematoma in the Morison's pouch, without any consequences) occurred. Local success after one treatment was 88.9% (16/18; partial necrosis of the 28-mm parahilar lesion and of the 35-mm parahilar/parenchymal lesion), reaching 94.4% (17/18) after a second treatment of the largest lesion; the lesion size and a parahilar location, therefore, seem to be negative prognostic factors. After a mean of 13 months (1-36), all patients are alive, with enough renal function to avoid dialysis.
Conclusion: According to our experience and to recent literature, percutaneous US-guided RFA can be the treatment for non-parahilar small RCCs, both in patients with contraindications to surgery and as an elective treatment.

9.2.6.

Early stage hepatocellular carcinoma in cirrhosis: long-term results of image-guided percutaneous radiofrequency ablation

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Purpose: To determine the long-term results of percutaneous radiofrequency ablation (RFA) as first-line treatment for nonsurgical patients with hepatic cirrhosis and early-stage hepatocellular carcinoma (HCC).
Materials/Methods: From June 1, 1996, to January 1, 2003, 206 patients with Child's class A or B cirrhosis and either single HCC <=5 cm in diameter or <=3 HCCs each <=3 cm were enrolled in a prospective, intention-to-treat clinical trial. One hundred eighty-seven (91%) of 206 patients received RFA as the sole first-line anticancer treatment, while 19 were considered unfit for RFA. Follow-up ranged from 3-78 months (mean, 24.1 months $\pm$ 21.2).
Results: The one-, three-, and five-year survival rates were 97%, 67%, and 41% in intention-to-treat analysis, and 97%, 71%, and 48% in the 187 compliant patients ($p = 0.51$). Survival of RFA-treated patients was dependent on Child's class ($p = 0.0006$) and tumor multiplicity ($p = 0.013$). Patients in Child's class A with a solitary HCC ($n = 116$) had one-, three- and five-year survival rates of 100%, 89% and 61%.
Conclusion: RFA is an effective treatment for cirrhotic patients with early-stage HCC. Survival rates of RFA-treated patients are equivalent to those reported for resection.

9.2.7.

Percutaneous radiofrequency ablation of liver malignancies with expandable multi-probe needles: a multicenter analysis of complications

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Purpose: To determine the rate of major and minor complications associated with the use of expandable, multi-probe radiofrequency ablation (RFA) needles.
Materials/Methods: A series of 1515 patients who received percutaneous RFA of liver malignancies at 12 centers from 1997 to 2003 were included in a retrospective study. RFA was performed by using 14-G expandable multi-probe needles with 4-9 prongs and 50-150W generators (RITA Medical Systems). Overall 2274 lesions (1130 hepatocellular carcinomas and 1144 metastases), ranging between 0.8 and 8.5 cm in diameter (mean, 2.7 ± 1.3 cm), were treated. Number, characteristics, and relationship of complications to the RFA procedure were analyzed.
Results: Two patients died (mortality rate, 0.1%). Major complications were observed in 32/1515 patients (2.1%) and included intraperitoneal bleeding (n=10); hepatic decompensation (n=3); hepatic abscess/biloma (n=2); bile duct stenosis (n=3); portal vein thrombosis (n=3); tumor seeding (n=8) and other (n=3). Minor complications were observed in 89/1515 (5.9%) patients. RFA of lesions with a superficial location was associated with higher risk of major complications ($p <.05$).
Conclusion: Percutaneous RFA of liver malignancies with expandable, multi-probe needles is associated with a low risk of major complications. Treatment of superficial lesions, however, requires caution.

9.2.8.

Evaluation of efficacy and medium-term survival after percutaneous radiofrequency ablation of hepatic metastases in patients with metastatic colorectal cancer

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Purpose: The aim of this retrospective study was to evaluate efficacy and medium-term survival after percutaneous radiofrequency ablation (RFA) in patients suffering from hepatic metastases of colorectal cancer.
Materials/Methods: Between 2000 and 2004, 68 patients (42 men, 26 women; mean 63 years, range: 38-87) with liver metastases from colorectal cancer were treated by RFA subsequently or parallel to chemotherapy. All procedures were performed under conscious sedation and local anaesthesia using computed tomographic-fluoroscopic guidance. The number of lesions, primary success rate, complications, follow-up time and disease-free survival were evaluated.
Results: One-hundred eighty-three metastases in 68 patients (2.7 +/- 1.1 lesions/patient) were treated using RFA. No major complications and only four minor complications were noted. The size of the metastases ranged from 5 to 60 mm (mean 22.8). Over an average follow-up period of 21.4 +/-10.6 months (range, 8 to 38 months), Kaplan Meier analysis demonstrated a probability of 81% of remaining locally disease-free and a probability to survive the first 38 months after treatment.
Conclusion: For patients with non-resectable hepatic metastases of colorectal cancer RFA is a safe adjunct in a multimodal treatment concept and may lead to an improvement of life expectancy.

9.2.9.

Efficacy and medium-term survival after percutaneous radiofrequency ablation in patients with hepatocellular carcinoma

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Purpose: Our aim was to assess efficacy, complication rate, and medium-term survival after percutaneous radiofrequency ablation (RFA) in patients with hepatocellular carcinoma.
Materials/Methods: Between 2000 and 2004, 55 patients (43 men, 12 women; mean age 65 years, range: 36-82) with hepatocellular carcinoma were treated by RFA. All procedures were performed under conscious sedation and local anesthesia using CT-fluoroscopic guidance. The number of lesions, the primary success rate, complications, disease-free survival and follow-up were evaluated.
Results: One-hundred twenty-four tumor nodules in 55 patients (2.25 +/- 0.5 lesions per patient) were treated. No major complications and only three minor complications were recorded. The size of the nodules ranged from 10 to 56 mm (mean 27). For an average follow-up period of 21.4 +/-10.6 months (range: 8-38 months) Kaplan Meier analysis revealed: 85% probability not to develop a loco-regional relapse; 64% probability of survival for the first 38 months after treatment.
Conclusion: RFA is a promising new therapeutic modality in patients with hepatocellular carcinoma, offering a low complication rate and a high rate of loco-regional tumor control.

9.3.1.

Image-guided core needle biopsy in children with suspected neuroblastoma

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Purpose: To evaluate image-guided core needle biopsy in children with neuroblastoma.
Materials/Methods: Prospective study of children with suspected newly-diagnosed or recurrent neuroblastoma. Biopsy (coaxial where appropriate) was performed with a semiautomatic core needle device.
Results: There were 76 children aged 19 days to nine years (mean 2.4 years). Ninety-two lesions were biopsied at 81 procedures (three patients had two biopsies and one patient had three). Adequate tissue was obtained in 90/92 lesions (97.8%, 95% confidence interval 92.4% to 99.4%). A diagnosis of neuroblastoma was confirmed in 65/76 patients (86%). Other final diagnoses were peripheral neuroectodermal tumour (4), lymphoma (2), congenital fibrosarcoma, rhabdomyosarcoma, teratoma and extrarenal rhabdoid tumour. There was no final diagnosis in one patient. The correct final diagnosis was reached by needle biopsy in 73/76 patients (96.1%, 95% confidence interval 89.0% to 98.7%). In three children in whom the biopsy showed only ganglioneuroma, the final diagnosis was ganglioneuroblastoma. Ultrasound was used for guidance in 88 lesions, computed tomography in nine and fluoroscopy (for transjugular biopsy) in two. There were no immediate complications of needle biopsy, and no needle-tract seeding was detected.
Conclusion: Image-guided core needle biopsy appears to be safe and accurate in children with suspected neuroblastoma.

9.3.2.

Endocavitary three-dimensional ultrasonography assistance for transvaginal or transrectal drainage of pelvic fluid collections

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Purpose: To evaluate the feasibility and usefulness of endocavitary three-dimensional ultrasonography (3D US) for intraprocedural planning of transvaginal (TV) and transrectal (TR) drainage of pelvic fluid collections.
Material/Methods: Nine patients with symptomatic deep fluid collections in the pelvis underwent TV (7) or TR (2) drainages. Endocavitary 3D US was used to clarify pelvic anatomy and plan access route and number. 3D US was assessed for ability to visualize relevant anatomy, identify new information, and alter interventional technique. Real-time 2D US with an attached biopsy guide was used to place the access needles.
Results: Endocavitary 3D US provided adequate visualization in 9/9 (100%) patients, yielded new information in 9/9 (100%), and altered interventional technique in 9/9 (100%). The most useful information provided by 3D US was the use of axial reformatted display to replicate the diagnostic computed tomography in order to clarify anatomy, identify loculations or septations that altered drain location or number, and provide precise targeting information for transcervical drainage of hematometrium.
Conclusion: Endocavitary 3D US, if available, is feasible and frequently provides new information that may alter TV or TR drainage technique.

9.3.3.

Percutaneous CT-guided biopsy of anterior mediastinum masses using a trans-sternal access

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Purpose: To demonstrate the efficacy of a new percutaneous CT-guided technique (PCTG) for histological examination of retro-sternal solid masses.
Materials/Methods: From January 2000 to December 2003, PCTG biopsies of solid retro-sternal masses were performed under local anesthesia in 18 patients. A "bone needle set" for the bone segment and an automatic 18-G needle for the collection of histological specimens were used. A preliminary CT evaluated the sternal bone thickness and dimensions of the expansive lesion. The bone biopsy needle was initially introduced and advanced beyond the outer table of the sternum. After correct direction of the needle, a coaxial 18-G needle was introduced for histology.
Results: Adequate samples for the histological examination were obtained in all biopsies. The material was diagnostic in all 18 cases (100%). No major, early, or late complications were observed; a mild pain at the puncture site was the only complaint.
Conclusion: Percutaneous trans-sternal CT-guided biopsy of anterior mediastinum solid masses is a fast, safe, and low-cost method. It represents a valid alternative to more invasive tecniques, such as thoracoscopy and mediastinoscopy.

9.3.4.

Percutaneous fine-needle aspiration biopsy and core needle biopsy of pulmonary lesions

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Purpose: To compare the effectiveness of percutaneus fine needle aspiration biopsy (FNAB) and cutting biopsy of pulmonary lesions.
Materials/Methods: One-hundred and five percutaneus interventional CT-guided diagnostic lung biopsies performed between July 2002 and December 2004 were retrospectively studied. For FNABs, 20-G fine needles were used; for cutting biopsies, automated 18-G core needles with 1-2 cm cutting-edge were employed. FNAB was performed in 54 patients; core biopsies in 51. In 14 core-biopsy cases and in 30 FNAB cases repeated manipulations
were performed. The samples were analyzed both cytologically and morphologically.
Results: The tissue collected was sufficient to establish a diagnosis
in 50/51 (98.03%) core biopsies and in 26/54 (48.1%) FNABs. Morphologic analyses showed: metastatic lesions (39), primary tumors (37), tuberculomas (3), hemangiopericytomas (2), hemodectoma (1), inflammatory lesions (17). FNAB negative results were 32.5%, verified after surgery. Core biopsy specificity was 87.5%. Three complications (pneumothoraces)occurred, one of which required therapeutic interventions.
Conclusion: Percutaneus transthoracic CT-guided core biopsy is a safe and effective method and provides useful diagnostic information in the majority of cases.

9.3.5.

Fine needle Trucut biopsy versus fine needle aspiration cytology: is the era of abdominal fine needle aspiration cytology over?

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Purpose: Historically, fine needle aspiration cytology (FNAC) has varying sensitivity, specificity, and accuracy in the diagnosis of abdominal lesions. A 15-20% insufficient sampling rate is associated with FNAC. We compared 20-G FNTB with historic FNAC results.
Materials/Methods: A retrospective review of 145 20-G FNTB US and CT-guided biopsies of abdominal tumours in 132 patients (M:F;76:56, mean age 61.12 years) was performed. Biopsies were of liver masses in 79, pancreas in 32, lymph nodes in nine, omentum in five, and other in 20.
Results: An average of 1.97 passes (range 1-4) was performed per biopsy. A definitive diagnosis was made in 139 of 145 biopsies (95.86%). Diagnoses consisted of malignant: metastatic liver disease (67), pancreatic adenocarcinoma (19), lymphoma (8), other (26) and benign (25). The insufficient sampling rate for FNTB was 5/145 (3.5%). No significant complications occurred.
Conclusion: 20-G FNTB yields a greater and consistent positive diagnosis rate (95.86%) than historic FNAC (64-85%). A greater insufficient sampling rate occurs with FNAC (15-20%) than with FNTB (3.5%). For abdominal biopsy, 20-G FNTB needles have a much higher yield than FNAC with no increase in complications. FNTB is the preferred choice, particularly where cytologic assistance at the time of biopsy is unavailable.

9.3.6.

Sympathetic skin response: a reliable monitoring tool for optimization of computed tomography-guided lumbar sympathetic trunk block

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Purpose: To evaluate reliability of sympathetic skin recordings (SSR) for early assessment of complete or insufficient lumbar sympathetic trunk block.
Materials/Methods: Fifty-eight lumbar sympathetic trunk injections were performed in ten patients with reflex sympathetic dystrophy syndrome of the foot. A 22-G needle was placed under CT-fluoroscopic guidance near the lumbar sympathetic trunk between L2 and L4 levels. After injection of 1 ml iopamidol 200 mg/ml, bupivacaine 5 ml was injected. SSR measurements were performed prior to and after the injection of contrast agent, and once a minute after the bupivacaine injection, using a standard electromyographic system.
Results: Eighty-two percent of injections were clinically successful. Minor complications (slight temperature increase) and absence of clinical effect were found in 5% and 13%, respectively. All clinically successful infiltrations were identified by SSR measurement within 7 minutes (85% within 3 minutes). In 5% SSR indicated full sympathetic nerve block despite the absence of clinical signs of successful blockade.
Conclusion: SSR provides a reliable tool to monitor lumbar sympathetic trunk injections. Effectiveness of the intended sympathetic nerve block can be indicated within few minutes, allowing readjustment of the needle position and reapplication of local anesthetics as necessary to achieve a complete sympathetic trunk block.

9.3.7.

Percutaneous treatment of periaortic fluid collections after aortic bypass by transcatheter percutaneous drainage alone: medium-term follow-up results

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Purpose: A very severe, although rare (2-3%) complication of abdominal aortic grafting is graft infection. Previous papers have assessed the feasibility and usefulness of percutaneous drainage as sole treatment of graft infections. The present paper assesses medium-term results of this treatment.
Materials/Methods: Between June 1995 and September 2001, 421 patients underwent abdominal aortic surgery by graft replacement or distal aortic aneurysm (emergency rupture: 51). During early follow-up (2-3 weeks) there were 18 cases of graft infections. All cases were treated by means of percutaneous drainage only, using posterior paravertebral oblique puncture under CT-guidance. The catheter(s) were left in place for up to 38 days, (mean: 13) and removed when residual fluid collections were less than 3 cc/day. Early (1-2 months) and late (up to 48 mo.) follow-up were performed by angioTC and leukocyte scintigraphy.
Results: All patients recovered completely from infection, with temperature and WBC counts normalizing early, followed by clearing of the periaortic space**.** Delayed angio-CT and scintigraphy confirmed the results.
Conclusion: Despite the widespread and well-established protocol of early prosthesis removal in case of prosthesis infection, our experience is to perform aggressive percutaneous drainage even in severe retroperitoneal deep prosthesis infections.

9.3.8.

CT-guided percutaneous treatment of functioning supra-renal adenomas: a comparative study between percutaneous ethanol injection and radiofrequency tissue ablation

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Purpose: Comparison of results in the treatment of functioning suprarenal (SR) adenomas using percutaneous ethanol injection (PEI) or radiofrequency tissue ablation (RFTA).
Materials/Methods: RFTA of SR functioning tumors was performed in 16 patients and PEI in 73. We compared clinical improvement including blood pressure (BP), lab values of renin activation (PRA), plasma concentration of aldosterone (PCA), reduction of drugs intake, and correlated age and time of high BP diagnosis in each method for six months post-procedure. Complications and hospital stay as well as costs were also compared.
Results: PEI achieved a normal BP in 45/73 patients (61.6%). In 21of the remaining 28 patients, the diary intake of antihypertensive drugs was reduced; in 7/28 patients we did not obtain any results. In the group treated by RFTA, a normal BP was achieved in 11/16 patients (68.7%). In the remaining five, the diary intake of antihypertensive drugs was reduced.
Conclusion: The results obtained by RFTA are comparable with those achieved by PEI. Both methods are easy, less invasive than surgery, of reduced costs, and significantly improve the life quality.

9.3.9.

US-guided fine-needle aspiration biopsy of the spleen in the diagnosis of visceral Leishmaniasis

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Purpose: To evaluate US-guided fine-needle aspiration biopsy (FNAB) of the spleen in patients with Leishmaniasis.
Materials/Methods: Clinical and imaging records of 16 patients aged 11-48 years (11 men) with visceral Leishmaniasis and a previous negative sternum needle aspiration biopsy (SNAB) were reviewed. Maximum spleen diameter was 14-21 cm (mean: 17), platelets were 60.000-120.000 (mean: 79.000) and INR was 1.36-1.0. FNAB were performed with 22-G/9-cm spinal needles.
Results: All slides were positive for Leishmania amastygotes and all cultures were positive for Leishmania infantum (sensitivity: 100%). The procedure was well tolerated in nine patients, while four patients complained of pain at the upper left abdominal quadrant and showed hemoperitoneum in the left subdiaphragmatic space at US (thickness: 0.5-2 cm) 10-20 minutes post-FNAB. Another patient, 24 hours after the procedure, experienced left thoraco-lumbar pain and an US showed left subdiaphragmatic blood collection (thickness: 3 cm). Follow-ups with daily US examinations showed the complete resolution of peritoneal fluid collections within 2-5 days. Blood transfusions were never required.
Conclusion: FNAB of the spleen is highly sensitive in the diagnosis of visceral Leishmaniasis. Since post-procedure self-limiting hemoperitoneum is frequent (5/16= 31% in our series), FNAB should always be performed only in case of negative SNAB.

9.4.1.

Triphasic helical-CT and real-time contrast-enhanced ultrasonography in the assessment of percutaneous ablation of hepatocellular carcinoma

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Purpose: To compare the diagnostic accuracy of contrast-enhanced ultrasound (CEUS) and triphasic contrast-enhanced helical-CT (CECT) in the assessment of short-term results of hepatocellular carcinoma (HCC) ablation.
Materials/Methods: Fifty-six consecutive cirrhotic patients with a single HCC nodule (1.8-5.0 cm; mean: 3.2 cm) proved at biopsy underwent percutaneous ablation therapy (PAT). All the patients underwent CECT and CEUS seven days before treatment and 14 and 21 days post-treatment. Those patients with post-treatment residual tumors underwent further PATs. The patients with a complete necrosis at CECT and/or CEUS were followed-up with US every two months and with CT every year. In case US or CT showed local recurrences, CECT/CEUS and one or more FNB of the lesions were performed.
Results: Post-treatment CECT and CEUS showed a complete necrosis in 42/56 nodules (75%) and in 45/56 (80%), respectively. Three nodules, partially necrotic at CECT and completely necrotic at CEUS, relapsed at two-, four-, and four-month follow-ups. During follow-up (6-20 months; mean: 11.9 months), eight patients with post-treatment complete necrosis relapsed within 4-18 months. FNB proved the presence of HCC in all the recurrences.
Conclusion: Diagnostic accuracy of CECT and CEUS was 85.7% and 83.3%, respectively (a non-statistically significant difference).

9.4.2.

Initial clinical results in the treatment of unresectable hepatic tumors with resin-based yttrium-90 radioembolization

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Purpose: To review the treatment of unresectable colorectal metastases with resin-based yttrium-90 hepatic arterial radioembolization.
Materials/Methods: Eighty-four patients having 127 infusions were reviewed. The target dose of beta radiation was 90 Gy to the tumor and less than 30 Gy to the normal liver parenchyma. Both whole liver and lobar infusions were reviewed. All patients were followed until further chemotherapy was given for disease progression or until death.
Results: The objective response rate was 35% by computed tomography scan, 70% by carcinoembryonic antigen levels, and 90% by positron emission tomography (PET) scan. The mean follow-up of these patients was 12 months but the median survival has not yet been reached. Grade-3 toxicities were nausea, pain and fatigue in 30% of patients. All patients having cessation of flow in the hepatic artery due to complete embolization had the post-embolization syndrome. No deaths or life-threatening toxicities were seen. There was no evidence of radiation hepatitis or veno-occlusive disease.
Conclusion: Radioembolization of the liver provides an encouraging response rate with an improvement in overall survival with acceptable safety in this group of patients. PET scans provide the best marker for response.

9.4.3.

Techniques for minimizing complications during yttrium-90 radioembolization of unresectable hepatic malignancies

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Purpose: To review the studies and techniques necessary for a safe delivery of yttrium-90 microspheres via an angiographic arterial catheter in patients with unresectable hepatic malignancies.
Materials/Methods: From July 2001 to August 1993, 67 patients underwent 78 yttrium-90 hepatic arterial administrations. Complications were categorized as inadvertent embolization, hepatic failure, and device leakage.
Results: Seventy-seven potential yttrium-90 candidates were screened with hepatic angiography and technetium-99 macroaggregated albumin shunt studies. Nine of 77 (12%) patients were excluded due to excessive lung shunting and one (1.3%) for uncorrectable gastrointestinal uptake. Eighteen of 67 patients received prophylactic embolization of gastric branches. All yttrium-90 administrations were performed on an outpatient basis, four patients required overnight hospitalization for treatment of pain or nausea; (2 of 9) 22% whole liver versus (2 of 68) 3% of lobar injections. Inadvertent embolization occurred in four patients and three treatments were aborted due to leakage of radioactive microspheres.
Conclusion: Yttrium-90 radioembolization is a safe, well-tolerated technique for the treatment of patients with unresectable hepatic malignancies; 87% of screened patients qualified for yttrium-90 therapy. Care must be taken to avoid inadvertent delivery of the microspheres to unintended vascular beds. Most patients can be treated on an outpatient basis.

9.4.4.

Color Doppler and clinical evaluation of transplanted kidneys in uremic, type1 diabetic patients: long term beneficial effects of pancreas and functioning islet transplantation

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Purpose: Kidney-pancreas (KP), kidney-islet (KI), and kidney-alone (KA) transplantation bring renal function restabilization, but diabetes is still present in KA-patients. We compared the transplanted kidneys of KP, KA and KI-transplanted patients, distinguishing functioning (KI-f) and non-functioning (KI-nf) islet-transplanted patients according to C-Peptide levels (C-Pep)>or<0.5 ng/ml.
Materials/Methods: From 1991 to 2002 the mean resistance index (RI) of 3 intraparenchimal arteries of transplanted kidney was evaluated with color Doppler (CD) in 78 KP, 25 KA, 17 KI-f, and 13 KI-nf patients. Urinary albumin excretion (UAE), serum creatinine (SC), and glycated hemoglobin (HbA1c) were also assessed at one month and 2, 4, 6 years from transplantation.
Results: RI, UAE, SC, HbA1c, one month and 6 years after transplantation, were: RI (KP=0.75-0.68. KA=0.76-0.76. KI-f=0.74-0.65. KI-nf=0.70-0.76); UAE (KP=22.3-12.0. KA=31.5-82.9. KI-f=93.5-12.0. KI-nf=72.3-129.4 mg/l); SC (KP=1.49-1.45. KA=1.67-2.49. KI-f=1.31-1.44. KI-nf=1.46-2.44 mg/dl); HbA1c (KP=5.7-5.9. KA=8.0-8.1. KI-f=7.2-7.5. KI-nf=7.7-8.9). A statistically significant reduction of RI and UAE, with SC stabilization, was found only in KP and KI-f patients. Significant worsening of UAE and SC was found in KA and KI-nf patients.
Conclusion: CD can allow accurate and reproducible assessment of transplanted kidneys. In type 1 diabetic uremic patients, pancreas and functioning islet transplantation exert a protective role in the transplanted kidney

9.4.5.

Chemoembolization of hepatocellular carcinoma: factors affecting response and survival

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Purpose: To define independent prognostic factors affecting survival in patients after transarterial chemoembolization (TACE) of hepatocellular carcinomas (HCC).
Materials/Methods: Between 1989 and 1998, 91 patients with unresectable HCC were treated by repetitive TACE. Dosages of epirubicine and ethiodized oil were adjusted to tumor size and liver function. The impact of tumor characteristics (size, macroscopic type, location, vascular invasion, capsular infiltration, grade of vascularization, grade of uptake of ethiodized oil at CT) and liver functions (Child-Pugh's class) on patient survival was evaluated by means of multivariate regression analysis.
Results: Independent prognostic factors were tumor type (p=0.008), tumor size (p=0.01), Child-Pugh's class (p=0.02) and grade of tumor vascularization (p=0.04). In patients with HCCs of nodular type, median survival was 17.0 months compared with 7.9 months of patients with HCC of infiltrating type (p<0.003). One-, two-, and three-year survival rates were 73, 31, and 8% in Okuda stage-I patients and 23, 6, and 4% in Okuda stage-II and stage-III patients, respectively (p<0.001).
Conclusion: Tumor characteristics and liver functions have an independent impact on patients' survival after TACE of HCC and should be considered during patients' selection.

9.4.6.

Percutanous microwave coagulation therapy and radiofrequency ablation for hepatocellular carcinomas with arterial and/or venous blockage of blood flow

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Purpose: Assess effects of hepatic artery occlusion (HAE) with/without hepatic venous outflow interruption (TIHVF) on coagulation diameter during percutaneous microwave coagulation therapy (PMCT) and radiofrequency ablation (RFA) for hepatocellular carcinoma (HCC).
Materials/Methods: Of 69 HCC in 62 patients (46 men), group 1 (G1, 32 nodules, mean diameter 22mm) underwent PMCT (16-G needle) plus HAE with gelatine sponge particle occlusion. G2 (18 nodules, 24mm) had PMCT, HAE, and temporary IHVF using 6-F balloon catheters to reduce portal venous flow. G3 (11 nodules, 19mm) had RFA with HAE. G4 (8 nodules, 27mm) had RFA, HAE, and IHVF. PMCT and RFA were performed by single, ultrasound-guided puncture. Coagulated areas were measured immediately by CT, and results re-evaluated at 6-54 months (mean 31). One patient with pneumobilia developed a liver abscess one month post-PMCT.
Results: Coagulation diameters: larger in G2 than G1 (46 versus 35mm, $p<0.05$), equal in G3 and G4 (38mm). Mean coagulation times: 4.9 min (2-8) with PMCT, 5 min (3-10) with RFA. Follow-up CT: no recurrence of 64/69 nodules (93%). Two- and four-year survival rates: 90% and 90%; tumor-free survival: 49% and 49%.
Conclusion: PMCT can coagulate significantly larger volumes combining HAE and IHVF than hepatic artery embolization only; RFA cannot.

9.4.7.

Ethanol injection of medium to large hepatomas using a multi-prong needle: efficacy and safety

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Purpose: To prospectively evaluate the safety and efficacy of alcohol injection of medium to large (3.5-6.9 cm) hepatomas using a multi-prong needle.
Materials/Methods: Eight patients, five men and three women (aged 46-76 years, mean: 65) had alcohol injection of unresectable hepatomas, mostly subcapsular or exophytic in location. An 18-G retractable multi-prong needle (RexMedical, PA) was used for injection under real-time ultrasound guidance. By varying the length of the prongs and rotating the needle, the alcohol was widely distributed within the tumor. Progress of ablation was monitored by contrast-enhanced ultrasound, CT or MR after one or two weekly injections and within a month after the final (third) injection and three months thereafter.
Results: An average total of 40 ml of alcohol was injected in an average of 2.4 sessions. Complete necrosis was noted in seven of eight lesions (86%); local recurrence occurred in one patient and new lesions in another. There was no mortality or major morbidity.
Conclusion: Alcohol injection using a multi-prong needle is safe and efficacious in treating medium to large hepatomas. Its survival benefits require further investigations.

9.4.8.

Image-guided radiofrequency ablation in the local treatment of small cortical renal tumors

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Purpose: To determine safety and efficacy of radiofrequency ablation (RFA) in the management of small cortical renal tumors.
Materials/Methods: From January 2001 to January 2004, 12 patients (aged 57-91 years) with 13 renal tumors underwent RFA under CT- or ultrasound-guidance. Tumor sizes were 16-36 mm. Four patients had a solitary kidney, one had bilateral tumors, and seven presented high surgical risk or severe renal failure. Two commercially available needle electrodes were used (three cooled-tips and ten hooked needles). RFA was performed under conscious sedation in 11 patients while one patient underwent RFA under general anesthesia during a surgical procedure for another pathology. During follow-up (22-715 days), patients underwent abdominal CT or MR at one, three, and six months, and every year thereafter.
Results: The treatment was well tolerated in all cases and no major complications occurred. Imaging follow-ups demonstrated a complete tumor necrosis in 11/13 lesions. One patient was lost at follow-up and another patient died for another pathology. A second successful RFA was done in one patient for a recurrence identified at six-month follow-up.
Conclusion: RFA of small renal tumors may be a safe and effective alternative for those patients with contraindications to surgery or with coexisting diseases.

9.4.9.

CT-guided interstitial brachytherapy: a novel technique for liver tumor ablation in poor candidates for radiofrequency or laser ablation

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Purpose: To evaluate CT-guided brachytherapy in patients with very large liver malignancies or with liver tumors located adjacent to the liver hilum.
Materials/Methods: Group A included 11 patients with >5-cm liver lesions, group B included nine patients with liver tumors <5 cm adjacent to the liver hilum. Brachytherapy dose planning was performed using 3D-CT data acquired after the positioning of a percutaneous applicator.
Results: The mean tumor diameter was 7.7 cm (range, 5.5-10.8) in group A and 3.6 cm (range, 2.2-4.9) in group B. A minimal dose of 17 Gy in the target volume was applied (12-25 Gy). Severe side effects were recorded in two patients (10%). The median follow-up was 13 months. In group A, primary local tumor control after six and 12 months was 74 and 40%, respectively; in group B, 100 and 73%, respectively. All but one local recurrences were successfully treated with another CT-guided brachytherapy leading to a primary assisted local control of 93% after 12 months.
Conclusion: CT-guided brachytherapy using 3D data sets proved to be effective in larger liver malignancies (up to 10 cm) or in those lesions adjacent to the liver hilum.

9.5.1.

Reduction of late in-stent coronary artery restenosis in a porcine model using the new poly[bis(trifluoroethoxy)phosphazene] nanocoat technology

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Purpose: To demonstrate reduction of late in-stent restenosis using the new poly[bis(trifluoroethoxy)phosphazene] (PTFEP) nanocoat technology in a porcine coronary artery model.
Materials/Methods: Twenty-one minipigs (25 kg) were divided into three groups (one week, four weeks, 12 weeks), five animals/group. PTFEP is a non-carbon highly pure, antiinflammatory and antithrombotic biopolymer. A coat thickness of 40-50 nanometers was applied on newly designed balloon-expandable stents (SS 316L, 3/12mm). Bare and coated stents were implanted in the main stem of either the right or the left coronary artery (1.2:1 ratio). Heparin was administered for anticoagulation (150 U/Kg). Before sacrifice, magnification angiography was performed. Explanted stents were examined by light microscopy and scanning electron microscope. Inflammatory and injury scores were determined.
Results: In none of the animals stent occlusion occurred. Late angiographic in-stent restenosis (luminal loss >30%) was seen in <10% of the coated versus 25% in the bare stents. This was reflected at microscopy showing no major inflammatory reaction in the tissue adjacent to the PTFEP-coated stent struts and significantly less intimal hyperplasia.
Conclusions: PTFEP nanocoating achieved a reliable prevention of late in-stent restenosis in a porcine coronary artery model. Its efficacy might be further enhanced by using it as a drug delivery platform.

9.5.2.

Regression of an atherosclerotic coronary artery plaque demonstrated by multislice spiral computed tomography in patients with stable angina pectoris taking statins

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Purpose: Noninvasive assessment of coronary artery disease with spiral computed tomography (SCT) and advanced 3D-image reconstruction system permit direct visualization of atherosclerotic plaques in patients with coronary artery disease. The aim of the present study was to evaluate the accuracy in determining coronary lesion configuration by SCT before and after a 12-month treatment with statins.
Materials/Methods: We describe five patients with plaque regression documented by SCTs. The patients (aged 55-65) all had lesions located in the left anterior descending coronary artery. Multiplanar reconstruction and cross-sectional images consistently depicted a tomographically protruding low-signal mass suggesting an atherosclerotic plaque. Intracoronary ultrasound (ICUS) documented an eccentric soft plaque with an sonolucent mass suggesting a lipid core. Independent reviewers evaluated the accuracy of SCT for presence, composition, distribution of atherosclerotic plaques, and remodeling response in comparison with IVUS. Lipid-lowering therapy with statins was started.
Results: Follow-up SCTs performed 12 months later documented an increase in the luminal area, while external areas remained unchanged. The plaque regression was confirmed by follow-up ICUS studies. SCT was therefore efficient in evaluating the plaque.
Conclusion: This new technology might become an alternative diagnostic procedure in patients with known or suspected coronary artery disease under treatment with statins.

9.5.3.

CT-guided pericardial drainage - a three-year personal experience

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Purpose: To report a personal experience of CT-guided pericardiocenteses. Most pericardial drainage is performed with ultrasound guidance. There are only a few published reports of CT-guided pericardiocentesis, using various drainage techniques.
Materials/Methods: All CT-guided pericardiocenteses performed over three years by the author were reviewed. CT was used to guide pericardial drainage with a standard coaxial technique: 20- or 22-G needles; over-the-wire exchange for an Accustik® set; subsequent pigtail drainage.
Results: There were 43 procedures, 17 using CT-fluoroscopy. The commonest etiology was cardiac surgery (20), with six related to malignancy. Tamponade was both present and relieved in 22; hemorrhagic fluid was seen in 28. Mean volume drained was 467 ml (0-1100 ml). No fluid was aspirated due to solid tumor (1) or poor patient cooperation (1). Complications were: major - further hemorrhage causing hypotension-1; minor - pneumothorax 1, myocardial puncture 1 (neither of which required treatment).
Conclusion: CT-guided pericardiocentesis is a safe and effective method for relieving pericardial effusions of various etiologies. It can be used rapidly and reliably in unstable patients with cardiac tamponade. Success rates compare very well with ultrasound-guided methods and it may be technically easier to perform.

9.5.4.

Magnetic resonance follow-up of myocardium cell therapy with smooth muscle cells loaded by superparamagnetic nanoparticles

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Purpose: To assess magnetic labelling of smooth muscle cells (SMCs) by superparamagnetic nanoparticles for the follow-up of SMC transplantation in ischemic myocardium.
Materials/Methods: SMCs of Fisher rats were incubated *in vitro* for two hours with a suspension of anionic maghemite nanoparticles. Cell proliferation, iron content per cell, and magnetic resonance imaging (MRI) signals of cells were followed from day 0 to day 14. Then, 10^6-iron labeled SMCs were injected in healthy and ischemically injured hearts of seven Fisher rats. Animals were sacrified two and 48 hours after injection. T2-weighted gradient and spin-echo sequences of excised hearts were obtained on a 1.5-T magnet, before histological sectioning
Results: In culture, SMC viability was not affected by magnetic labelling: iron particles were detected within intracytoplasmic vesicles up to day 14, and the intracellular concentration at D0 (1.7 pg/cell) decreased parallel to cell division. T2-weighted MRI images of excised heart rats demonstrated hyposignal in myocardium two and 48 hours after local injection of labeled SMCs, and histologic sections evidenced iron particles in SMCs.
Conclusion: Magnetic labeling of SMCs with anionic superparamagnetic particles allows detection of cells by MRI after local transplantation in the heart.

9.5.5.

Multi-slice computed tomography in comparison with coronary angiography in the detection of coronary vessel stenoses

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Purpose: To investigate the accuracy of multislice spiral computed tomography (MSCT) in the detection of significant stenoses of coronary vessels with cardiac computed tomography.
Materials/Methods: In 94 patients (79 male, mean age 56±5 years) with suspected coronary artery disease, MSCT (GE Light Speed-16, slice collimation 0.625 mm) was performed. After this exam we compared the results with coronary angiography (CAG). For each patient the exam was elaborated with MPR, MIP, AVA and volume rendering reconstructions, using a dedicated work station (Advantage 4.1 GE Medical System).
Results: Five patients were excluded from the analysis for the presence of motion artefacts due to high heart beat. In the other 89 patients the exam was conducted with no problems and all coronary vessels could be evaluated. Considering only the segments judged evaluable, sensitivity was 90%, specificity 98%, positive predictive value was 90%, negative predictive value 98%.
Conclusion: Using a scanner with a slice collimation of 0.625 mm, our study confirms the potential role of MSCT in the detection of significant coronary stenoses with a sensitivity of 89% and a very high specificity (98%).

9.5.6.

A new endovascular technology for creating a complete double-sided cava-pulmonalis anastomosis

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Purpose: To define the possibilities of performing Glenn and Fontan operations on animal models using endovascular techniques only.
Materials/Methods: By this new trans-catheter technique five operations were performed.
Results: A specially-designed kinematical needle was transferred from the superior vena cava into the right branch of the arteria pulmonalis, thus creating an intravascular connection. The needle's magnetic tip into the right branch of the arteria pulmonalis was captured with a Dormia basket and delivered into the inferior vena cava via the right ventricle. Subsequently, following the needle's way, a special prosthesis with a tubular configuration in its middle part and flared ends was placed into the newly-created connection between these two vessels. The second step was to deliver a stent-prosthesis from the superior vena cava via the created anastomosis and to place it in such a way that a 12-mm portion of it would open inside the right branch of the arteria pulmonalis while the remaining portion would open inside the superior vena cava. In two experiments, after creating the above-described anastomoses, by means of a stent-graft, the superior and the inferior vena cava were connected.
Conclusion: This technique opens a new perspective in treating patients with congenital heart diseases.

9.5.7

Coronary artery imaging with multi-slice spiral CT

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Purpose: To evaluate technique and primary clinical value of 16-slice spiral-CT scans in the coronary artery.
Materials/Methods: Plain and contrast-enhanced CT-scans were performed with a 16-slice CT scanner (Sensation 16, Siemens, Germany) in 230 cases; if the heart rate was grater than 65 bpm, 50-75 mg of oral Betaloc were given; 100 ml of Ultravist (370 mgI/ml) or Omnipaque (350 mgI/ml) and 30 ml of 0.9%-NaCl chaser bolus with a rate of 3.5 ml/sec were administered. MPR, MIP, and VRT reconstructions with enhanced scan images were made in all cases; 40 patients underwent conventional coronary angiography also.
Results: Of the 230 cases, 78.3% patients were of first-degree image quality. Most of the first, the second and the third, and part of the fourth subsegment branches could be isotropically shown by MPR, MIP, and VRT reconstruction images. Six MIP reconstruction planes and nine VRT reconstruction views are recommended for demonstration of coronary arteries. A comparative study of the 40 cases who had undergone CTA showed that sensitivity and specificity of 16-slice spiral CT compared with CTA in identifying >50% stenoses were 100% and 99%, respectively.
Conclusion: Sixteen-slice spiral CT scan is a reliable screening method to diagnose coronary heart disease.

9.5.8

Coronary angiography with multislice spiral computed tomography: a comparative study with conventional angiography

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Purpose: To investigate the value of 16-slice spiral CT in the diagnosis of coronary heart disease.
Materials/Methods: Plain and contrast-enhanced CT scan was performed in 230 cases with a 16-slice CT scanner (Sensation 16, Siemens, Germany)after Betaloc administration, if necessary. Calcium scoring with plain scan images and MIP, and VRT reconstructions with enhanced-scan images were made in all cases; among them, 40 cases with first-degree image quality underwent conventional coronary angiography also. Coronary lesions were divided into five categories. Calcification characteristics of the different categories were observed; sensitivity, specificity, and accuracy of coronary CT-angiography (CTA) in the diagnosis of coronary lesions were calculated.
Results: Those coronary arteries depicted as normal with conventional angiography showed calcifications and/or small soft plaque(s) with CT. Calcium volume, mass, and score increased with the increase of the degree and range of the coronary artery lesion. Sensitivity, specificity, and accuracy of 16-slice spiral coronary CTA to identify >50% coronary stenoses (including local and diffuse stenoses) were 100, 99, and 99.2%, respectively.
Conclusion: If with high image-quality, 16-slice spiral coronary CTA can be used as a reliable method in the diagnosis of coronary heart disease.

9.5.9.

Branch involvement in descending aorta dissection: radiologic evaluation with angiography

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Purpose: To evaluate aortic branch involvement in descending aorta dissection using angiography. We assessed the frequency of involvement of different aortic branches and types of vessel compromise.
Materials/Methods: Since January 2000, 51 patients (35 men and 16 women) with descending aorta dissection were diagnosed at our institution. Angiography was performed only on those patients who might be candidates for endovascular treatment. Analysis is based on angiographic findings.
Results: The left renal artery was the most frequently affected aortic branch (supplied by the false lumen in 14 cases, dissected in 5 and occluded in 2). The most frequently dissected branch was the left common iliac artery (n=21). In patients with peripheral vascular ischemia (mesenteric ischemia n=2; renal ischemia n=13; lower extremity ischemia n=7) it was possible to describe the type of vessel compromise (static, dynamic and mixed) by means of angiography.
Conclusion: The course of dissection determines the frequency of involvement of different aortic branches. If peripheral vascular ischemia is diagnosed, it can be treated using endovascular techniques.

9.6.1.

Mechanical thrombolysis and thrombectomy in patients with cerebral sinus thrombosis

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Purpose: Most patients with cerebral sinus thrombosis (CST) recover after treatment with heparin, but a subgroup has a poor prognosis. Those patients may benefit from direct (intra-sinus) mechanical thrombectomy in combination with thrombolysis (TT)
Materials/Methods: Prospective patients with CST were selected for TT if they had deteriorating consciousness despite conventional treatment, including anti-epileptics and full anticoagulation. Mechanical thrombectomy with a rheolytic catheter of all thrombosed sinuses was started, sometimes followed by thrombectomy with a Fogerty-catheter for further debulking. After flow re-establishment, urokinase (bolus 120 to 600 $x10^3$ U; then 100 x 10^3 U/hr during 8 hours) was infused through a multisite hole catheter in the sinus.
Results: Ten patients (six women) were treated; their mean age was 32 years and their mean Glasgow coma score was 8.5. Six patients had haemorrhagic infarct before TT; seven had generalized seizures. Six patients recovered (Rankin 1), one is presently moderately disabled (Rankin 3), and three died (before TT, they had large hemispheric infarct and oedema which caused transtentorial hernations).
Conclusion: TT may improve outcome in severe CST. Recovery might also be partly attributed to the treatment of seizures, and not solely to TT.

9.6.2.

Micropored drug eluting stent grafts for canine carotid aneurysms

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Purpose: Micropored drug eluting stent grafts (DESGs) composed of a metallic stent with a microporous thin film impregnated with heparin were developed for percutaneous transluminal angioplasty. Early endothelialization is promoted by micropores produced by an excimer laser ablation technique. Early thrombus is prevented by heparin. DESGs were used for embolization of canine carotid aneurysms with an autologous external jugular vein patch.
Materials/Methods: One month after creation, aneurysms were occluded with stentgrafts. Affected arteries were removed with the aneurysms, immediately, one week, one month, and three months after embolization, and studied histologically to evaluate patency and endothelialization over the thin film.
Results: Treated carotid arteries were all patent with aneurysms occluded completely at any periods (13 aneurysms in seven dogs). Even at one week, endothelialization was confirmed on the intraluminal surface of the stentgraft. At one and three months, all treated aneurysms with enough patent arteries were filled with organized tissues and completely occluded.
Conclusion: Our developed micropored DESG appears to be promising for the treatment of aneurysms, especially with respect to immediate termination of blood inflow and early endothelialization in the neck of the aneurysm.

9.6.3.

The risk of bone cement leakage with kyphoplasty and vertebroplasty

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Purpose: Vertebroplasty and kyphoplasty are new techniques to treat osteoporotic compression fractures. Kyphoplasty has a theoretical advantage over vertebroplasty in decreasing the risk of cement extravasation outside the vertebral body. The purpose of this paper is to retrospectively evaluate the occurrence of cement extravasation.
Materials/Methods: We retrospectively reviewed our institution's experience with kyphoplasty and vertebroplasty. We reviewed the radiographic images of patients treated with both procedures and evaluated the occurrence of bone cement extravasation.
Results: From July 2001 through June 2003, 102 patients at our institution were treated with vertebroplasty with 173 levels treated. From October 2002 through May 2003, 18 patients were treated with kyphoplasty with 22 levels treated. Cement extravasation occurred in 68.2% of patients treated with vertebroplasty and in 4.5% of those treated with kyphoplasty. Leakage into the epidural space occurred in 8.8% of patients with vertebroplasty, with two patients (1.9%) having a cement pulmonary embolism during vertebroplasty. No occurrence of epidural leakage of cement or pulmonary emboli were encountered with kyphoplasty.
Conclusion: Kyphoplasty and vertebroplasty are new techniques to treat compression fractures. This retrospective review demonstrates that vertebroplasty has a markedly increased risk of bone cement extravasation than kyphoplasty.

9.6.4.

Intracranial stenting for patients with symptomatic intracranial stenosis

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Purpose: To assess safety and efficacy of intracranial stenting for symptomatic intracranial stenoses.
Materials/Methods: One-hundred and seven consecutive patients with recurrent low-flow transient ischemic attacks (TIA) or nondisabling ischemic stroke and corresponding intracranial stenosis (50% or greater, 114 lesions) proved by angiography (evidence of atherosclerotic risk factor or dissection) were enrolled in the study.
Results: Seventy patients had an anterior and 37 a posterior circulation stenosis. In six of them, a contralateral intracranial stenosis coexisted; another one had an ipsilateral tandem intracranial stenosis. The technical success rate of intracranial stenting was 94.7% (108/114 lesions). Complications occurred in eight patients (7.7%): five subarachnoid hemorrhages, two acute occlusions, and one distal embolization followed by the death of the patient. At clinical follow-up performed in 97 patients (median: ten months) there were no strokes and only one patient experienced a TIA event. A six-month angiographic follow-up was performed in 13 patients and showed two restenoses (15.4%).
Conclusion: Intracranial stenting for patients with symptomatic intracranial stenosis seems an effective method which needs a strict and skillful peri-procedural management.

9.6.5.

A method for the rapid induction of a mild therapeutic hypothermia in the brain of pigs

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Purpose: To develop a method for a rapid selective brain cooling to be used in the hypothermic therapy against ischemic brain damage.
Materials/Methods: Pigs (70kg) were anesthesized with Ketalar, tracheotomized, and immobilized. Temperature was measured bilaterally in parietal cortices. A 12-F catheter was introduced into the femoral vein for blood withdrawal, connected to a cooling device, a roller pump, and a 5-F catheter with the tip positioned into one internal jugular vein, caudal to the rete mirabile. The rete mirabile enabled selective cooling of cerebral arterial blood flow by retrograde venous hypothermic perfusion. Body normothermia was maintained by recirculating 38.5°C blood using a double-lumen catheter into one external jugular vein.
Results: Brain cortical temperature decreased bilaterally from 36.5 to 30.0°C within 10 minutes after retrograde infusion of 200 ml/min of perfusate (13°C) through the internal jugular vein catheter. Body temperature was kept at 37°C, by the veno-venous perfusion at 200 ml/min with an efficiency of 0.5°C/hr.
Conclusion: Rapid and selective brain cooling while keeping the body normothermic is possible. The method has its clinical applicability in the treatment of strokes, neonatal asphyxias, and cardiac arrests; in addition, no manipulation of the arterial system is required.

9.6.6.

Transcatheter arterial embolization for treatment of severe acute hemorrhage of the extracranial head and neck

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Purpose: To evaluate the efficacy of transcatheter arterial embolization in severe hemorrhage arising from extracranial arteries in the head and neck.
Materials/Methods: Database review was performed of all patients undergoing angiography of the head and neck from June 2000 to December 2003. The search revealed 18 patients referred for severe bleeding of the head and neck uncontrolled by conservative therapy. Fourteen patients had hemorrhage secondary to penetrating trauma (11 gun shot wounds, three stab wounds), three secondary to blunt trauma (motor vehicle accidents) and one patient had intractable idiopathic epistaxis. Patients with bleeding secondary to tumors were excluded from this study.
Results: Diagnostic catheter angiography demonstrated acute arterial injury with active extravasation of contrast in each patient. Embolization was achieved using microcoils in nine patients, particles (PVA or Gelfoam) in four patients and glue (nBCA) in one patient. The remainder required a combination of these methods. All patients underwent embolization to complete angiographic stasis. There were no significant post-procedure complications.
Conclusion: Transcatheter arterial embolization is a safe and effective therapy for the treatment of severe extracranial hemorrhage of the head and neck.

9.6.7.

Rheological changes after stenting of cerebral aneurysms: a finite element modeling approach

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Purpose: To investigate the influence of stent placement on dynamic viscosity in an intra-cranial aneurysm with a smaller branch using a finite element modeling approach.
Materials/Methods: A two-dimensional model with a parent artery, a smaller branching artery and an aneurysm located at the bifurcation, before and after stent placement, was used for simulation. Flow velocity plots and wall shear stress before and after stent placement was calculated over the entire cardiac cycle. Values for dynamic viscosity were calculated with a constitutive equation that was based on experimental studies and yielded a viscosity which decreases as the shear rate increases.
Results: Stent placement lowered peak velocities in the main vortex of the aneurysm by a factor of at least four compared to peak velocities in the main artery, and considerably decreased the wall shear stress of the aneurysm. Viscosity increases after stenting persisted over a major part of the cardiac cycle, with a factor of up to ten, most pronounced near the dome of the aneurysm.
Conclusion: Finite element modeling can offer insight into rheological changes induced by stent treatment of aneurysms, and allows visualizing viscosity changes induced by stent placement.

9.6.8.

Cerebral venous congestion as an indication for thrombolytic treatment

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Purpose: Many articles in neurology state that, in cerebral venous congestion, anticoagulation is the treatment of choice. Our investigation evaluates the need for thrombolytic treatment.
Materials/Methods: Twenty patients (eight men and 12 women, age ranging from 22 to 66 years) with acute dural sinus thrombosis were studied over the past three years. Fourteen of them had imaging signs of cerebral venous congestion with edema and/or parenchymal hemorrhage after a period of heparinization; in 13/14 cases, thrombolytic treatment with 10-15 mg of tissue plasminogen activator and/or balloon catheters to remove acute thrombi was employed.
Results: Twelve of the13 patients recovered completely without any deficit; one required the surgical removal of a huge intracerebral hematoma. One patient died because of extensive cerebral edema, and six patients who did not show imaging changes received heparin only, with complete clinical recovery. Follow-up magnetic resonance-venographies in these six cases showed increased collaterals without definite reopening of the dural sinus. Treatment with heparin may lead to further hemorrhage or edema if no recanalization of the dural sinus is performed.
Conclusion: Acute dural sinus venous thrombosis may require thrombolytic and/or mechanical disruption of thrombi to relieve venous congestion and avoid severe consequences.

9.6.9.

Pharmacological and mechanical endovascular treatment for dural sinus thrombosis

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Purpose: Dural sinus thrombosis is correlated with high morbidity/mortality rates due to venous hypertension and hemorrhagic strokes. We report our experience in 4 consecutive cases.
Materials/Methods: Since February 2003, 4 patients have been referred to our centre for cerebral sinus thrombosis confirmed by magnetic resonance imaging and angiography. All patients presented in deep coma. Systemic endovenous infusion of heparin plus IIb/IIIa inhibitors (Tirofiban) was immediately started and continued for 12 hours. In 3/4 it was necessary to continue local thrombolysis using both repeated microboluses and continuous infusion (Urokinase 30-50,000 UI/h for 12 hours) via microcatheter or multihole 4F catheter. In 2/4 recanalization was obtained only after self-expandable stent (Dynalink 0.018"™) deployment in the straight sinus, followed by intrastent angioplasty. Follow-up was performed with magnetic resonance angiography.
Results: Reestablishment of venous outflow was obtained in 4/4 with progressive improvement over a few hours. One-year follow-up showed persistent patency of the recanalized dural sinuses. 3/4 patients are totally asymptomatic at present; 1 has minimal neurologic deficits.
Conclusion: Dural sinus thrombosis may be treated successfully with appropriate systemic therapy. However, when clinical recovery is not immediately obtained, endovascular treatment may be proposed with excellent results.

9.7.1.

Endovascular treatment of Type B aortic dissection: preliminary results

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Purpose: To report results of endovascular treatment in patients with type B aortic dissection.
Materials/Methods: From April 2000 to May 2003, 29 patients were treated for type B dissection with endovascular techniques. Procedures consisted of stent-graft placement in 18 cases, stent-grafts with fenestration in 3, fenestration alone in 3 and peripheral stent placement in 5.
Results: Twenty-three stent-grafts were placed in 21 patients; in 2 cases an additional bifurcated abdominal stent-graft was inserted. In 19 cases complete primary tear closure was achieved. Two patients showed complete thrombosis of the false channel. 20 patients presented neither progression nor procedural complications on follow-up. In 3 cases fenestration was the only treatment, with clinical improvement. In 3 cases successful renal stent implantation was performed. In 2 cases a covered stent was used to seal major reentry in the renal artery; in both cases reduction of inflow to the false channel was achieved.
Conclusions: Endovascular treatment of descending aorta dissection is safe and is an alternative for open surgery.

9.7.2.

Mid-term results of aortic diameter evaluation after thoracic stent-graft implantation for aortic dissection: a multicenter study

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Purpose: To evaluate aortic diameters after stentgraft implantation for aortic dissection in the descending thoracic aorta.
Materials/Methods: Fifty patients with a type-A dissection after ascending aorta surgery (10), a type-B dissection (34), or an intramural haematoma (6) underwent stentgraft repair in three centers. Sixty-six stentgrafts were implanted in acute (18) and chronic (32) dissections (50 patients). Thrombosis and aortic diameter were studied by CT-angiography at different aortic levels, before and after stentgraft implantation (at discharge and follow-up). Measurements were standardized.
Results: Stentgraft placement was successfully performed without major complications in all patients. A complete thoracic thrombosis of the false lumen was observed in 42.5% of cases at discharge and in 60% at follow-up (15 months). A decrease of the total aorta diameter (5 mm, $p<0.05$) and the false lumen diameter (11 mm, $p<0.0001$) was achieved at follow-up. Diameters of the abdominal aorta remained stable in association with a persistent false lumen perfusion at this level.
Conclusion: The stentgraft coverage of the thoracic entry tear, by inducing a thrombosis of the false lumen, decreases the diameter of the total aorta, thus confirming the closure all entry tear.

9.7.3.

Bilateral hypogastric occlusion during endovascular aortic stent-grafting: clinical significance

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Purpose: Applications of bifurcated endografts would be expanded by the ability to occlude both hypogastric arteries (HGAs) in abdominal aortic aneurysm (AAA) repair involving both distal common iliac arteries (CIAs). Potential occlusion of bilateral HGA is generally considered a contraindication to endografting. We evaluate the feasibility and safety of hypogastric embolization during AAA endografting involving distal bilateral CIAs.
Materials/Methods: Of our last 79 bifurcated endografts, bilateral HGA occlusion/embolization was performed in 13 cases (16.5%). Aneurysms involving bilateral CIAs within 1.5cm of the HGA orifice were selected for bilateral hypogastric embolization/occlusion. Embolization was achieved by coil deployment, and occlusion was accomplished by covering the branches with grafts at the same session as AAA grafting. Patients were followed by CT every 3 months for one year and yearly thereafter.
Results: AAA was successfully excluded in all patients without endoleaks. Gluteal claudication was noted in 6 cases, which resolved within 2 months in all but 2 patients. Impotence was seen in 1 patient. Pelvic ischemia was not found in any patients.
Conclusion: Bilateral occlusion of the HGAs appears to be safe. Most moderate complications resolved over time. The benefits gained from endovascular treatment may outweigh the moderate morbidity seen in this patient population.

9.7.4.

Endovascular treatment of longterm complications after aortic surgery

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Purpose: Late complications of open aortic surgery, including perianastomotic leaks and pre- and postanastomotic dilatation, are infrequent and require secondary procedures. We examined our experience with secondary endoluminal treatment of patients who developed late complications after open surgical procedures.
Materials/Methods: Eleven patients underwent endovascular procedures after developing complications of previous open surgery including dissection, distal leak, and thoracic aneurysm after tubular grafting of the thoracic aorta with (n=2) and without (n=2) aortic valve replacement, proximal and distal anastomotic aneurysm after infrarenal tubular aortic graft (n=2), aorto-biiliac (n=2), aorto-bifemoral (n=2) bypass, and mono iliac bypass (n=1). Patients were followed for up to 48 months (mean 23 months) by either CT or ultrasound.
Results: Technical and immediate clinical success was achieved in all patients without complications. The thoracic perianastomotic leak could be sealed with a Talent endograft, the aneurysms of thoracic and abdominal aorta were totally excluded using Excluder, Zenith, and Talent endoprostheses and Hemobahn for distal anastomotic aneurysm. During follow-up, all stentgrafts remained patent without endoleaks. Patients remained asymptomatic and free from recurrence until the present time.
Conclusion: Endovascular treatment using endoprosthesis is an effective treatment for late complications after open aortic surgery, including leaks and perianastomotic aneurysms.

9.7.5.

Endovascular repair of type B aortic dissection: immediate and medium-term results

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Purpose: To report the medium-term results of endovascular repair of type-B aortic dissections with endografts.
Materials/Methods: Fourteen patients with chronic (n=6) or acute (n=8) type B dissections were treated with endografting. The dissections extended to the iliac arteries in 10 patients and to the infrarenal aorta in 2 patients, and were confined to the thoracic aorta in 2 patients. Indications for treatment included gastrointestinal ischemia, uncontrolled hypertension, and associated thoracic aortic aneurysm. The Excluder and Talent endografts were used. Patients were followed with CT for a maximum of 26 months.
Results: The proximal tear was successfully sealed in all patients. Immediate complete thrombosis of the thoracic false lumen was achieved in 7 patients and partial thrombosis was seen in 3 patients. The true lumen significantly increased in all but one patient, who developed an aneurysm treated with open surgery. Four patients died 1 to 4 weeks after the procedure secondary to visceral ischemia that had occurred prior to the endograft procedure. The remaining 10 patients were dissection-free throughout the follow-up period.
Conclusion: Our medium-term results show that an endovascular technique appears to be effective in the treatment of type B dissection in patients without severe visceral ischemia.

9.7.6.

Stent-grafting of inflammatory abdominal aortic aneurysms

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Purpose: To report the radiological and clinical medium-term follow-up of patients with inflammatory abdominal aortic aneurysms (AAA) after endovascular aortic aneurysm repair (EVAR).
Materials/Methods: Ten patients with inflammatory AAA (mean age 65 years, mean AAA diameter 49.7 mm) were identified in a single-center prospective database between June 1997 and June 2003. Devices with Dacron (n=4) or ePTFE (n=6) covering were inserted. Four patients had additional corticosteroid therapy.
Results: The mean computed tomographic and clinical follow-up period was 30 months. Reduction of the thickness of the perianeurysmal fibrosis was observed in eight patients, and progression in one. In nine patients the aneurysmal sac diameter decreased. Out of four patients with hydronephrosis, three required ureteral stenting. Serum creatinine and hydronephrosis improved in all during follow-up. EVAR-associated complications were observed in four patients: periinterventional femoral artery dissection (n=1), aortic instent-graft thrombus formation with blue toe (n=1), and late disconnection with consecutive thrombosis of stent graft limb (n=2).
Conclusion: EVAR is feasible in inflammatory AAAs and can reduce perianeurysmal fibrosis and aneurysmal sac diameter in most cases.

9.7.7.

Feasibility and results of a closer device for larger percutaneous punctures (12-27 F)

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Purpose: To evaluate feasibility and short-term results of a percutaneous vascular suture (PVS, Perclose 8-10 F, Prostar XL, Abbott) for larger holes.
Materials/Methods: Forty consecutive patients were treated by endovascular procedures, either thoracic stentgrafts or iliac covered stents (abdominal aortic stentgraft extension) where the introducer sheath diameter at the femoral puncture (n=49) was between 12 and 27 F. Ultrasound at the puncture site was performed at discharge, one month after procedure, and at follow-up (10.7 months, range 2-27).
Results: In one patient, evaluation of the PVS could not be performed for a procedure-related iliac rupture. In the remaining 48 punctures, 42 homolateral approaches were closed with 84 PVS (two-system Perclose technique) and six contralateral approaches were closed with seven PVS. A technical success was achieved in 44/48 holes (92%) and surgery was required in four cases. Manual compression was necessary in four additional cases. Two patients died during the first month for multivisceral alterations. At follow-up, five deaths were reported without relation with PVS and one false aneurysm was treated surgically.
Conclusion: Endovascular procedures requiring larger holes (up to 27 F) could benefit of the use of PVS with a high technical success, if a percutaneous approach is chosen.

9.7.8.

Occurrence of acute retrograde aortic type-A dissections after endovascular stentgraft treatment of the descending thoracic aorta

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Purpose: Evaluation of acute retrograde type-A aortic dissections following stentgraft treatment of the descending thoracic aorta (DTA).
Materials/Methods: Five patients with descending thoracic aortic pathologies underwent stentgraft placement into the DTA. Two of them presented with a chronic aortic type-B dissection, one had a subacute type-B dissection, one a descending thoracic aortic aneurysm with a maximum aneurysm diameter of 6 cm, and one patient suffered of an ulcerating aneurysm of the descending aorta with a beginning dissection. Age range was 47 to 83 years. Aneurysm etiology was atherosclerotic for three patients, one ulcerating aneurysm, and one patient presented an aneurysm due to cystic medial necrosis (Erdheim-Gsell). Two different types of aortic stentgrafts were used.
Results: After proper stentgraft placement, all the patients showed a retrograde aortic type-A dissection. Three patients died: one for multiorgan failure, two for aortic rupture secondary to retrograde type-A dissection. Two patients are still alive, without leaks, and under follow-up.
Conclusion: Since retrograde type-A dissection represents a severe life-threatening complication, a detailed pre-interventional work-up should be undertaken to avoid such severe, sometimes fatal, complication in endovascular aortic treatment, especially considering aneurysm etiology, patient selection, stentgraft type, and stentgraft placement technique.

9.7.9.

Magnetic resonance imaging monitoring of differences in histological organization in aneurysms after endovascular aneurysm treatment

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Purpose: To assess magnetic resonance imaging (MRI) monitoring of histological organization processes in excluded aneurysms after stent therapy.
Materials/Methods: Thirty-four patients were monitored with MRI after endovascular aneurysm treatment [1.5 Tesla, T1wTSE (TR173ms; TE4,1ms), T2w (TR5572ms; TE99ms)] and T1w after GdDTPA, at one week, three and six months, and yearly. Signal intensities (SI) before and after contrast bolus were categorized after segmentation of the aneurysm sac. The distribution of distinct signal classes in anatomical subregions was quantitatively analysed and correlated to histological organization classes previously defined in an experimental method: detritus, tissue with increasing fibre proliferation, and tight connective tissue.
Results: Follow-up revealed variable diameter changes. Decreasing SI in T2w images indicated ongoing histological organisation and was associated with aneurysm shrinkage. In contrast, reduced aneurysm shrinkage or even diameter increase was associated with missing signal decrease (detritus or poor fibre proliferation). Contrast enhancement represented vascularity (T1w) and indicates ongoing tissue organisation. No correlation between amount of preexisting partial thrombus and diameter decrease was found.
Conclusion: Ongoing histological organisation processes can be detected by non-invasive MRI. T2w sequences are superior for discriminating organisation classes. Aneurysm shrinkage was associated with decreasing SI (T1w, T2w) and contrast enhancement (T1w), indicating histological organisation processes.

19.1.1.

A separate expandable nitinol stent: experience in 102 patients with malignant gastroduodenal strictures

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Purpose: To investigate technical feasibility and clinical effectiveness of a separate expandable nitinol stent in the palliative treatment of malignant gastroduodenal strictures.
Materials/Methods: This separate stent consists of two stents, an outer partially-covered stent and an inner bare nitinol stent. The outer diameter of the stent delivery system was 3.8 mm. Fluoroscopic placement of the separate stent was attempted in 102 consecutive patients with malignant gastroduodenal strictures. All patients presented with severe nausea and vomiting.
Results: Stent placement was technically successful and well-tolerated in 101 (99%) of the 102 patients. After stent placement, 85 (84%) of these 101 patients experienced improvement of their symptoms. Stent migration or tumor ingrowth did not occur in any patient. Tumor overgrowth occurred in five patients, mucosal hyperplasia in one, bleeding in one, and jaundice in one. Thirty-, 60-, 90-, and 180-day survival rates were 78, 58, 39, and 8%, respectively.
Conclusion: The separate stent with a 3.8-mm stent delivery system is easy to insert, safe, and reasonably effective for the palliative treatment of malignant gastroduodenal strictures. It also seems to contribute to decreasing the rates of stent migration and tumor ingrowth in malignant gastroduodenal strictures.

19.1.2.

Colorectal stenting: an effective therapy both preoperatively and in palliation

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Purpose: To demonstrate effectiveness of preoperative and palliative stenting in acute colonic obstruction.
Materials/Methods: Fifty-five consecutive patients (mean age: 68 years; range: 35-93) with clinical and radiological signs of colonic obstruction were referred to our department, 36 (65%) for a preoperative treatment and 19 (35%) for palliation. In 49 patients (89%) the obstruction was malignant, in six (11%) benign. Enteric Wallstents were implanted under fluoroscopic/endoscopic guidance.
Results: A technical success was achieved in 30 (83 %) of the 36 patients referred for preoperative stenting: 28 (93%) underwent surgery 2-22 days (mean 7.8 days) after. A single-stage tumor resection and a primary anastomosis was performed in 25 cases (89% of all operations), while three patients had colostomies. The remaining two patients died before surgery could be performed. The technical success rate of the 19 patients referred for palliation was 95%, the clinical success rate 72%, and the complication (reocclusion in most cases) rate 61%. After non-invasive interventions, the secondary patency was 78%. Mean reported life time after stenting was 119 days (range 10-568 days).
Conclusion: Preoperative stent placement in acute colonic obstruction allowed an elective one-stage operation in most cases. In palliation, it proved to be a valuable alternative to colostomy.

19.1.3.

Primary insertion of large bore (18Fr) button gastrostomy catheters: technique and complications

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Purpose: Previously we have documented that 14Fr button gastrostomy catheters can be placed de novo by interventional radiology. We have since evaluated the feasibility of inserting large bore (18 Fr) button-type gastrostomy catheters as a primary procedure.
Materials/Methods: We retrospectively reviewed 71 patients who had primary insertion of 18 Fr button gastrostomies (M:F; 50:21, age range 25-83). All patients had a gastropexy performed. Five patients were referred to our service from the gastroenterology service after failed gastrostomy attempts. Technical success, complications, and outcome were recorded in all patients.
Results: Technical success rate was 100%. Six of our button catheters were replaced after balloon degradation and subsequent dislodgement. One catheter occluded 8 months after the primary procedure. A second catheter was dislodged by a confused patient. There were 9 minor complications, including four cases of cellulitis, treated with intravenous antibiotics, and 5 patients who complained of pain at the gastropexy site. All of the latter were treated with oral analgesics. There were no major complications.
Conclusion: Large bore (18 Fr) button gastrostomy catheters can be safely placed percutaneously de novo. Long term patency rate is improved due to the lower likelihood of blockage and dislodgement.

19.1.4.

Embolization procedures in acute arterial gastrointestinal bleedings: technique and results

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Purpose: To describe techniques and evaluate safety and efficacy of coil embolization methods in patients with different causes of acute gastrointestinal bleeding (GIB).
Materials/Methods: Ninety-two patients (56 men, aged 21-93 years) with acute GIB were treated by embolization. In life-threatening cases angiography was performed immediately; in the other patients, GIB was localized by scintigraphy. GIB was caused by angiodysplasia (31), post-pancreatitic pseudoaneurysms (24) and hemorrhage into pseudocysts (7), colonic diverticulitis (12), iatrogenic (6) and posttraumatic lesions (4), tumors (5) and inflammatory bowel diseases (3). Primary technical success, complications, and long-term efficacy of superselective embolization (mean: 22 months) were evaluated.
Results: In 52 patients intramural bowel vessels were embolized, in nine cases distant feeding vessels were occluded. No ischemic complications occurred. In 89 patients primary embolization was sufficient, in 72 patients it was definitive. In three patients with colitis and tumors, the bleeding was not completely stopped. In six patients with multiple angiodysplasias, GIB recurred (30-day interval). Patients with tumors, inflammation and complications of pancreatitis were treated surgically in optimized conditions.
Conclusion: Superselective coil embolization is a safe and highly effective method in the definitive and preoperative treatment of acute GIB. Exact intramural coil placement does not provoke ischemic complications.

19.1.5.

Long-term follow up of life-threatening colonic haemorrhage treated with embolisation

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Purpose: Generally good results have been published widely for immediate outcomes of embolisation for life-threatening colonic haemorrhage. However there are no data in the literature on the long-term outlook for these patients. This study aims to redress this.
Materials/Methods: Retrospective case note review of patients embolised for colonic haemorrhage over a seven-year period in a teaching hospital.
Results: Twenty-two patients (12 men, median age 75 years, range 43-91) were embolised with coils and/or Gelfoam. Haemorrhage was thought to be due to diverticular disease or angiodysplasia in the majority, with one bleeding rectal tumour and one post-haemorrhoidectomy. Haemorrhage was controlled at the end of the embolisation procedure in all patients, although two (9%) continued bleeding and required emergency hemicolectomy. Eleven (50%) had no further bleeding, eight (36%) had further bleeding managed conservatively and one (5%) required a further embolisation at the same site 15 months later. Three (14%) patients developed minor ischaemic complications which were managed conservatively, and there were no complications requiring further intervention or surgery. Thirty-day mortality was 5%. Median follow up was 43.2 months (range 2-79).
Conclusion: Selective embolisation is an effective treatment for colonic haemorrhage in both the short and long term.

19.1.6.

Spontaneous extraperitoneal hemorrhage in patients with anticoagulation: management by transcatheter embolization

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Purpose: To report our experience with management of unstable spontaneous extraperitoneal hemorrhage with selective transcatheter embolization in patients under anticoagulation therapy.
Materials/Methods: From November 1997 to January 2004, 15 consecutive patients underwent angiographic evaluation for spontaneous extraperitoneal bleeding complicated by hemodynamic collapse while undergoing anticoagulation therapy. Angiography demonstrated bleeding mostly via the lumbar arteries in patients with iliopsoas hematomas. Multiple arteries (inferior epigastric, superior gluteal, deep circumflex iliac, superficial circumflex iliac) supplied the bleed in patients with rectus sheath, flank or gluteal hematomas.
Results: Microcoil or gel-foam embolization successfully controlled extravasation, with stabilization of hemodynamic parameters almost immediately in all patients and consequent decrease in transfusion requirement. Thirteen of the 15 patients survived the immediate post-procedure interval. Two patients died one day after the procedure from multiple organ system failure; their families chose to withdraw care.
Conclusion: Selective transcatheter embolization can be a viable life-saving option in spontaneous extraperitoneal bleeding associated with hemodynamic collapse.

19.1.7.

ePTFE-covered stents in the palliative treatment of malignant biliary obstructions

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Purpose: To determine technical and clinical safety and efficiency of expanded polytetrafluoroethylene (ePTFE)-covered stents in the management of malignant biliary obstructions.
Materials/Methods: Forty-five patients with malignant bile duct strictures were treated with 49 stents. The stent has an inner ePTFE lining and an outer supporting structure of nitinol wire, with or without proximal holes to provide drainage of the cystic duct or biliary side branches. Clinical evaluations were done before stent placement and at three, six, nine, and 12 months. Average follow-up duration was 5.6 months (range, ten days to 13 months).
Results: Stent placement was successful in all cases. Survival rates were 40 and 10% at six and 12 months. Primary patency rates at three, six, and 12 months were 100, 98, and 91%, respectively. Four patients (8.9%) presented with recurrent obstructive jaundice and needed repeat intervention; none of them showed stent ingrowth. No migrations occurred. Procedure-related complications were four (8.9%), including one death because of biliary sepsis (2.2%) and acute cholecystitis in two patients (4.5%).
Conclusion: ePTFE-covered stent implantantion is feasible and effective in achieving biliary drainage. The percentage of patients undergoing lifetime palliation and medium-term patencies are promising. The incidence of cholecystitis should however be considered.

19.1.8.

Percutaneous interventions in the management of complications after adult living donor liver transplantation

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Purpose: To evaluate the role of percutaneous management of surgical complications after living donor liver transplantation (LDLT) in adults.
Materials/Methods: Over a four-year period, 14 adults underwent elective LDLT (12 right and two left lobes). The biliary tract was reconstructed by hepatico-jejunostomy in eight patients and hepatico-hepaticostomy in six. A portal graft interposition was necessary in two. In nine (64%) patients biliary complications occurred: seven (50%) anastomotic (5) or sub-anastomotic (2) strictures, four (29%) anastomotic (1) or cut-surface (3) leaks, two (14%) intra-hepatic bilomas. Vascular complications (four, 29%) included one portal vein thrombosis, one arterial tight stenosi,s and two biopsy-induced pseudo-aneurysms.
Results: Four biliary strictures were successfully treated by internal/external drainage, balloon-dilatation and/or stent placement and three were primarily surgically treated. All leaks and bilomas were treated by combined percutaneous drainage and biliary derivation. Management of vascular complications by superselective embolization, TIPS-supported local venous lysis or arterial angioplasty succeeded in all four patients. During the follow-up (median: 22 months) complication-induced severe graft dysfunctions required redo-transplantation in two patients (14%). Four patients (29%) died from unrelated causes.
Conclusion: The higher complication rate of post-LDLT as compared with post-OLT remains a significant problem. Primary percutaneous approach to these complications should be recommended.

19.1.9.

Life-threatening bleeding complications from transjugular liver biopsies (TJLB) in patients with hematologic malignacy

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Purpose: Transjugular liver biopsy (TJLB) is a safe and effective technique for obtaining liver specimens when fine-needle aspiration (FNA) is contraindicated. Bleeding complications with TJLB were studied in patients with hematologic malignancies and cirrhosis.
Materials/Methods: Eighteen TJLBs were performed in 17 patients who had undergone bone marrow transplantation. These were compared with a cohort of 32 TJLBs performed in patients with end-stage liver disease (hepatitis or alcohol). All biopsies were performed with a 19-G liver-biopsy set and procedures were done by six interventional radiologists.
Results: Three of the patients in the hematologic group had severe bleeding (16.7%, $p<0.04$). In patients with cirrhosis, no significant bleeding complications occurred.
Conclusion: Our experience with TJLBs suggests an increased frequency of bleeding complications in patients with hematologic malignancy compared with patients with cirrhosis. The frequency of post-biopsy bleeding in such patients appears to be higher than that reported in other series. The technical details of the transjugular biopsy procedure did not vary between types of patients. While it is not certain why hematologic patients are more prone to bleeding complications from TJLBs, possible explanations include resistance to transfusions for thrombocytopenias and softer liver textures compared with cirrhotic patients.

19.2.1.

The Regards study: a prospective registry of renal angioplasty in 353 patients

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Purpose: To report the current results of percutaneous transluminal angioplasty of the renal artery (PTRA).
Materials/Methods: Between 9/02 and 12/02 all consecutive PTRA performed in 40 centres in France and Belgium were prospectively collected. Indications and technique of angioplasty as well as immediate results and complications were recorded in all patients.
Results: PTRA was performed in 353 patients (405 arteries) aged 64.3 +/- 15.9 years (range 21.8-97.6). Native kidney arteries were treated in 390 cases (atheroma 80%) and transplanted kidney in 15. Target lesions were ostial in 67% and mean degree of stenosis was 80.3 +/- 12%. Most patients (90%) were treated using 0.018/.014 inch platforms. Stent placement was performed in 71% of cases. First month complications included 3 deaths (0.9%) and 4.5% complications. Mean creatinine clearance increased from 57.8+/-27 ml/min to 60.7+/-28 ml/min ($p<.05$) . Mean systolic blood pressure decreased from 166.6+/-24 mm Hg to 144.4 +/-19.6 mm Hg ($p<.05$). Mean diastolic blood pressure decreased from 87.9+/-13 mm Hg to 79.3+/-12.4 mm Hg ($p<.05$) immediately after the procedure.
Conclusion: Despite participation of centres with various levels of expertise, this study demonstrates that PTRA using current techniques is a very safe intervention.

19.2.2.

Ethanol and polyvinyl alcohol mixture for renal angiomyolipoma embolization

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Purpose: To demonstrate results of ethanol and polyvinyl alcohol mixture embolization as the treatment for renal angiomyolipomas.
Materials/Methods: Fourteen symptomatic and six asymptomatic patients with 21 renal angiomyolipomas larger than 4 cm were treated with transcatheter embolization during a eight-year period using a mixture of ethanol and polyvinyl alcohol (PVA) particles. Follow-up angiography was performed (mean: 13 months).
Results: All angiograms showed the characteristic tortuous, hypervascular and aneurysm formation angiogenic component. Immediate complete obliteration was observed in 20 tumors. Angiography follow-up was performed in 13 patients at mean of 20 months. A reduction of the angiogenic component was seen in all tumors.
Conclusion: Ethanol and PVA mixture is an efficient embolizing material for renal AML with a long-term durability.

19.2.3.

MR-guided renal embolization using intra-arterial contrast-enhanced MR-angiography and active catheter tracking

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Purpose: The aim of this study was to assess the feasibility of MR-guided renal embolization in a porcine model using active catheter tracking.
Materials/Methods: All experiments were performed on a conventional short-bore 1.5 Tesla whole-body MR scanner (Siemens Symphony). A dedicated active 5.5-F catheter with three micro-coils was used for renal artery catheterization, in combination with a conventional guidewire (Terumo). Real-time catheter tracking was used in combination with an interactive user interface which enabled to change automatic slice alignment as well as MR imaging parameters. After selective catheterization of intrarenal arterial branches, the embolization material was injected. Selective intra-arterial contrast-enhanced MR-angiography of both kidneys was performed to assess embolization results.
Results: Ten kidneys were included. In four cases, catheterization of the right renal artery failed due to the size of the catheters and the lack of MR visible guidewires. When compared with pathologic specimens, selective 2-D and 3-D MR-angiography data allowed a reliable assessment of the success of the embolization.
Conclusion: MR-guided tumor embolization of the kidney is feasible in a conventional MR scanner. Intra-arterial contrast-enhanced MRA allows a reliable control of embolization results.

19.2.4.

Management of mesenteric ischemia due to arterial or venous occlusion

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Purpose: To describe various interventional treatment techniques in patients with visceral ischemia.
Materials/Methods: Twenty-two patients (12 women, ten men, aged 42-77 years) with visceral ischemia were treated by interventional recanalization. Ischemia was caused by portal venous thrombosis (10), arterial occlusion (11), and a combination of both (1). Patients with portal thombosis were treated by transjugular-transhepatic thrombus fragmentation, thrombolysis and thrombectomy. In two patients with primary surgical therapy, an additional catheter was placed intraoperatively. Those patients with arterial ischemia underwent PTA and balloon-expandable stent implantation of splanchnic vessels. Primary technical success, complications and long-term efficacy were evaluated.
Results: A primary technical success was obtained in all patients. In four patients, bowel resection was inevitable because of critical ischemia. Arterial stenoses were treated without peripheral embolic or occlusive complications. Recanalization of portal veins was complete in six patients and hemodynamically sufficient in other six. In one patient a major complication (subcapsular liver rupture) was treated surgically.
Conclusion: In the early period, acute mesenteric arterial ischemias and venous occlusions can be treated interventionally, in a few cases in combination with operative methods. Long-term patency of recanalized vessels can be documented by MRI and duplex-sonography.

19.2.5.

Renal artery percutaneous recanalization: is lesion morphology important in predicting the outcome?

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Purpose: To assess the relationship between lesion morphology and immediate and long-term results of renal artery percutaneous recanalization.
Materials/Methods: We included 98 patients with significant (>60%) atherosclerotic renal artery stenosis and renovascular disease treated by percutaneous renal angioplasty (PTRA, n=43) or stenting (n=55). Preprocedurally, magnetic resonance/computed tomographic angiography (MRA/CTA) were performed in all patients. Images were retrospectively reviewed to assess features of the stenoses (grade, length, site, calcifications). Procedural data (balloon/stent length and diameter), immediate complications (residual stenosis, dissection, embolization), and restenosis on follow-up were noted, assessing the relationship between these data and lesion morphology by statistical analysis.
Results: In the PTRA group, a significantly ($p<.05$) higher incidence of minor complications was observed with higher grade stenoses, longer balloons, and smaller diameter balloons; restenosis was significantly more frequent in case of lower balloon oversizing. In the stent group, no significant relations were found between in-stent restenosis and morphological/procedural data, whereas immediate complications were significantly more frequent in patients with paraostial stenoses and when longer stents were deployed.
Conclusion: The assessment of lesion anatomy on MRA/CTA images could improve procedural planning, allowing selection of proper devices to reduce the incidence of immediate complications.

19.2.6.

Multislice CT-angiography with multiplanar reconstruction for the evaluation of renal artery stents: a retrospective study of 30 stents

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Purpose: To evaluate the results of multislice computed-tomographic (MSCT) angiography with multiplanar reconstruction (MPR) for estimating the patency of renal artery stents.
Materials/Methods: Twenty-two MSCT scans (Sensation 16, Siemens) performed in follow-up of PTA with stent implantation for atheromatous renal artery stenosis were retrospectively reviewed. A total of 30 stents were studied. MPR and 2D curved reconstructions were performed. We visually assessed the capacity of the MSCT to visualize the in-stent lumen, as well as the presence of in-stent proliferation.
Results: The study of the in-stent vascular lumen was possible in all cases. Several elements appeared to be of greatest importance for this visualisation: the use of a reduced field of view, adaptation of the window of visualisation, and the use of MPR and 2D curved reconstructions to visualise the in-stent lumen in several planes. The quantification of in-stent proliferation was considered to be possible by a semi-quantitative method (<50%, from 50 to 69%, 70 to 99% or occluded); in-stent proliferation was found in ten stents.
Conclusion: MSCT angiography with MPR reconstruction permits visualisation of the arterial lumen within the stents despite high attenuation values. The diagnostic of in-stent restenosis is possible with this technique.

19.2.7.

The GREAT study: Palmaz Genesis peripheral stainless steel balloon-expandable stent, bare versus sirolimus-eluting, in renal artery treatment: six-month follow-up results

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Purpose: Assessment of the safety and performance of the .018 Palmaz Genesis stainless steel balloon-expandable stent for the treatment of renal artery stenosis (RAS).
Materials/Methods: This multi-center (11 sites), prospective, non-randomized, controlled study evaluates the safety and performance of the Genesis stent (Cordis), with or without sirolimus, in the treatment of RAS in 105 patients (52 treated with the bare Genesis followed by 53 treated with sirolimus-eluting stents). Patients with RAS $\geq$50% were sequentially treated with bare versus sirolimus-eluting stent. Primary endpoint was the angiographic (QVA) in-stent percentage diameter stenosis (%DS) at six months.
Results: Mean in-stent %DS at six months was 23.9$\pm$22.9%, (-2.3 -96.8%) for the bare stent group (52 patients) The in-stent restenosis rate (%DS greater than 50%) at six months was 14.3%. No fatal events occurred up to six months post-implantation. Major adverse events occurred in five patients: four required a revascularization (7.7%) and one experienced a reversible CVA (1.9%).
Conclusion: The .018 Palmaz Genesis stainless steel balloon-expandable stent appears to be a very safe and effective device in the treatment of RAS. The results of the group with sirolimus-eluting stent will be available for presentation.

19.2.8.

Clinical outcomes following angioplasty of renal transplant artery stenosis

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Purpose: To assess the clinical outcomes following endovascular therapy in the management of renal transplant artery stenosis.
Material/Methods: A retrospective review of transplant patients with renal artery stenosis (RAS)
who underwent either angioplasty or stenting between 1991 and 2003.
Results: 34 cases (2.5%) were identified from 1351 transplant recipients. The mean time to diagnosis was 17 (2-84) months. RAS presented with renal impairment in 79.4% (n = 27), refractory hypertension in 55.9% (n = 19), peripheral oedema in 23.5 % (n = 8) and ACE inhibitor induced renal impairment in 14.7% (n = 5). Angioplasty gave a clinical success rate of 73.5 % (n = 25), and a mean reduction in serum creatinine level of 141umol/l (range 17-438). Blood pressure control improved in 35 % (n = 12). Angioplasty failed in 3 cases necessitating transplant nephrectomy (8.8 %). 3 patients had recurrent stenosis angioplastied and only one needed stenting for a complex recurrent stricture. The mean duration of follow up was 26 (2-112) months
Conclusion: Primary angioplasty was clinically successful in 73.5%. Stent insertion is rarely necessary. Allograft loss can be major complication in severe stenosis.

19.2.9.

Role of interventional radiology in the management of renal artery aneurysms

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Purpose: To present our experience in the endovascular treatment of renal artery aneurysms.
Materials/Methods: Endovascular treatment was undertaken in 12 patients after incidental discovery (by CT angiography or Doppler ultrasound) of a renal artery aneurysm. In 2 cases aneurysm was related to fibromuscular dysplasia, one case was secondary to endocarditis, while in other 9 cases etiology remained undetermined. Treatment was planned according to the morphologic findings on selective angiography (shape of the aneurysm, size of the neck, relationships to the division branches of the renal artery). Coils were used in 11 cases; a bare stent was placed in the trunk of the renal artery in one of these 11 cases, because of a wide aneurysmal neck. Exclusion of the aneurysm was obtained in one case by using a covered stent.
Results: Technical success rate was 100%. Migration of a coil followed embolisation of a huge aneurysm with a large arteriovenous fistula. Follow-up studies showed patency of the renal artery maintained in 100% of the cases and exclusion of the aneurysm in 90%.
Conclusion: Our experience shows that endovascular treatment of renal artery aneurysm is feasible provided that its morphology is adequate.

19.3.1.

Percutaneous radiofrequency ablation of lung tumors: a prospective multicenter clinical trial

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Purpose: To determine feasibility, safety, and effectiveness of percutaneous CT-guided radiofrequency ablation (RFA) of malignant lung tumors.
Materials/Methods: Ninety-seven patients with 166 malignant lung tumors tumors $\leq$3.5 cm in diameter (mean, 1.6$\pm$0.8 cm) were enrolled in a multi-center, prospective clinical trial. Diagnoses included non-small cell lung cancer (n=31), metastasis from colorectal adenocarcinoma (n=52), and other metastases (n=12). All patients were considered unfit for surgery. CT-guided RFA was performed by using a 150-200W generator and expandable multiarray needles (RITA Medical Systems). Follow-up period ranged from one to 18 months (mean, 6.3 months $\pm$ 5.1).
Results: RFA was technically feasible in 96 of 97 patients. Overall, 165 lesions were treated in 121 sessions. Major complications consisted of pneumothorax (n=18) and pleural effusion (n=4) requiring treatment, atelectasis (n=1) and pneumonia (n=1). Eighty-one (89%) of 91 lesions in 68 patients who were followed up for six months after RFA showed no tumor progression on CT. Complete ablation of treated lesions was confirmed by the absence of tumor re-growth over a period of one year or more in 48/53 (91%) lesions in 44 patients.
Conclusion: CT-guided RFA yields high local tumor control rates in patients with pulmonary malignancies, and is associated with acceptable morbidity.

19.3.2.

Radiofrequency ablation in primary lung tumors and pulmonary metastases: results of a prospective study

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Purpose: To evaluate radiofrequency (RF) ablation in lung tumors.
Materials/Methods: 60 patients with primary lung tumors (n=9) or metastases (n=51) of <4 cm, five or less in number, were treated under CT guidance using LeVeen RF probes and a RF 3000 generator. Every patient was followed with CT-scan 48h after the procedure and every 2 months for one year. Lung function was tested at one month.
Results: Adverse events occured in 68% of the procedures: pneumothorax (55%), hemoptysis (6%), pleural effusion (20%), alveolar hemorrhage (14%), pneumopathy (6%), and atelectasis (3%). Seven patients with pneumothorax required drainage. The mean tumor size increased from 17$\pm$9 mm before RF to 39$\pm$13 mm at 48h, then progressively decreased at 2, 4 and 6 months. No modification of lung function was noted after one month. After a median follow-up of 8 months, 7 local recurrences were discovered. Two occurred before 6 months and 5 between 6 and 12 months. The recurrence rate at 8 months was 15% $\pm$ 6%.
Conclusion: Lung RF ablation appears to be feasible, well-tolerated and effective. This technique has to be included in the overall therapeutic strategy. A better patient selection and technical improvements might reduce the local recurrence rate.

19.3.3.

Massive pulmonary embolism: rheolytic thrombectomy versus enzymatic intrapulmonary thrombolysis

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Purpose: To retrospectively investigate technical efficacy and clinical success between intrapulmonary thrombolysis with urokinase (UIT) and Angiojet rheolytic thrombectomy (ART) in massive pulmonary embolism (MPE).
Materials/Methods: Fourteen consecutive patients with MPE were studied. UIT was performed in eight patients with high-dose intrapulmonary urokinase, while six underwent selective ART. In the ART group, additional low doses of urokinase were administered because of a residual embolic burden. Pre- and post-intervention angiographic Miller indices were graded.
Results: Hemodynamic impairment was improved in 13 patients, while one death occurred in the ART group. The mean Miller index before intervention was 0.46 in the UIT group--reduced to 0.24 after intervention--versus 0.55 and 0.18 in the ART group, respectively (48% versus 67% reduction). The mean urokinase dose used was 2,000,000 IU in the UIT group versus 650,000 IU in the ART group (66% reduction). Mean procedural duration was 11 hours in the UIT group versus 2.8 hours in the ART group (75% reduction).
Conclusion: Mechanical thrombectomy techniques represent an emerging therapeutic approach to MPE. ART seems more effective and safer than UIT by accelerating thrombus debulking, reducing doses of enzymatic thrombolysis, and rapidly restoring cardiovascular balance.

19.3.4.

Acute pulmonary embolism: mechanical fragmentation treatment using thrombectomy devices

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Purpose: Acute pulmonary embolism is a serious disease, usually misdiagnosed and often fatal. Endovascular treatment by catheter directed fibrinolysis has shown to be the treatment of choice in these situations, but in hyperacute patients it may be not sufficient. Percutaneous thrombectomy devices, developed to treat obstruction in various vascular segments, could be used in the pulmonary arteries as well. We present our use of this new tool.
Materials/Methods: Between June 1997 and December 2003, we performed catheter-directed fibrinolysis in 480 patients with pulmonary embolism, which was acute in 120/480 cases. In 24/120 cases we used percutaneous thrombectomy devices to perform thrombus fragmentation in addition to local fibrinolysis. Four different types of devices were used.
Results: In all cases thrombus fragmentation was obtained and local fibrinolysis time was decreased, but significant differences were found among thrombectomy devices. No procedure-related major or minor complications were observed.
Conclusion: Percutaneous thrombectomy devices proved to be highly effective in obtaining thrombus fragmentation in acute pulmonary embolism patients. Subsequent local fibrinolysis was always recommended to obtain complete pulmonary artery recanalization. Significative differences were noted among the devices used.

19.3.5.

Pulmonary and bronchosystemic embolization in the management of hemoptysis in Behçet's disease

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Purpose: To report our experience with percutaneous transcatheter occlusion of pulmonary artery aneurysms (PAA) and/or bronchial artery embolization in Behçet's disease.
Materials/Methods: Nine men, mean age (31±12 years), eight with known Behçet's disease and one considered to have thromboembolic disease, were treated for hemoptysis. Eight patients underwent chest CT revealing 23 partially clotted proximal PAAs with a surrounding hemorrhage in two cases. The mean number of PAAs per patient was 2.5 ±1.6 and the mean size 3.9±1.6 cm.
Results: Seventeen PAAs were embolized in seven patients, using steel coils, autologous clots and/or cyanoacrylate. PAA healed in one patient under medical therapy only. Bronchosystemic artery embolization was performed in two patients for recurrence of hemoptysis after successful PAA occlusion. One patient had only bronchial artery embolization because the PAA could not be occluded. In three patients, bronchosystemic embolization was performed prior to PAA occlusion. Seven patients had pulmonary hypertension with no increase after the procedure. In the follow-up, two patients were successfully re-embolized for incomplete occlusion of PAA and one patient died probably from PAA rupture one month after embolization.
Conclusion: Combined embolization of PAA and bronchosystemic arteries should be considered in Behçet's disease with massive hemoptysis.

19.3.6.

Influence of a dexamethasone-eluting covered stent on tissue hyperplasia: preliminary study in a canine bronchial model

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Purpose: To evaluate feasibility and efficacy of a dexamethasone (DXM)- eluting, polyurethane-covered stent (drug stent, DS) to reduce tissue hyperplasia in a canine bronchial model.
Materials/Methods: A DS and a polyurethane-covered stent (control stent, CS) were alternatively placed in each left main and lower lobe bronchus in 12 dogs. The dogs were sacrificed one (n=4), two (n=4), or four (n=4) weeks later. Gross and histologic findings were evaluated after sacrifice.
Results: Stent migration was detected in one dog just before sacrifice one week following stent placement. Epithelial erosion/ulcer (involved percentage out of the entire epithelial circumference) was significantly less in the DS (46.88±23.75) than in the CS (73.75±14.08) (p=0.026). A decrease in epithelial erosion/ulcer as the follow-up period increased was observed in both DS and CS. Granulation tissue thickness (mm) was less in DS (2.63±2.05) than in CS (3.49±2.95) (p=0.751). A tendency toward an increase in granulation tissue thickness and chronic lymphocytic infiltration as the follow-up period increased was recorded in both DS and CS.
Conclusion: Local delivery of DXM via covered stents is feasible and seems to be effective in reducing tissue hyperplasia secondary to stent placement in a canine bronchial model.

19.3.7.

Radiological treatment of hemoptysis: treatment strategies in patients with multiple systemic arterial roots

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Purpose: To present our experience on the embolization of systemic lung vessels and evaluate the issues related to the presence of multiple systemic arterial roots found in 16 patients.
Material/Methods: In the past 15 years, 130 patients (94 men, 36 women; aged 20-83 years) wee treated for repeated episodes of hemoptysis. Their underlying diseases were tuberculosis (45), bronchiectasis (26), cancer (17), and others (42). Hypertrophic arterial branches were selectively catheterized and then occluded with polyvinyl alcohol, fibrin sponges, and Embospheres.
Results: A technical success was achieved in 126/130 patients (96.9%). We completed 169 embolizations; in particular, 37 treatments were performed in 16 patients (mean 2.3) who had three or more arterial roots feeding the lesions. In the other 110 patients the average number of treatments was 1.2. In four cases, embolization was impossible due to the presence of a spinal artery in the arterial bed that could have been occluded.
Conclusion: Percutaneous embolization is an efficient treatment for hemoptysis. In case of large bleeding lesions with multiple systemic arterial roots, mostly due to chronic inflammation and involving the pleura, repeated treatments are necessary to completely occlude the pathological arterial bed, with an increased risk of spinal artery embolization.

19.3.8.

Minimally invasive occlusion of recurrent tracheo-esophageal fistulae

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Purpose: To describe the treatment of recurrent fistulae in patients with tracheo-esophageal fistulae (TEF) post-primary surgical repair.
Materials/Methods: Six pediatric patients (aged less than one year) presented with recurrent TEF treated with combined bronchoscopy and fluoroscopy-guided catheter placement through the fistula into the esophagus. Trauma was induced in the fistula with a combination of wire manipulation, suction, and electro-cauterization. The fistulae were then embolized with hystocryl mixed with lipiodol. The procedure was visualized under fluoroscopy and direct video imaging.
Results: The procedure was performed from one to three times with resolution of the fistulas.
Conclusion: The treatment of TEF with a combination of minimally invasive techniques is successful and avoids major surgery.

19.3.9.

The use of metal stents in children airways

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Purpose: Prospective non-randomized study of children undergoing insertion of metallic airway stents at a referral children's hospital.
Materials/Methods: Patients were selected for stenting after referral to our multidisciplinary tracheal service. The stents were inserted between September 1999 and January 2004 by the interventional radiology team, using bronchographic and bronchoscopic guidance. Technical data were recorded prospectively, and patients were followed up by clinical members of the team, either in person or by telephone.
Results: There were 26 patients, aged from 24 days to 15 years (median nine months). Indications were: stenosis (mostly post-surgical) in 15 patients, malacia (8) and extrinsic compression (8). Fifty-eight stents (Palmaz 48, Symphony 6, other self-expanding 4) were inserted at 40 procedures, into the trachea (34), left main bronchus (18), right main bronchus (5) and left lower lobe bronchus (1). Four stents have been removed. Ten patients have died, seven of underlying heart and/or lung disease, and one each of arteriotracheal fistula, pericardial patch dehiscence and sepsis.
Conclusion: The use of metal stents may assist in the management of major airway problems in children previously viewed as having an extremely poor prognosis. Careful selection of patients and stent types is essential.

19.4.1.

Long-term results after thrombolysis with adjunctive GP IIb/IIIa receptor blockade: comparison of reteplase versus urokinase

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Purpose: The aim of this study was to compare the safety and efficacy of a combination therapy with the GP IIb/IIIa antagonist abciximab and the third-generation thrombolytic agent reteplase with the standard thrombolytic agent urokinase plus abciximab.
Materials/Methods: Due to the same study design and comparable baseline characteristics, the patients of the two prospective randomized trials "PROMPT" and "APART" were pooled. Fifty patients were treated by reteplase+abciximab and 70 received urokinase+abciximab.
Results: Success (disobliteration or not) and time required for thrombolyis did not differ between the two groups. Those patients who received reteplase+abciximab tended to develop more minor complications (mainly bleeding). In long-term follow-ups (2-3 years) no differences were observed in the two groups. The reocclusion rate was 44.9% in the reteplase+abciximab and 50.9% in the urokinase+abciximab group. Only 2/120 major amputations were recorded in the follow-up period.
Conclusion: PROMPT and APART data showed no major differences between reteplase and urokinase, both administered together with a GP IIb/IIIa receptor antagonist and in a pulsed-spray fashion. The proposed regimen was safe. The low amputation rate in both groups may be attributed to abciximab.

19.4.2.

Comparison of rotational thrombectomy and local thrombolysis in acute and subacute limb ischemia

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Purpose: The aim of this study was to compare intraarterial thrombolysis and mechanical thrombectomy in the treatment of acute and subacute limb ischemia.
Materials/Methods: One-hundred thirty-seven patients, mean age 65±8.4 (range 47-75), presenting with acute or subacute occlusions of the femoral artery were treated with either a mechanical thrombectomy system (Straub Rotarex™) (n=65), or with local thrombolysis (recombinant tissue plasminogen activator, rt-PA) (n=72). Mean occlusion lengths were 21 cm (5-35) in the thrombectomy group and 22 cm (8-32) in the thrombolysis group.
Results: The technical success rate was 96.9% for thrombectomy and 95.8% for thrombolysis. After a mean follow-up of 12±3 months primary, primary assisted, and secondary patency rates were 73.0, 82.5, and 95.2% for thrombectomy and 68.8, 75.4, and 88.4% for thrombolysis, respectively. There were 12 distal embolizations in the thrombectomy group and 38 in the thrombolysis group and, respectively, one and two retroperitoneal hematomas. There were no amputations or deaths during follow-up. The mean hospitalization period was three days (range 2-6) for thrombectomy and five days (range 3-9) for thrombolysis.
Conclusion: Patency rates did not show any significant difference in the two groups. The advantage of mechanical thrombectomy was a significant lower complication rate and a shorter hospitalization.

19.4.3.

Long-term follow-up after local i.a. fibrinolysis of femoro-distal reconstructions with a low-dose regimen

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Purpose: To report our long-term results of local fibrinolysis with a low-dose protocol in a spray-lysis technique in patients with acute bypass occlusion.
Materials/Methods: One-hundred thirty-two acute bypass occlusions in 63 patients (1-6 therapies/bypass), 40.2% femoro-crural or femoro-pedal bypasses, injection of 5-31 mg rtPA (Actilyse©) over 4-22 hours through 5- or 4-F spray-lysis catheters.
Results: In 5/132 procedures the catheter could not be advanced into the thrombosed bypass. Cross-over procedures were performed in 39% cases. A technical success was achieved in 113/127 bypasses (89%). An additional PTA was necessary in 48/127 procedures. TASC IIA lesions have significantly better outcomes than IIB or III lesions. Nine bleeding episodes (6.8%) occurred, four major (one cerebral bleeding, three surgically treated hematomas of the groin or the abdominal wall) and five minor bleedings. All major complications were related to previous administrations of coumarin. Primary assisted patency rate was 30% at one year and 15% at two years. Amputation-free survival was 69% after one year and 58% after two years.
Conclusion: Our low-dose, spray-lysis, over-night regimen is highly successful and safe. Patients with previous administration of coumarin bear a higher procedural risk. Repeated therapies of the same bypass show less success.

19.4.4.

Preliminary comparison of AKónya Eliminator, a new non-rotational mechanical thrombectomy device, and and the Arrow-Trerotola PTD in a swine model

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Purpose: To compare a new 6-F non-rotational basket thrombectomy device (IDev Technologies, AKónya Eliminator™, AKE) with the 5-F Arrow-Trerotola PTD with regard to clot maceration and torque control.
Materials/Methods: Straight (ipsilateral iliofemoral) and curved (contralateral iliofemoral) arterial test conduits were created and filled with clot in seven pigs. To evaluate clot maceration, each device was withdrawn from the distal end of the conduit operating them with rapid back-and-forth strokes (AKE) or motor activation (PTD). After two passes (30-second each) the clot slurry was aspirated. Additional passes with aspiration were used until complete clean up. To evaluate torque control, the devices were directed from either iliofemoral artery into side-branch or viceversa.
Results: In the straight conduit, AKE required 2-3 passes (mean 2.5) while PTD 2-5 passes (mean 3) to clean the segment. In the curved conduit, the AKE needed an average of 2 passes vs. 4.3 passes for the PTD (p=0.01). To select the desired vessel, the AKE required 1-5 attempts (mean 2.5) vs. 3-12 attempts (mean 7.3) for the PTD (p=0.007).
Conclusion: AKE was similar to the PTD with regard to clot maceration in a straight conduit, but superior in torque control and clot removal in a curved conduit.

19.4.5.

Massive pulmonary embolism: transcatheter lysis with Reteplase

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Purpose: Massive pulmonary embolism (PE) is a serious problem, very difficult to manage. Conventional treatment (systemic anticoagulation and thrombolysis) is associated with significant hemorrhagic and other complications. Our new method of therapy is the selective, local transcatheter infusion of Retavase (Reteplase, recombinant) into the pulmonary arteries.
Materials/Methods: Twelve patients (24-70 years old) with massive bilateral hemodynamically unstable PE, with severe respiratory compromise, were treated with catheter-directed thrombolysis with Reteplase infusion at 0.5-1 U/hr. Two catheters were simultaneously inserted into the common femoral veins and placed in each one of the two pulmonary arteries. The infusion lasted 20 to 48 hours.
Results: All patients recovered well, with significant drops in pulmonary artery pressures ranging from 13-34 mm Hg. Improvements in pulmonary perfusion with resolution of clot occurred at 24 hours (n = 6) and 48 hours (n = 5) of infusion. No significant complications occurred despite the severity of the clinical condition of most patients. Concomitant heparin was given to some patients.
Conclusion: Bilateral selective infusion of Retavase is safe, effective and well tolerated for the management of patients with massive PE, especially those who are not candidates for conventional means of therapy.

19.4.6.

Mechanical thrombectomy of acute iliofemoral deep venous thrombosis using an Arrow-Trerotola percutaneous thrombolytic device with low-dose urokinase

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Purpose: To evaluate feasibility and effectiveness of mechanical thrombectomy with the Arrow-Trerotola percutaneous thrombolytic device (ATPTD) in the treatment of the acute iliofemoral deep venous thrombosis (DVT).
Materials/Methods: Mechanical thrombectomy with the ATPTD was performed in 15 patients with acute iliofemoral DVT. Combination therapies with catheter-directed urokinase thrombolysis (n=12), IVC filter insertion (n=3), sheath aspiration thrombectomy (n=15), and angioplasty and stent placement (n=12) were performed.
Results: All the patients achieved a technical and clinical success. In 13 of them without contraindication to the use of urokinase, its total dosage did not exceed 1,000,000 IU (range, 300,000-1,000,000; mean, 840,000). The mean duration of urokinase infusion was 16 hours (range, 12-20). In two patients with contraindication to the use of urokinase, a mechanical thrombectomy with ATPTD was successful without its use. There were no major complications. One patient developed heparin-induced thrombocytopenia, but no clinical problems were recorded after the cessation of heparinization. One-year patency rate was 73.3%.
Conclusion: The ATPTD is an effective mechanical thrombectomy device for the treatment of acute iliofemoral DVT with the advantages of requiring low-dose urokinase or not requiring urokinase.

19.4.7.

Mid-term clinical experience of the Angiojet rheolytic thrombectomy device

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Purpose: To determine outcomes following recanalisation of thrombotic occlusion using a rheolytic thrombectomy device.
Materials/Methods: Fifteen patients (11 men, age 37-84, average 65.5 years) presenting with acute thromboembolic occlusion, were managed with use of the Angiojet thrombectomy device (AJ). Outcomes were determined retrospectively from case records.
Results: Sixteen vessels were treated using AJ: vascular grafts (4); dialysis fistula (1); portal vein (1); portocaval shunt (1); femoropopliteal (5), tibial (2), common iliac (1) and subclavian (1) arteries. Adjunct tPA was used in six (40%) cases. Technical and clinical success was achieved in 12 (80%) cases. Mean follow-up was 10.7 (range 1-25) months. There were five deaths (three men) at mean 32.4 days post-procedure (three deaths were within 30 days). Age range of the ten survivors (eight men) was 37-83, mean 66.2 years). Of 12 patients presenting with limb ischaemia, there was 30-day amputation-free survival in eight (67%).
Conclusion: In this disparate group of cases, the AJ device appears to produce clinically useful recanalisation in up to 80% of patients. Adjunctive lysis may be unnecessary in the majority of cases. A randomised study is required for level-1 evidence and has been instituted by the authors.

19.4.8.

Predicting the success of balloon angioplasty of clotted hemodialysis grafts –more information is needed.

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Purpose: To determine factors affecting outcomes following balloon angioplasty of clotted hemodialysis grafts. Characteristics which predict patency after balloon angioplasty for venous anastomotic stenosis leading to graft thrombosis are not well characterized. We reviewed our experience with this technique to identify predictors of long term patency.
Materials/Methods: Balloon declotting and angioplasty was attempted in 331 upper extremity hemodialysis grafts. Final pressure gradients (FPG) across the venous anastomosis, ratios of FPG to systolic blood pressure (SBP), primary success rates, operator, time to next intervention, and other factors were assessed.
Results: Balloon declotting and angioplasty was successful in 300/331 (91%). Success rates varied between operators (84%-100%) but were unrelated to FPG (mean 7.2, range by operator from mean 4.6-8.5) or ratio of FPG to SBP (mean 0.046, range by operator from mean 0.029-0.056). Of grafts requiring subsequent revision for which data is available there was no correlation between time to revision and FPG or FPG/SBP ratio (correlation coefficients 0.03 and 0.09). There was no relation to operator volume or primary success rate.
Conclusion: Patency rates after balloon declotting with venous anastomosis angioplasty vary for reasons which are unclear. More work is required to identify predictors of a good outcome.

19.4.9.

Combination of percutaneous techniques in thrombosed haemodialysis accesses

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Purpose: We present our experience with percutaneous haemodialysis occluded shunt repermeabilization with a combination of PTA, antegrade Arrow-Tretola device, and retrograde balloon inflation from a femoral vein access.
Materials/Methods: In the past 16 months we treated 35 thrombosed brachioaxillary grafts in 30 patients (13 women and 17 men, mean age: 54 years, range: 32-80). Mean thrombosed time was 27 hours (range 12 hours to ten days). We punctured the access as proximally as possible. The first step was a vein-graft anastomosis PTA; from the same access, we slowly pulled the Arrow-Tretola device macerating and stripping the clot from the vessel wall. Finally, we advanced the balloon the from femoral vein into the radial artery. We pulled back a low-pressure inflated balloon to clean the arterial plug. Unfractionated heparin was given to all and 200.000 units of urokinase were added in six cases.
Results: A technical success was achieved in all patients. The presence of a thrill at the graft was noted in 31 cases and all patients went to haemodialysis after the procedure. No symptomatic pulmonary thromboembolism or other major complications occurred. Ninety-day primary patency was 72%; assisted patency 87%.
Conclusion: This combination of mechanical percutaneous interventions improves clinical results.

19.5.1.

Percutaneous vertebroplasty for osteosclerotic metastases

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Purpose: To determine the efficacy of percutaneous vertebroplasty in the treatment of blastic spinal metastases.
Materials/Methods: Fifty-two patients (46 women, six men), aged 27-84 years, presenting with painful blastic vertebral metastases underwent 59 vertebroplasties (103 vertebras treated).
Results: Analgesic efficacy was found in 94% of patients at six months; most of them remain improved at long-term follow-up. Complication rates were higher that those reported for lytic metastases (local complications: 8.5 / 3.5, pulmonary embolism: 3.5 / 1.5).
Conclusion: Antalgic effect was similar in blastic metastases as in osteolytic ones, despite an increase of local complications in relation to technical difficulties. Nevertheless this procedure can be recommended in case of painful fracture blastic metastases which are refractory to pain treatment.

19.5.2.

Percutaneous cementoplasty of sacrum: a retrospective study of 23 patients to evaluate technical feasibility, complication rate, and antalgic results

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Purpose: To present the technical aspects of sacrum cementoplasty as a variant of vertebroplasty technique and to report short-term results.
Materials/Methods: A retrospective study of 23 patients from January 2001 to December 2003, reporting indications and technical aspects (quality of volume filling, cement leakage). Clinical response was measured at one day and one month after the procedure by a visual analog pain scale.
Results: Cementoplasty of the sacrum was indicated for metastasis (17/23), osteopenia (2/23), hemangioma (1/23), or myeloma (2/23). A good quality of filling was achieved in 17 patients. In six cases a second procedure was necessary to complete filling of the lesion: two cases because of incomplete treatment during the first attempt and four because of progression of the lesion itself. We had 12 cases of minimal leakage with no clinical complications, and five cases of moderate leakage with radicular pain. No motor deficit occured following these 29 procedures. At one-month follow-up we observed good pain relief in 17 patients.
Conclusion: In this small series we observed good feasibility of sacral cementoplasty. Technical results and clinical evaluation are good even if there is more cement leakage than vertebroplasty, but with few clinical implications.

19.5.3.

Percutaneous vertebroplasty under computed tomography fluoroscopic guidance of vertebrae with involvement of the spinal canal

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Purpose: To evaluate the safety and effectiveness of percutaneous vertebroplasty under computed tomography fluoroscopic guidance (PVP-CTF) of vertebrae with involvement of the spinal canal.
Materials/Methods: From August 1997 to December 2003, 104 vertebrae (71 patients) were treated by PVP-CTF. The affected vertebrae were divided into four groups: A, no canal involvement; B, canal involvement without stenosis; C, canal involvement with <20% stenosis; D, canal involvement with >20% stenosis. The frequency of cement leakage, the rate of neurological complications, and the effectiveness of pain control were evaluated in each group.
Results: Cement leakage and neurological complications rates were: 2/47 (4.3%) and 0/47 (0%), 0/17 (0%) and 1/17 (5.5%), 1/20 (5%) and 1/20 (5%), and 2/19 (10.5%) and 1/19 (5.3%) in groups A, B, C, and D, respectively. Complete response rates of pain relief were 59, 78, 50, and 71% in groups A, B, C, and D, respectively. These differences are not statistically significant.
Conclusion: PVP-CTF may be useful in the treatment of those patients with painful vertebral fractures associated with involvement of the spinal canal.

19.5.4.

Prospective post-vertebroplasty pain and mobility evaluation: a two-year follow-up study

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Purpose: An independent Pain Center evaluated blindly and prospectively percutaneous vertebroplasties (PV) performed in a consecutive group of 47 patients/155 levels.
Materials/Methods: During two years, 47 patients were referred for PV, with spine pain and vertebral lesion at MR. Lesions were metastatic in 13 cases (45 levels), osteoporotic in 25 (80 levels), hemangiomas in four (6 levels), multiple myelomas and bone lymphomas in five (24 levels). In the angiography suite, a fluoroscopy-guided transpedicular approach was obtained, using 2-3 mm OD needles, followed by PMMA injection and post-treatment CT-assessment. All patients were blindly followed up by completing, during the interview, a questionnaire already validated in prior studies for local population. This related to pain, mobility, and drug use, prior and every two months post-treatment.
Results: An independent Pain Centre blindly interviewed all patients. An average pain relief of 6.57/10 units was observed (mean follow-up: 12 months), with more than 8/10 units in 24/47 patients. One patient did not show a significant pain relief (only 1/10 unit). All patients achieved pain medication reduction and mobility improvement. A total analgesics withdrawal was possible in 35/47 patients (74.4%).
Conclusion: A prospective blinded follow-up from an independent Pain Centre objectivated PV as an effective technique.

19.5.5.

Bone metastases: preliminary results of pain relief by percutaneous radiofrequency thermal ablation

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Purpose: To evaluate the efficacy of percutaneous radiofrequency thermal ablation (RFTA) on pain control of bone metastases.
Materials/Methods: Six patients (three men; mean age. 56.6, range 43-68) with a total number of seven painful skeletal metastases were enrolled to be treated with CT-guided percutaneous RFTA by multi-tip needle. Six lesions presented osteolytic CT pattern and one was osteoblastic associated with a pathological fracture. All patients were refractory or poor candidate to radiation therapy. Pain level was estimated with "brief pain inventory-short form" the day after, two weeks, one month and every two weeks (range: 2-24 weeks) after the procedure. CT was performed two weeks after RFTA.
Results: Five patients experienced quite immediate (within 24 hours) pain relief, with significant analgesic need reduction; one patient had no benefit at all by RFTA and eventually underwent cordotomy. Before treatments, the mean worst pain score was 7.0 (range 5-9), two weeks after treatment it was 2.5. No procedure-related complications were observed.
Conclusion: RFTA of bone metastases seems to be safe and effective on pain relief. Main indication at the moment concerns patients refractory or poor candidate to radiation therapy.

19.5.6.

Pre-treatment contrast injection predicts epidural cement leakage in vertebroplasty

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Purpose: To evaluate the utility of pre-treatment contrast injection (PTCI) for prediction of subsequent epidural cement leakage during vertebroplasty.
Materials/Methods: Pre-treatment contrast injections (PTCIs) were routinely performed prior to cement injection at 683 levels in 334 patients. A retrospective review of the last 100 consecutive patients was performed comparing leakage patterns during PTCI versus cement injection. Attention was limited to epidural accumulation, since cement deposition at this location may lead to devastating spinal cord damage.
Results: Epidural contrast stains on PTCI were observed at four levels, all followed by cement leakage in the same area. No other epidural contrast or cement leakages occurred. With early recognition of epidural cement accumulation, bulk leakage was avoided in all four cases and complications were limited to a single case of radiculopathy that spontaneously resolved in less than three weeks.
Conclusion: Epidural cement accumulation is a rare but potentially devastating complication of vertebroplasty. PTCI has high positive predictive value and negative predictive value for epidural cement leakage during vertebroplasty. In the absence of adverse consequences for false positives during PTCI, the low pre-test probability for epidural cement leak is of little importance.

19.5.7.

CT-guided percutaneous steroid injection for the treatment of inflammatory arthropathy of the temporomandibular joint in children

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Purpose: To review technique and preliminary outcomes related to percutaneous CT-guided temporomanibular joint (TMJ) injection in children with inflammatory arthropathy.
Materials/Methods: Over 12 months, 15 children with juvenile chronic arthritis of the TMJ were treated for bilateral (n=9) or unilateral (n=6) involvement. MRI demonstrated erosions or effusions of the affected joints in 13 children prior to the procedure. The procedures were performed with sedation (n=14) or general anesthesia (n=1).
Results: All TMJ injections were technically successful. Follow-up MRI in six children demonstrated resolution of joint effusions (n=3), decrease in joint effusion (n=1), decrease in joint erosion (n=1), or no change (n=1).
Clinically the tooth-to-tooth gap assessment was improved (n=8), unchanged (n=3), worsened (n=1) or not assessed (n=3).
Conclusion: CT-guided TMJ injection in children is a safe and accurate method of intraarticular steroid administration and resulted in improvement in imaging findings and joint mobility in a significant proportion of children treated.

19.5.8.

Balloon-dilatation in the nasal cavity and paranasal sinuses

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Purpose: Patients treated with surgery of paranasal sinuses or the nasal cavity suffer from recurrent stenoses when the lumen is limited by important bony structures, like as in the frontal sinus ostium, the choana, or the lateral maxillary region. In these cases, repeated balloon-dilatations were considered an alternative to surgical reinterventions.
Materials/Methods: Fourteen patients (nine men), aged 15-70 years, were treated by repeated balloon-dilatations in the frontal sinus ostium (11), the nasal choana (1), and the maxillary sinus (2). Dilatations were repeated at intervals of four weeks to three months. One to eight dilatations were necessary to achieve a stable wide lumen. Follow-ups were done by clinical and endoscopic evaluation.
Results: All the patients where treated successfully. There were no complications nor recurrences within a follow-up of one to eight years.
Conclusion: Repeated balloon-dilatations of recurrent post-operative stenoses in paranasal sinuses and the nasal cavity is a less invasive, complication-free, and successful alternative to surgical reintervention.

19.5.9.

Treatment of osteoid osteoma by radiofrequency thermal ablation

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Purpose: Demonstration of the effectiveness of radiofrequency thermal ablation (RFTA) in the treatment of osteoid osteoma.
Materials/Methods: From 1/2/02 to 31/7/03, eight patients with histologically confirmed osteoid osteoma, 5 male and 3 female, age range 7-33 years (mean: 22) underwent RFTA.We used 17F electrodes with a 1 cm cooled tip during 15 minutes in manual mode without impedance control. Clinical evaluation was made after 24 hours and fifteen days on the basis of need for analgesia.
Results: RFTA of the osteoid osteoma was technically feasible in all patients; and effective in 90%. One patient had a deep burn of the electrode track and another reported pain, controlled by analgesics, after the procedure.
Conclusion: RFTA should be the first choice for the treatment of osteoid osteoma replacing open surgery.

19.6.1.

Selection of patients with carotid artery disease: medication, carotid endarterectomy, or carotid artery stenting?

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Purpose: To describe an algorithm of treatment selection for carotid artery revascularization in our Department.
Materials/Methods: In 2003, all 308 patients referred by the Neurology Department for carotid revascularization were entered in an algorithm for treatment selection. According to patients' neurological symptoms, co-morbidities, limiting factors for CAS and CEA, and patient's personal preferences, a treatment modality was decided.
Results: Ninety-five (30.8%) patients presented with an asymptomatic carotid lesion of over 80% and 213 (69.2%) had symptomatic lesions over 50%. In the group of asymptomatic patients, based on the algorithm, 59 (62.1%) received CAS, 20 (21.1%) CEA, and 16 (16.8%) medical treatment. All symptomatic patients received an interventional treatment, 153 (71.8%) were treated with CAS and 60 (28.2%) with CEA. In total, 292 patients received an interventional treatment: 212 (72.6%) CAS and 80 (27.4%) CEA.
Conclusion: In the treatment of carotid artery disease, a careful patients' selection is mandatory to obtain good results. The algorithm explains the high amount of CAS procedures performed in our Department.

19.6.2.

Carotid stenting using self-expandable monorail carotid Wallstents and EPI-filter cerebral protection devices in patients with failed surgical attempts due to intraprocedural EEG alterations

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Purpose: To assess safety and efficacy of CAS in high surgical risk patients using the EPI-filter cerebral protection device.
Materials/Methods: Fourteen patients underwent CAS after a failed surgical attempt due to a significant depression of EEG background activity in one or both hemispheres few seconds after clamping. CAS was performed under continuous EEG monitoring using self-expandable monorail carotid Wallstents and the EPI-filter. Follow up was performed by Doppler ultrasonography at seven days, three and six months, and, subsequently, every six months post-procedurally.
Results: Technical success was 100%. No significant EEG alterations occurred during all phases of the procedure. No intraprocedural neurological complications occurred. Post-procedural digital subtraction angiographies revealed an optimal caliber of treated arteries and a normal intracranial blood flow. At a mean follow up of 12.8 months, all patients presented stent patency. No neurological complications were reported during the follow up.
Conclusion: The EPI-filter protection device allows continuous cerebral blood flow during CAS. Carotid stenting with this filter is a safe, efficient and feasible procedure that allows treatment of those patients considered at high surgical risk due to severe EEG alterations during clamping.

19.6.3.

In-stent recurrent stenosis after carotid angioplasty: a single Institution experience

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Purpose: In-stent recurrent stenosis (ISR) is the more frequent complication after mid- and long-term follow-up of carotid artery angioplasty and stenting (CAS). The purpose of this study was to identify those clinical factors which may contribute to the development of ISR.
Materials/Methods: Between December 2000 and November 2003, 337 patients were treated with CAS. More than half of the patients (72.4%) were symptomatic; 11 patients had bilateral lesions. Stenting was performed for *de novo* stenoses in 192 (55.1%) lesions and for postendarterectomy restenosis in 156 carotid axes (44.9%). We performed 341 elective (98%) and seven emergent procedures (2%).
Results: Overall perioperative complications included two (0.6%) minor strokes and two (0.6%) major strokes. Twelve patients, for a total of thirteen carotid axes (3.4%) (in one case, restenosis was bilateral) had ISR. The segments affected by restenosis were two proximal ends, six distal ends and five middle segments. ISR was moderate in two cases and severe in 11; seven patients were symptomatic and six asymptomatic. All ISR were treated: four with balloon dilatation and the remaining nine with secondary stenting.
Conclusion: This study supports the multifactorial origin of ISR and indicates some peculiar risk factors not previously described in the literature.

19.6.4.

Early experience with Mo.Ma.: a new cerebral protection device for carotid artery stenting

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Purpose: To discuss the principles of efficacy and utilisation of the MoMa proximal occlusion cerebral protection system in clinical practise.
Materials/Methods: The system uses a dual balloon-cuffed guide catheter to occlude flow from the common and external carotid arteries. Internal carotid artery instrumentation and stenting is then carried out without risk of antegrade flow of any embolic material. Five consecutive patients underwent carotid artery stenting (CAS) at UCLH using the MoMa proximal occlusion device for cerebral protection.
Results: All 5 cases were successful in device deployment and CAS result with no neurological complications as assessed independently at 30 days.
The principles of application, design of the device and its strengths and limitations will be discussed.
Conclusion: The MoMa proximal occlusion cerebral protection system is easy to use and effective in practise as an adjunctive device for cerebral protection during CAS. This early experience warrants further investigation.

19.6.5.

Carotid stenting under cerebral protection: our experience in 79 patients

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Purpose: To evaluate safety and efficacy of carotid artery stenting (CAS) under cerebral protection.
Materials/Methods: Between March 2002 and December 2003, 79 patients with 85 internal carotid artery stenoses (56 primary and 29 post-thrombo endarterectomy) underwent CAS under cerebral protection (80 carotid Wallstents + EPI-filter protection device, four Acculink carotid stents + Accunet device, one Conformexx stent + EPI-filter). Follow-up was performed by Doppler ultrasonography at seven days, three months, six months and, subsequently, every six months post-procedurally.
Results: Technical success was 100%. A pre-dilation was necessary in six patients. Two patients developed a TIA, immediately resolved after filter removal. One minor stroke was observed. Two autolimiting vagal reflexes occurred during balloon inflation. Embolic debris was found at the post-procedural revision of the filters in four primary stenoses. Post-procedural digital subtraction angiography confirmed an optimal caliber of the treated artery and a physiological intracranial blood flow. All stents were patent at follow-up. A mild intimal hyperplasia occurred in three patients at six (two cases) and 12 months (one case). No late neurological complications were observed.
Conclusion: CAS under cerebral protection is safe, effective and significantly reduces the risk of intra-procedural embolism.

19.6.6.

Management of large-neck internal carotid artery pseudoaneurysms by covered stents

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Purpose: To demonstrate efficacy and safety of the endovascular treatment of large-neck internal carotid artery (ICA) pseudoaneurysms, using covered stents.
Materials/Methods: Between 1999 and 2003 we treated 5 patients with large-neck pseudoaneurysms. Four were post-traumatic and 1 was spontaneous; 4 patients were symptomatic. Maximum diameter of the pseudoaneurysms was 10 to 45 mm, with a neck between 8 and 25 mm. All patients underwent 6Fr guide catheter positioning into the ICA.
5 Symbiot ePTFE covered stents and 1 JOSTENT were deployed using the monorail technique. Post-procedurally all patients underwent six weeks of therapy with clopidogrel (75 mg), and aspirin for six months.
Results: Post-procedure digital subtration angiography demonstrated, in all patients, complete exclusion of the aneurysms without complications. Computed tomography and echo-color Doppler performed at 3, 9, and 24 months confirmed exclusion of the aneurysms and patency of ICA in 4 cases.
In 1 case the controls revealed rupture of the stent, so we deployed a second stent graft.
Conclusion: Despite limited experience with covered stents in the treatment of large neck internal carotid artery pseudoaneurysms, this technique seems very promising if combined with post-procedural antiaggregant therapy.

19.6.7.

Appropriate selection of protection devices and stents for endovascular revascularization of carotid artery stenosis

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Purpose: To describe the importance of device selection for carotid artery stenting (CAS).
Materials/Methods: The different geometries and working principles of each stent and protection device available in the market provide unique functional properties. The individual characteristics of each device may represent an attractive choice in one circumstance, but render it less desirable in other situations. The selection of the appropriate carotid stent and protection device to be used in a specific case depends on the patient's anatomy, the characteristics of the materials used, the personal experience, and the operator's preferences.
Results: Based on our experience in over 800 CAS procedures with different types of cerebral protection and carotid stents, we have established objective guidelines to select the appropriate cerebral protection device and stent for a specific lesion and anatomical configuration.
Conclusion: Since a successful CAS depends on both the experience and skill of the interventionalist and on a careful device selection for different lesion types, a thorough product knowledge becomes mandatory.

19.6.8.

The impact of a protection filter (EmboShield™) on cerebral perfusion in the middle cerebral artery territory during carotid stenting: a randomised trial

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Purpose: To compare in vivo microhaemodynamic changes between protected and unprotected groups.
Materials/Methods: Thirty patients underwent primary carotid stenting. Fifteen were protected and 15 unprotected. Magnetic resonance perfusion mapping was performed 24 hrs pre- and 3 hrs, 24 hrs and one month post-procedure. A multi-time point, single-shot T2-weighted EPI technique was acquired. Gadolinium diethylenetriamine pentaacetic acid was the perfusion agent. Post-acquisition processing comprised calculation of time-to-peak (TTFM) signal change in the middle cerebral artery (MCA) territory. Comparisons of TTFM between hemispheres obtained during each scan episode and the change in TTFM pre- to post-stenting were performed using paired t-tests (data were normally distributed). Direct comparisons of inter-subject TTFM were not undertaken as the techniques used were semi-quantitative.
Results: There was a significant reduction in the degree of interhemispheric asymmetry post-stenting at each time-point. This was noted immediately and sustained at 30-days. There were no differences in perfusion characteristics between protected and unprotected groups.
Conclusion: At the microhaemodynamic level, the use of EmboShield has no adverse effects on cerebral perfusion in the MCA territory.

19.6.9

Carotid Artery Revascularization Using the Boston Scientific Filterwire and the Endotex Nexstent: Results from the CABERNET Clinical Trial

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Purpose: The CABERNET clinical trial was conducted to investigate the safety and efficacy of the NexStent™ (EndoTex Interventional Systems, Cupertino, CA), a Nitinol self-expanding stent, in conjunction with the FilterWire EX-EZ™ distal protection system (Boston Scientific, Natick, MA), for treatment of patients with extracranial carotid artery stenosis.
Material/Methods: The trial is a prospective, non-randomized, single-arm, multi-center registry for patients at high-risk for surgery with de novo carotid disease or a restenotic CEA. Patients were enrolled in centers throughout the U.S. and Europe. Primary endpoints for the study include death, stroke and MI rates at 30-days and at 1-year, and are compared to a historical control of patients undergoing CEA.
Results: The 30-day post-procedure event rates for death, stroke and MI show favorable results for carotid stenting and are comparable to rates presented from other carotid stenting registries using distal protection with respect to a similar sample population.
Conclusion: Final data compilation to be collected and adjudicated by June '04 and presented at the meeting.

19.7.1.

Quantification of inflammatory reaction towards Embosphere and Contour SE microspheres after embolization in uterine sheep

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Purpose: To compare the inflammatory reaction developed from one week to two months around Embosphere (ES) and Contour SE (CSE) microspheres (ms) after uterine embolization in sheep.
Materials/Methods: Eighteen sheep were included in a three-period study (one week, three weeks, two months; three animals for each period and product). Embolization with microcatheter of both uterine arteries was performed with .25ml of 500-700 µm microspheres. Animals were sacrificed and uterine samples frozen for immunohistochemistry with CD markers: CD2 (T lymphocytes, NK cells), CD4 (T-helper), CD8 (T-cytotoxic), CD14 and CD68 (macrophages and giant cells), CD21 (B-lymphocytes). CD marker intensity ratios (intensity around ms/intensity at a distance from ms) on each ms were assessed by Statview 5.0 (SAS) and Mann-Whitney test.
Results: Inflammation was mild to moderate for both types of ms, but generally there was more CD marker on CSE as compared with ES: more CD4 in the three periods (p=.0041, p<.0001, p=.0003); more CD14 at one and three weeks (p= 0.020, p=.0003); more CD2, CD4, and CD8 at three weeks (p=.0048, p<.0001, p=.0003); more CD68 at three weeks (p=.0061). No CD21 was found around the ms.
Conclusion: CSE induced a slightly more intense inflammatory response at short-term implantation than ES.

19.7.2.

Location of Embosphere and Contour SE embolization microspheres in sheep uterus

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Purpose: To compare location of 500-700 micrometers Embosphere (ES) and Contour SE (CSE) microspheres (ms) after uterus embolization in sheep.
Materials/Methods: Eighteen (nine animals for each product) Prealpes ewes weighing 40-60 kg were studied. Microcatheter embolizations of the uterine arteries were performed with .5 ml of 500-700 µm microspheres each. Animals were sacrificed one week after. Pathological analyses included: (i) sizes of the vessels occluded and (ii) ms location (endometrium, myometrium, perimyometrium, or proximal arteries). The 5.0-2000 version of SAS-Statview was employed.
Results: Inflammation was mild to moderate for both types of ms, but generally there was more CD marker on CSE as compared with ES: more CD4 in the three periods (p=.0041, p<.0001, p=.0003); more CD14 at one and three weeks (p= 0.020, p=.0003); more CD2, CD4, and CD8 at three weeks (p=.0048, p<.0001, p=.0003); more CD68 at three weeks (p=.0061). No CD21 was found around the ms.
Conclusion: CSE induced a slightly more intense inflammatory response at short-term implantation than ES.

19.7.3.

Targeted fibroid embolization with calibrated microspheres: mid-term clinical and MRI results

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Purpose: To evaluate safety and efficacy of uterine fibroid embolization (UFE) with calibrated microspheres.
Materials/Methods: One-hundred and forty women (median 42 years) with symptomatic uterine fibroids underwent embolization using calibrated microspheres (Embospheres in 85 and Embogold 55 women). Indications for treatment were heavy menstrual bleeding in 88%, pain in 66%, and bulk-related symptoms in 54% of patients. Clinical and MRI follow-ups were obtained at three months in 25 (18%), at six months in 44 (31%) and at 12 months in 71 (51%) patients. Mean clinical follow-up was 8.5 months (median 12, range 3-12). Relief of symptoms and volume reduction of the uterus and fibroid were assessed.
Results: There were no major complications. Minor complications are discussed. At last follow-up, MRI mean uterine volume reduction was 40.5% (median 42) and mean dominant fibroid volume reduction was 50.1% (median 66). At last clinical follow-up, improvement of presenting symptoms was reported to be: 85% (bleeding), 87% (pain) and 84% (bulk-related). Overall patients' satisfaction at last clinical follow-up was: 49% very satisfied, 40% satisfied, and 11% not satisfied.
Conclusion: UFE using calibrated microspheres is safe and effective in controlling menstrual bleeding, pain and bulk-related symptoms.

19.7.4.

Classification of leiomyomas before embolization and prediction of outcome

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Purpose: To identify the categorical morphological factors of leiomyoma and their relevance for late outcome.
Materials/Methods: Since January 2001, 60 women who had undergone uterine fibroid embolisation underwent pre- and post-procedural magnetic resonance (MRI) imaging protocol, with MRI after ten days, three, six, nine, and 12 months, to determine the natural course of embolised fibroids and to categorize the lesions morphologically, determining the extent of endometrial coverage of submucous fibroids in percentage.
Results: At present, follow-up longer than 12 months is available in 34 women. In seven, no more fibroids were seen. Measuring the percentage of endometrial coverage of the fibroids, we found that submucous fibroids with less than 50% coverage generally showed expulsion, with a significantly lower rate in more highly covered fibroids. Expulsion of an intramural fibroid was not noted; the residual size of the dominant intramural fibroid measured 29% after 12 months of the original volume.
Conclusion: MRI is highly effective to predict outcome of intramural and submucous fibroids. The percentage of endometrial coverage is a good predictive factor for spontaneous expulsions of submucous fibroids.

19.7.5.

Treatment of dyspareunia after uterine artery embolization

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Purpose: Uterine fibroid is gaining popularity in the treatment of symptomatic uterine fibroids. Most reports are limited to major symptoms, such as bleeding, pain and bulk-related symptoms. The aim of this study is to evalute the effect of uterine artery embolization in the treatment of dyspareunia.
Materials/Methods: During a three-year period, 30 patients with symptomatic uterine fibroids and dyspareunia were treated in two centers. The patients data were retrospectively reviewed in relation with dyspareunia from a prospectively acquired database. Bilateral uterine embolization was performed using PVA (355-700[mu]) or Embospheres (500-700[mu]). Patients were followed clinically and with MRI at three and 12 months.
Results: Embolization was technically successful in all patients. One patient underwent hysterectomy during the follow-up for infection. Among the remaining 29 patients, dyspareunia was cured in 17 (59%) patients and improved in ten (34%). In two patients, dyspareunia remained unchanged. The overall satisfaction rate was 94%. The relationship between the location of fibroids based on MRI images and dyspareunia will be presented.
Conclusion: Uterine artery embolization is associated with a high rate of clinical success in the treatment of dyspareunia due to uterine fibroids.

19.7.6.

The "short form 36" questionnaire and health-related quality of life following uterine artery embolisation

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Purpose: To use the previously validated short form 36 (SF36) questionnaire to assess health status in women with symptomatic fibroids before and up to 48 months following uterine artery embolisation (UAE).
Materials/Methods: The SF36 comprises 36 questions assessing eight dimensions of health encompassing physical, social and emotional status. Forty-seven women undergoing UAE completed the SF36 questionnaire pre-embolisation. Follow-up was completed by 35, 25, 18, 15 and 12 women at 3, 6, 12-24, 24-36 and 36-48 months respectively.
Results: Pre-treatment SF36 scores in all dimensions of health were lower than those established for the normal population, indicating the disease burden of fibroids. At three months post-embolisation, the mean scores for all dimensions of health were higher than pre-treatment scores; these increases were statistically significant in all but two dimensions (paired t-test; $p<0.05$). At six months, the scores were significantly higher in six out of eight dimensions. At 12-24, 24-36 and 36-48 months, scores increased from baseline scores (significantly in two dimensions of health).
Conclusion: Health as assessed by the SF36 questionnaire is significantly improved at three and six months after UAE. This improvement is maintained up to 48 months. This increase in scores provides evidence for the efficacy of UAE.

19.7.7.

Uterine artery embolization: long term results

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Purpose: To assess the safety and effectiveness of uterine artery embolization using gelatin sponge particles for women with symptomatic uterine fibroids.
Materials/Methods: From May 1999 - December 2003, 68 patients (age range, 35-55 years; mean age, 45.3 years) with symptomatic uterine fibroids underwent uterine artery embolization. Gelatin sponge particles, approximately 500-900 microm in diameter, were used in all patients. The follow-up was assessed by questionnaire and gynecologic examination. Reduction of the largest tumor and uterine volume reductions were assessed using magnetic resonance (MR) imaging. The follow-up period ranged from 2 to 54 months (mean, 32 months).
Results: Technical success was obtained in all patients. All women reported improvement in their symptoms, 92% had complete resolution of menorrhagia. Three women had a successful full-term pregnancy after embolization. MR imaging revealed that the mean largest tumor volume reduction rates were 72% after embolization, and the mean uterine volume reduction rates were 62%. No major complications were observed in any women.
Conclusion: Uterine artery embolization with gelatin sponge particles is a safe and effective treatment for symptomatic fibroids.

19.7.8.

Success factors, risks, and complications of uterine fibroid embolization

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Purpose: To analyse the risk-benefit ratio of uterine fibroid embolization (UFE).
Materials/Methods: Besides careful evaluation of our own series of patiens (>60), we performed a metaanalysis of the 50 most important publications.
Results: The most frequent complications reported in the literature are associated with the angiography procedure; serious complications are extremely infrequent. Submucous fibroids are more prone to sequestration and extrusion. Among our own patients, fibroid extrusion was found in three out of four women with submucous fibroids. The reported incidence of infection following UFE is 1-2%, becoming evident eight to 17 days after embolization. Hysterectomy due to UFE is required in 3.5-5%, chiefly because of persistent bleeding or infection. Persistent or temporary ovarian failure is found in 1-8%, chronic vaginal discharge in about 5%. The technical success rate of bilateral embolization is reported to be 95-100%. In our patient series, four minor and two major complications occurred during the follow-up period. In one patient hysterectomy had to be performed because of persistent bleeding. Another suffered from non-permanent ovarian failure.
Conclusion: The embolization of fibroids is a safe angiographic intervention. Nevertheless, the interventional radiologist must be aware of the common risks and complications and the strategies to avoid them.

19.7.9.

Effect of uterine artery embolisation on menstrual blood loss and uterine volume

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Purpose: To assess changes in menstrual blood loss (MBL) and fibroid size following uterine artery embolisation (UAE).
Materials/Methods: Fifty-one women with symptomatic fibroids underwent UAE between 1999 and 2003. They collected menstrual protection from one menses pre-embolisation and at regular intervals thereafter (3, 6-9, 12-24, 24-36 and 36-48 months). The alkaline haematin technique was used to objectively measure MBL. The uterus was imaged using magnetic resonance imaging before and six months following embolisation. Bilateral UAE was performed with polyvinyl alcohol (PVA) particles using a standard technique. The Wilcoxon signed rank test was used for statistical analysis.
Results: Mean pre-treatment MBL was 233 ml (n=51, median=160 ml and range 11-1339 ml). At 3, 6-9, 12-24, 24-36 and 36-48 months post-embolisation, the median reduction in MBL was 52% (n=34, 95% CI 33.5-65.5, p<0.001), 44% (n=34, 95% CI 22.0-62.0, p<0.001), 72% (n=25, 95% CI 53.5-87.0, p<0.004), 86% (n=17, 95% CI 68.0-93.0, p<0.001) and 84% (n=6, 95% CI 69.5-99.0, p<0.036), respectively. The median reduction in uterine volume was 50% (p<0.05).
Conclusion: UAE causes a statistically significant reduction in MBL which is maintained up to 48 months and significant uterine volume reduction at six months.

38.1.1.

Use of the MELD score to predict early death in patients undergoing elective transjugular intrahepatic portosystemic shunt

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Purpose: To evaluate the model for end-stage liver disease (MELD) score as a predictor of early death (30-day mortality) in patients undergoing elective transjugular intrahepatic portosystemic shunt (TIPS).
Materials/Methods: The medical records of 121 patients who underwent elective TIPS were reviewed. Patients with an early death (ED) were identified and compared with patients who survived (S) more than 30 days after TIPS. MELD score, pre- and post-TIPS portosystemic gradients (PSG), procedural times and complications were compared. Data were analyzed using non-paired T-test and percentages.
Results: Technical success was 100%. Thirteen patients had an ED (12%). Mean PSG before TIPS was 20.5 mm Hg (ED) and 22.7 (S) (NS). Mean PSG after TIPS was 6.5 (ED) and 6.9 (S) (NS). Mean procedural time was 95.6 minutes (ED) and 89.2 minutes (S) (NS). Pre-TIPS MELD score was 19 (ED) and 14 (S) (P=0.008). The 24-hour post-TIPS MELD was 22.6 (ED) and 17.3 (S) (P=0.001). Complications were similar in both groups; capsular perforation (n=1) (ED); capsular perforation (n=1), puncture of the gallbladder (n=1), bile duct injury (n=1) and hepatic artery injury (n=1) (S) (NS).
Conclusion: The MELD score was significantly higher in the ED group both before TIPS and at 24 hours post-TIPS.

38.1.2.

Preoperative portal vein embolization to prepare for complex liver resection

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Purpose: To evaluate safety and efficiency of tailored preoperative portal vein embolization (PPVE) to prepare for complex liver resection.
Materials/Methods: Among 108 PPVE performed during ten years, 101 were performed before right or right extended hepatectomies. The remaining 7 were tailored to complex anatomical liver resections. These resections were planned to leave in place segment 4 in 2 patients; segments 4, 5, and 8 in 2 patients; segments 2, 3, 6 and 7 in 2 patients; and segments 5 and 6 in one patient with a large accessory right hepatic vein.
Results: PPVE was performed with free flow injection of a mixture of cyanoacrylate and Lipiodol. All branches feeding the segments to be resected were embolized. Coils were used to occlude segmental branches in 1 patient, due to the risk of cyanoacrylate reflux. PPVE required a mean hospital stay of 2 days. After 28 days, non-embolized liver hypertrophied by a mean of 45% (21-88). Liver resections could be performed in 5 patients, and were cancelled in two due to extrahepatic tumor progression or insufficient hypertrophy.
Conclusion: PPVE can be safely used to induce hypertrophy of the future liver remnant before complex hepatectomy.

38.1.3.

Use of a balloon-expandable PTFE stent-grafts for transjugular intrahepatic portosystemic shunt revisions: results in 30 patients

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Purpose: To evaluate the efficacy of polytetrafuoroethylene (PTFE) covered stent-grafts for transjugular intrahepatic portosystemic shunt (TIPS) revisions.
Materials/Methods: Thirty patients underwent TIPS revision for shunt malfunction (intimal hyperplasia or hepatic vein stenosis) using balloon-expandable PTFE-covered stent-grafts (Jostents, Jomed AG). The Jostent is characterized by a high radial force and a sandwich-like construction: a thin layer of expanded-PTFE placed between two stainless-steel stents. Initial TIPS were performed in 19 patients with Wallstents and in 11 with Viatorr stent-grafts. Shunt revisions had been already performed, unsuccessfully, in nine cases.
Results: TIPS revisions were successfully performed in all cases with a marked reduction of the porto-systemic gradient (from 15.4 to 6.4 mm Hg). After a mean follow-up of 14.3 months, 21 patients (30%) are alive with a patent shunt while four patients (13.3%) are dead for multiorgan failure. Because of their worsening conditions, five patients (16.6%) underwent orthotopic livel transplantation with a patent shunt. In three (10%) cases only a subsequent revision was necessary after 20 days, two and three months for a mild stenosis at the level of the hepatic vein and the intrahepatic tract. A patency rate of 90% was recorded.
Conclusion: The Jostent represents an useful tool in TIPS revisions.

38.1.4.

Transjugular intrahepatic portosystemic shunt (TIPS) in the treatment of massive and symptomatic chronic portal thrombosis in non-cirrhotic patients

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Purpose: To present our experience in the percutaneous treatment of symptomatic massive portal thrombosis in non-cirrhotic patients. All the patients underwent a TIPS procedure to facilitate outflow and maintain portal patency.
Materials/Methods: Six patients with main portal vein thrombosis (6/6) extending to the right and left branches (3/6), the splenic vein (5/6), and the superior mesenteric vein (6/6) were included. Their etiologies were: pancreatic malignancy (3), orthotopic liver trasplant (1), idiopathic thrombocitosis (2) and idiopathic (1). One or more approaches were employed to achieve portal recanalization (transhepatic 5/6, transileocolic 1/6, transsplenic 1/6, and transjugular 1/6). In all cases the procedure was completed with a TIPS (ultrasound-guidance: 3/6, "gunshot" technique: 2/6, or fluoroscopy-guidance: 1/6).
Results: There were no complications. One patient had a repeat episode of variceal bleeding (30 months), two remain asymptomatic (16 and 24 months), two underwent a cephalic duodenopancreatectomy and are alive (four and 36 months), one died of tumoral progression (ten months).
Conclusion: Percutaneous techniques for portal recanalization are an interesting alternative even in non-acute thrombosis. Following restoration of the portal flow, a TIPS procedure may be necessary to maintain it.

38.1.5

General anesthesia and conscious sedation during creation of transjugular intrahepatic portosystemic shunts

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Purpose: To evaluate operating times (OT) of two different analgesic approaches during transjugular intrahepatic portosystemic shunt (TIPS) procedures.
Materials/Methods: From March 1992 to December 2003, 302 TIPS were performed in our Department. We retrospectively reviewed the type of anesthesia used and OTs in the 128 TIPS carried out during the last five years. OT was recorded from cannulation of the internal jugular vein to the final angiogram after TIPS creation.
Results: Local anesthesia and conscious sedation (CS) by intravenous administration of fentanyl and/or midazolam was employed in 76 patients, while general anesthesia (GA) with positioning of an endotracheal tube was employed in 52. The main characteristics of the two groups were comparable, except for the advanced stage of liver disease in GA patients. Mean OTs were similar in both groups (CS: 132$\pm$64 min; GA: 118$\pm$62 min). The overall time spent in the angiographic suite was higher in the GA group because of the necessary anesthesiologist arrangement.
Conclusion: In our experience, TIPS procedure performed under GA did not extend OTs as compared with CS. Moreover, GA increases the patient's safety for the lack of voluntary movements, the complete pain relief, and an easier hemodynamic and airway management in case of complications.

38.1.6.

Transjugular intrahepatic portosystemic shunt: procedural and clinical parameters predicting shunt patency and patient survival

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Purpose: To identify clinical and procedural parameters associated with transjugular intrahepatic portosystemic shunt (TIPS) patency and patient survival.
Materials/Methods: Sixty-one patients treated with urgent TIPS for bleeding and 62 patients with elective TIPS were enrolled. All clinical and procedural parameters and MELD scores were investigated with logistic regression and life-table analysis.
Results: Fifty-one of the 123 patients died (41%) and 27/123 underwent liver transplantation (22%). In revised TIPS, the mean portocaval pressure gradient pre-TIPS was significantly higher than in non-revised TIPS (20.5 mm Hg versus 17.0 mm Hg, p=.005). Significant associations between MELD scores and three-, six-, and 12-month survival (p=.015, .029, .007) and between serum creatinine and survival beyond 12 months (p=.032) were identified. Higher portocaval pressure gradients pre-TIPS and lower gradients post-TIPS were associated with higher three- and six-month mortalities (p=.005, .007). A cut-off R = 1.79 MELD score was consistent with the high negative predictive value for mortality (95%) found in the literature.
Conclusion: MELD score was confirmed as a predictor of mortality both in urgent and non-urgent TIPS patients. Higher portocaval pressure gradients pre-TIPS and lower gradients post-TIPS were significantly associated with a higher mortality.

38.1.7.

Benign duodenal strictures: treatment by fluoroscopy-guided balloon dilation

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Purpose: To evaluate clinical efficacy and safety of fluoroscopy-guided balloon dilation of benign duodenal strictures.
Materials/Methods: Fluoroscopy-guided balloon dilation was performed in eight patients with benign duodenal strictures. Indications for treatment were obstructive symptoms such as vomiting or dysphagia caused by peptic ulcers (n=6), Crohn's disease (n=1), and postoperative adhesion (n=1). Barium studies and endoscopies were performed just before and after balloon dilation, to evaluate immediate technical success and complications. Recurrence was observed during the follow-up period.
Results: In all patients, fluoroscopy-guided balloon (15 or 20 mm in diameter, 4 or 6 cm in length) dilation was performed in one session and the procedure was technically successful. Duodenal perforation occurred immediately after balloon dilation in one patient, who underwent emergency surgery. Barium studies performed one month after balloon dilation showed an improvement of symptoms and a good passage in seven patients (88%). During the mean follow-up of 29 months (range, 2-100 months), a recurrence occurred in 2/7 patients (29%) and, finally, surgery was performed, whereas the other five patients showed good results with no recurrence (7.71%).
Conclusion: Fluoroscopy-guided balloon dilation seems to be effective and safe for patients with benign duodenal strictures.

38.1.8.

Value of preinterventional imaging before transjugular intrahepatic portosystemic shunt. Comparison of color-Doppler and magnetic resonance-imaging/magnetic resonance-portography

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Purpose: To evaluate the usefulness of preinterventional imaging before transjugular intrahepatic porto-systemic shunt (TIPS). The role of color-Doppler-ultrasonography (CDUS), MR-imaging, and MR-portography (MRI/P) were studied regarding the TIPS outcome.
Materials/Methods: Before 20 TIPS, all the patients were examined with CDUS and ten also with MRI (T1-HASTE-TRUE-FISP) and MRP (T1-weighted-3D-spoiled-GRE after i.v.contrast). Evaluated parameters included liver size, portal anatomy/patency, variceal depiction, location/size of hepatic veins and portal hilum in relation with the lateral spine margin and the upper point of the right hemidiaphragm.
Results: In all the cases, MRI in combination with CDUS provided more accurate anatomic information compared with CDUS alone. In two patients, a partial portal vein thrombosis was found with both modalities. Varices were better depicted with MRI/P. All TIPS procedures studied with both imaging techniques were successfully completed. Two out of the ten TIPS studied with CDUS alone could not be completed, due to the lack of portal vein localization. Both patients were subsequently examined with MRI/P and had a successful reintervention.
Conclusion: Visualization of anatomic structures before TIPS by means of CDUS and MRI/MRA led to a quicker and safer procedure completion.

38.1.9.

A pilot international clinical trial: selective internal radiotherapy for liver metastases combined with systemic chemotherapy

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Purpose: Work-in-progress is presented of a two-centre Phase-I study of concurrent radiosensitising chemotherapy and selective internal radiation therapy (SIRT). This was designed to test the hypothesis that the combination of oxaliplatin with 5-FU and leucovorin used in combination with SIRT may improve response and survival in patients with irresectable liver metastases from colorectal cancer.
Materials/Methods: Systemic chemotherapy is administered to patients combined with injection of SIR-spheres (which contain the β-emitter, yttrium-90) into the hepatic arterial supply. Primary endpoints are toxicity, response rate, times to treatment failure, and time to progressive disease.
Results: Three patients were treated at the first dose level (30 mg/m2 oxaliplatin), who received between 1.3 and 3.1 GBq of SIRT. Two patients experienced partial responses by RECIST criteria on initial and repeat scanning and one patient had stable disease. Three patients have been recruited to the second dose level (60 mg/m2 oxaliplatin).
Conclusion: SIR-spheres have been administered to over 1300 patients in US, Australia and Southeast Asia since 1987 and some evidence exists of high-response rates in patients with metastatic colorectal cancer. We report our early results of combined systemic chemotherapy and SIRT.

38.2.1.

Embolization of symptomatic large uterine fibroids: clinical results and MR imaging

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Purpose: To evaluate safety and efficacy of uterine fibroid embolization (UFE) in symptomatic large uterine fibroids.
Materials/Methods: Forty women (median age: 43 years; range: 30-52) with symptomatic large uterine fibroids (fibroid >10 cm and/or uterine volume >700 cc) underwent embolization. Indications for treatment were heavy menstrual bleeding in 83% of patients, pain in 52%, bulk-related symptoms in 80%. Clinical and MRI findings were obtained prior to the procedure and at six-month follow-up. Relief of symptoms and volume reduction of the uterus and the fibroids were assessed.
Results: UFE was performed using PVA particles (nine women) or calibrated microspheres (31 cases). Hysterectomy was needed in three patients. Complications will be presented. At six-month MRI follow-up, the median uterine volume reduction was 50% and the fibroid volume reduction 55%. At clinical follow-up after the same period, the improvement of presenting symptoms was reported to be: 76% (bleeding), 95% (pain), and 75% (bulk-related). Overall patient satisfaction at six months was: 40% very satisfied, 40% satisfied, and 20% unsatisfied.
Conclusion: UFE of symptomatic large uterine fibroids seems to be safe and effective.

38.2.2.

Complete versus partial devascularization of fibroids after uterine artery embolization: impact on volume reduction and clinical outcome

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Purpose: To evaluate the efficacy of uterine artery embolization (UAE) with use of tris-acryl microspheres to induce fibroid infarction. To assess fibroid volume and clinical outcome with respect to degree of infarction.
Material/Methods: Seventy patients (mean age, 43 yr; range 34-61) underwent UAE. Devascularization of fibroids was assessed by contrast-enhanced MRI 72h after UAE. Dominant fibroid volume was calculated before and 3 or 6 months after UAE. Symptom severity was measured by questionnaire.
Results: In 48 patients (68.6%) 100%, in 14 (20%) >50%, in 4 (5.7%) <50%, and in 4 (5.7%) 0% of the fibroid load was infarcted. Patients with complete versus partial infarction had significantly ($p<0.05$) higher volume reduction (44% versus 15% at 3 months and 61% versus 34% at 6 months). Clinical follow-up showed improvement of menorrhagia in 97% of women irrespective of degree of infarction achieved. Improvement of urinary pressure was less often noted by patients with partial versus complete infarction of fibroids (66% versus 90%).
Conclusion: UAE with tris-acryl gelatin microspheres leads to complete infarction of fibroids in the majority of cases. In the short term, symptomatic improvement differs for bulk-related symptoms but not for menorrhagia with respect to the degree of fibroid infarction initially achieved.

38.2.3.

Perfusion of uterine fibroids using gadolinium-enhanced magnetic resonance imaging performed 24 hours after arterial embolization

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Purpose: To prospectively evaluate fibroid perfusion in women treated with uterine fibroid embolization, and to correlate volume reductions and clinical improvement with residual fibroid perfusion.
Materials/Methods: Seventy-nine women treated with embolization had gadolinium-enhanced magnetic resonance imaging (MRI) performed after 24 hours to evaluate residual fibroid perfusion. Limited uterine artery embolization was performed using large tris-acryl microspheres. MRI was performed in case of unilateral embolization, ovarian artery supply to the fibroids, or arterial spasm. Clinical evaluation and MRI were obtained at 6 months to assess patient outcome, volume reduction, and residual fibroid perfusion.
Results: In the group of 40 women who completed the first follow-up (mean 194 days), complete devascularization of all fibroids was present in 29 (73%). All women with complete fibroid devascularization had significant clinical improvement whereas menorrhagia was significantly heavier and longer in women with viable fibroids. In this group, 4 women had no improvement and 4 had recurrence after 6-19 months with 3 requiring a second embolization. No difference in uterine and dominant fibroid volume reductions was found between patients with complete vs incomplete fibroid infarction.
Conclusion: Long-term clinical improvement after uterine artery embolization depends on fibroid infarction and not on fibroid shrinkage.

38.2.4.

Complications after uterine fibroid embolization

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Purpose: To evaluate the frequency and severity of complications of uterine fibroid embolization (UFE).
Materials/Methods: Four-hundred thirty-two women underwent UFE between November 2001 and January 2004. All patients had magnetic resonance imaging (MRI) examination before embolization, and 253 were evaluated by questionnaire and MRI three months after the procedure. Mean volume of the dominant fibroid was 203 cm^3 (14-915 cm^3). Most procedures were performed using vascular access obtained via the left axillary artery. PVA particles (350-500 and 500-710μm) were deployed as a embolic agent.
Results: UFE was technically successful in all but three cases. There was no clinical improvement in 13 patients. In three the diagnosis was incorrect (two adenomyosis, one ovarian tumor). Two patients had incomplete embolization, and eight were still symptomatic although volume reduction of dominant fibroid was greater than 30%. Three of them underwent hysterectomy but not because of infection. Eight patients, who expelled fibroids, needed hysteroscopic intervention. Minor complications in treated patients included hematoma (25), amenorrhoea (18), allergic reaction (18), temporary nerve injury (12), hospitalisation without intervention (6), and vessel dissection (1).
Conclusion: After UFE major complications (SCVIR class D) were observed in 21/253 patients (8%) and minor complications (class A, B, C) in 80/253 (31.6%).

38.2.5.

Efficacy of selective arterial embolization in the management of life-threatening post-partum hemorrhage

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Purpose: To evaluate efficacy and safety of arterial embolization in postpartum hemorrhage and determine those parameters associated with clinical outcome after embolization.
Materials/Methods: From January 1998 to January 2002, 102 women (mean age: 31.8 years) with postpartum hemorrhage underwent arterial embolization. Inclusion criteria were third-trimester delivery, primary postpartum hemorrhage, blood loss >1500 ml, hemodynamic shock or coagulopathy. Embolization was considered effective when no surgical procedure was necessary after embolization. Univariate and multivariate analyses were then performed.
Results: Embolization was effective in 73 women (72%), while the remaining 29 required a surgical procedure. Nine laparotomies, seven hysterectomies, two uterine artery ligations, 11 repairs of genital tears were performed after embolization. Using multivariate analysis, uterine atony was correlated with success in 89% of cases ($p<0.05$), whereas C-section and hemodynamic shock were correlated with failure in 48% and 39% of cases, respectively ($p<0.05$). Two deaths occurred, despite a successful embolization.
Conclusion: The success rate of arterial embolization reported in our large women population is lower than that previously reported. Uterine atony seems to be the optimal indication. Further studies are required to define the value of embolization in other clinical settings.

38.2.6.

Nonsurgical approach to female sterilization

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Purpose: To evaluate the effectiveness of transcervical female sterilization using n-2-butyl cyanoacrylate (NBC) as an occlusive agent.
Materials/Methods: Female sterilization was performed in 12 women with a mean age of 39 years. On the basis of selective salpingography, cannulation of Fallopian tubes was performed using microcatheters and microguidewires. One cubic centimeter of NBC mixed with lipiodol and tungsten powder to make it visible under fluoroscopic guidance was necessary to occlude each Fallopian tube. During the first month, women used an alternative method of contraception. One month later, hysterosalpingograms determined the absence of patency of Fallopian tubes.
Results: Occlusion of Fallopian tubes was possible in all women. No pain or discomfort was noted either during the procedure or at follow-ups. Follow-up of 36 to 74 months did not demonstrate pregnancy in women in whom the hysterosalpingogram performed one month after the procedure showed the effectiveness of the occlusion.
Conclusion: Long-term follow-up of Fallopian tube occlusion using NBC as an occlusive agent is effective.

38.2.7.

Change in health-related quality of life associated with uterine fibroid embolization as measured by the UFS-QOL questionnaire

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Purpose: To determine the change in health-related quality of life associated with UFE as measured by a validated quality of life questionnaire.
Material/Methods: The uterine fibroid symptom and quality of life questionnaire (UFS-QOL), a validated new disease-specific symptom and health-related quality of life questionnaire for leiomyomata (Obstet Gynecol. 2002;99(2):290-300) was administered to 24 women undergoing uterine fibroid embolization (UFE). The questionnaire consists of eight symptom questions and 29 health-related quality of life (HRQL) questions with six subscales. A follow-up UFS-QOL was completed 4 to 11 months (median: 5) post procedure. Sum scores for symptom severity and HRQL subscales and final transformed scores were calculated.
Results: Severity of leiomyoma-related symptoms decreased after UFE from a 61.06 to 41.59 (arbitrary units of the transformed score) without reaching significance at a mean follow-up of 5 months. Health-related quality of life scores improved in all subscales at follow-up. Mean change scores were statistically significant for 4 of 6 HRQL subscales and total HRQL score ($p < 0.05$).
Conclusion: Patients undergoing UFE report significant improvements in health-related quality of life within a short term after the procedure. The UFS-QOL is a simple and useful tool to assess quality of life improvement after UFE.

38.2.8.

Uterine artery embolization versus hysterectomy: comparison of peri-procedural complications, post-procedural pain and days of hospitalization

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Purpose: To compare hysterectomy and uterine artery embolization (UAE) with regard to peri-procedural complications, post-procedural pain, and days of hospitalization.
Materials/Methods: Between February 2002 and February 2003, 100 patients were randomized: 54 UAEs were performed with PVA; 46 total or subtotal hysterectomies were performed either vaginally, abdominally, or laparoscopically.
Results: A bilateral UAE was achieved in 45 patients (82%), while six women (11%) received a unilateral procedure. In three (5%) patients the procedure failed for the absence of uterine arteries on both sides. Hysterectomies were: 39 abdominal, five vaginal, and two laparoscopic. In both groups, only minor complications were recorded. Average days of hospitalization for embolization was 1.9 days (SD 1.0) and for hysterectomy 6.1 days (SD 1.7) ($p< 0.001$). Post-interventional pain scores during admission were higher in hysterectomy patients, but these values were significant only 24 hours after the procedure.
Conclusion: Failure to embolize both uterine arteries was higher than what reported in the literature in this first evaluation. Peri-procedural complication rates after embolization and hysterectomy were low in both groups. The patients in the embolization group had a shorter duration of hospital-stay. Post-interventional pain scores were better 24 hours after embolization.

38.2.9.

Efficacy of uterine artery balloon-occlusion and embolization in pregnancies complicated by placenta percreta and placenta previa

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Purpose: To evaluate the efficacy of uterine artery balloon-occlusion and embolization in placenta percreta/previa.
Materials/Methods: Medical records of ten patients (seven placenta increta/percreta, three placenta previa) from 2001 to 2004 were retrospectively reviewed. Mean patient age was 33 years (23-39). Nine were multiparous. Seven patients had previous Caesarian sections, and two had previous dilation and currettage.
Results: Prior to delivery in eight patients, occlusion-balloon catheters were placed in both uterine arteries via femoral sheaths: four patients had invasive placenta (increta/percreta) and significant antepartum hemorrhage, one had percreta without bleeding, and three had previa with bleeding. In the three patients whose occlusion-balloons were inflated during delivery, there was a significant intra-operative blood loss reduction. Two patients with percreta had planned Caesarian hysterectomies. Of the five patients with invasive placenta who had undergone embolization with retention of placenta, three (60%) had a normal uterus on ultrasound/magnetic resonance at 3-12 months; the other two experienced hemorrhage at two months requiring emergent hysterectomy despite repeat embolization.
Conclusion: This interventional radiology approach to abnormal placentation shows promising in controlling bleeding at Caesarian hysterectomy, and also in uterine preservation but delayed hemorrhage requiring hysterectomy is a possible complication. Further study is required to define optimal management.

38.3.1.

Stress hormone release and haemodynamic changes during carotid artery stenting. Comparison with carotid endarterectomy

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Purpose: Haemodynamic instability is a feature of carotid endarterectomy (CEA) and is correlated with neurological and cardiac complications. Carotid artery stenting (CAS) has been shown to induce bradycardia and hypotension, the consequences of which are still unknown. Our aim was to investigate the pattern of catecholamine response in patients undergoing CAS and CEA and to correlate this with haemodynamic changes.
Materials/Methods: Adrenaline and noradrenaline levels were measured at 5-time points in 13 patients undergoing CEA and 13 patients undergoing CAS. Intra-operative blood pressure and heart rate were recorded.
Results: Adrenaline and noradrenaline levels (expressed as ratio from baseline) increased significantly following carotid artery clamping in patients undergoing CEA (noradrenaline: pre-clamp 1.54$\pm$0.36; 24 hours post-unclamp 8.38$\pm$5.5. p<0.001; adrenaline: pre-clamp 1.12$\pm$0.14; 60 minutes post-unclamp 17.59$\pm$5.3, p<0.001). In patients undergoing CAS, catecholamine levels remained unchanged (noradrenaline: pre-clamp 0.96$\pm$0.06; 24 hours post-unclamp 0.92+0.12 p=NS; adrenaline: pre-clamp 0.83+0.09; 60 minutes post-unclamp 0.56+0.12, p=NS).
Conclusion: CAS is associated with a significantly less marked catecholamine response than CEA. This finding suggests that CAS may be a safer procedure in patients in whom exaggerated catecholamine responses may be deleterious and in those with associated coronary artery disease.

38.3.2.

Elective primary stenting of intracranial stenoses: early and mid-term results

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Purpose: To assess technical feasibility, safety and clinical outcome of primary stenting for the treatment of intracranial arterial stenoses.
Materials/Methods: From April 2000 to December 2003, 21 patients (median age 61 years) with symptomatic intracranial arterial stenosis refractory to the medical therapy underwent primary stenting. Nine (43%) stenoses were located in the anterior circulation (MCA two, ICA seven) and 12 (57%) involved the posterior circulation (BA eight, VA four) including six (50%) highly calcified lesions. Pre-dilatation was necessary in two (10%).
Results: Stent placement (19 neuro-vascular INX stents and two peripheral Herculinks) was successful in 19 (91%) patients. A coronary covered stent was successfully deployed to manage a basilar rupture in the remaining two patients. The average stenosis reduced from 86 (70-99) to 15% (0-35) after stenting. Transient and permanent procedural neurological morbidity rates were respectively 10 and 5%. One patient died from subarachnoid hemorrhage six days after basilar stent-grafting. During the follow-up (median: 15 months), no recurrent neurologic event occurred. Control angiograms performed in 12 patients revealed no significant restenosis.
Conclusion: Technical and clinical results of primary stenting for intracranial stenoses are promising. The impact of this technique on long-term stroke prevention is still unknown and requires further studies.

38.3.3.

Primary carotid stenting: a new approach

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Purpose: To evaluate the safety and effectiveness of carotid stenting without pre- or post-dilation in patients with carotid stenosis.
Materials/Methods: Between May 2002 and August 2003 a prospective non-randomized study was performed in 50 carotid arteries in 46 consecutive patients. These patients had greater than 75% stenosis and were treated with Acculink stents. Stents were placed without pre- or post- balloon dilatation. Following the initial stent procedure, clinical observation, Doppler ultrasound and radiography was conducted at 24 hours, 1 month, and thereafter every 3 months for up to 19 months.
Results: Technical success, defined by a post-stenting lumen narrowed by <50%, was achieved in all patients. The stents continued to expand after placement. No immediate mortality occurred. Three incident TIAs (1 dysarthria, 1 aphasia, 1 hemiparesia) resolved completely. During follow-up, Doppler ultrasound showed patent luminal flow and <40% residual stenosis in all patients; however, one patient developed neointimal hyperplasia within the stent 3 months post-procedure that was successfully treated with balloon dilatation.
Conclusion: Carotid stenting without pre- or post- dilatation appears to be feasible and effective. It could minimize the risks of neurologic events generated by pre-deployment dilation.

38.3.4.

Proximal occlusion cerebral protection devices in carotid artery stenting

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Purpose: To present our experience with two types of commercially-available proximal occlusive cerebral protection devices (PAES and MoMa) for carotid artery stenting (CAS).
Materials/Methods: Proximal or reversed flow in the internal carotid artery during instrumentation has been proposed to reduce the risk of antegrade embolism. Two devices are commercially available for use in CAS procedures. A consecutive series of patients undergoing CAS with cerebral protection was carried out utilizing the Parodi Anti-Embolism System (PAES). 10 procedures were performed with the PAES device. A further 5 patients were treated consecutively with the MoMa proximal flow blockage device.
Results: Nine out of 10 PAES devices and 5/5 MoMa devices were deployed successfully. In all cases of successful deployment, CAS was carried out with no neurological complications as assessed independently at 30 days. The principles of the methods will be compared and the technical aspects of device deployment will be discussed.
Conclusion: Proximal occlusion for cerebral protection in CAS is both attractive in principle and feasible and safe in practise. Further experience is required to ascertain ideal choice of device and to make formal comparison with filtration methods.

38.3.5.

Computed tomography-perfusion of the brain in the assessment of patients undergoing carotid stenting

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Purpose: Brain perfusion-CT to assess patients undergoing carotid artery stenting (CAS).
Materials/Methods: CAS with filter neuroprotection was performed in 50 symptomatic patients (ICA stenosis >70%): 38 with unilateral ICA stenosis and 12 with coexisting ICA occlusion. CTs were performed using a multidetector CT-scanner: non-contrast brain scans, dynamic perfusion imaging and CT-angiography. Maps showing absolute values of cerebral blood flow (CBF), cerebral blood volume (CBV) and mean transit time (MTT) were generated from tissue-enhancement curves.
Results: CAS was successful in all. Among the 38 patients with unilateral stenosis, perfusion deficits were present in 33 (87%). MTT elongation was noted (6.2-6.8s), together with a decreased CBF (40-46ml/100g/min) and a slightly increased CBV (3.2-3.4ml/100g). In all 33 patients, perfusion improvements were observed after CAS. Immediately after the intervention, normalization was recorded in 27 patients (70%) while, after six months, in 36 (94%). In the group with a coexisting occlusion, perfusion deficits were present in all the 12 patients (MTT 8.1-9.8s; CBF 28-30ml/100g/min; CBV 3.6-3.9ml/100g). After CAS, perfusion normalization was found in six (50%); after six months, in three more patients (75%).
Conclusion: Perfusion-CT can assess brain perfusion before and after CAS. It helps to qualify patients for CAS and shows its effectiveness.

38.3.6.

Carotid recanalization in non-acute internal carotid artery occlusion. A therapeutic option for hemodinamic stroke

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Purpose: Carotid occlusion is sometimes a definitive process induced by the progression of atheroesclerotic plaques. This phenomenon may be irreversible, and the degree of the ischemic damage depends on the presence of a good collateral circulation.
Materials/Methods: We included 18 patients hospitalized at our Hospital for ischemic stroke in watershed areas (70%) or TIA (30%). Vascular studies showed occlusion of internal carotid arteries. Risk factors were: hypertension (50%), sigarette smoking (50%), hypercholesterolemia (30%), and diabetes (20%). In these patients, a carotid angioplasty with stent implantation was performed.
Results: The occluded carotid artery was successfully recanalized in 70% of the patients, without any morbities or mortalities. At discharge, clopidogrel plus aspirin were prescribed during the first month. The follow-up ranged from five months to four years and complications were not recorded in these patients.
Conclusion: Angioplasty and stenting is a safe procedure in patients with carotid artery occlusion and stroke or TIA with hemodynamic deficiency. In most of the patients, recanalization was possible and new ischemic events did not occur.

38.3.7.

The impact of EmboShield™ on posterior carotid artery perfusion during protected and unprotected carotid stenting

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Purpose: Microhaemodynamic changes in this functionally remote territory [posterior cerebral artery (PCA)] are compared between groups within a randomised trial.
Materials/Methods: There were 15 patients in each group. Four time-point MR perfusion mappings were performed using a single-shot T2-weighted EPI technique. Post-acquisition processing comprised calculation of time-to-peak (TTFM) signal change. Comparisons of the TTFM parameter were as previously for the middle cerebral artery (MCA) territory. Differences were correlated with integrity of the Circle of Willis, assessed on time-of-flight magnetic resonance angiography (SLINKY).
Results: There were no significant reductions in interhemispheric asymmetry in the protected group post-stenting. The pattern in the unprotected group mirrored that for the MCA territory i.e a significant, sustained reduction in interhemispheric asymmetry. Eight percent of the protected group had a fetal-type posterior communicating artery (PCom) whilst 29% of the unprotected group did. Correlation studies showed no differences in anterior cerebral artery or MCA perfusion between groups.
Conclusion: Differences in posterior cerebral artery microhemodynamics between groups are likely to be due to differences in the posterior circle. The normal adult configuration of the PComs tends towards hypoplasia but a fetal-PCom may provide a contiguous vascular bed from the intervened carotid artery to the PCA territory.

38.3.8.

A randomised trial of clopidogrel versus heparin in carotid stenting

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Purpose: To determine whether the addition of clopidogrel rather than heparin to aspirin improves the immediate outcome of carotid stenting.
Materials/Methods: Patients had carotid stenting with cerebral protection and received heparin 5000 IU at the time of procedure. All patients were taking aspirin. Patients were randomised to receive either clopidogrel at least 12 hours prior to the procedure and for a further 28 days, or heparin infusion for 24 hours post-procedure. The primary end-point was any neurological complication. Clinically assessment occurred pre-procedure, immediately post-procedure, at discharge, at 30 days, and at one year. Duplex was performed at 30 days and one year; 120 patients were to be recruited.
Results: Recruitment was stopped at 50 patients after an interim analysis. Three patients did not undergo stenting. The heparin group (24 cases) experienced three major strokes (two TIAs, one amaurosis fugax). The clopidogrel group (23 cases) had no neurological complications ($p=0.02$). There was no difference in other complications. At 30 days there were four occlusions and two significant stenoses in the heparin group versus one significant stenosis in the clopidogrel group ($p=0.05$).
Conclusion: All patients undergoing carotid stenting with cerebral protection should be taking clopidogrel and aspirin as dual anti-platelet therapy.

38.3.9

Carotid Artery Revascularization Utilizing the Boston Scientific Filterwire and Carotid WallstentResults from the BEACH Trial: 30 day outcome

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Purpose: Prospective trial to evaluate safety and efficacy of the Carotid Wallstent delivered via rapid exchange techniques with the Filterwire for treatment of carotid artery lesions in patients considered to be at high risk for surgery. The purpose of this report is to summarize the 30day results regarding all strokes and MI.
Methods: Inclusion criteria included symptomatic patients with $\geq$ 50% stenosis, or asymptomatic patients with $\geq$ 80% by ultrasound and angiography all of whom had to meet at least one definition of high risk for surgery by protocol. The trial has a one year composite endpoint of Ipsilateral stroke, neurological death and Q and non-Q MI at one year. Follow up was done with duplex and independent neurological examination.
Results: 480 patients were entered in the study, including 113 (23.5%) symptomatic and 387 (76.5%) asymptomatic patients. 86% of lesions were in the ICA only. Ipsilateral strokes occurred in 3.1%(15) patients and contralateral strokes in 1%. The all death rate was 1.5%, all stroke rate was 4.2%, and all AMI rate of 0.8%. These data compare favorably to reported data of other recent trials with 30 day data reported.
Conclusion: Data compares favorably to reported data of other recent trials.

38.4.1.

Early and long-term results after fenestration technique for acute malperfusion syndrome in case of aortic dissection

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Purpose: To report feasibility and safety of the fenestration technique in aortic dissections complicated by severe organ malperfusion.
Materials/Methods: Since 1997, 44 patients (34 men, ten women) with acute malperfusion in aortic dissection (19 type A and 25 type B) were treated by fenestration technique (mainly scissor technique) because of dynamic compression of the true lumen by the false lumen. Twenty-nine patients had isolated renal, bowel or inferior limb ischaemia, whereas 15 patients had organ failure association. In 25/44, a complementary stenting of malperfused arteries was necessary. The mean follow-up was 40 months (range, 9-80).
Results: Fenestration was technically successful in 100%. In two cases, fenestration was performed for bowel ischemia before type A dissection repair. There were no complications of aortic rupture and mean procedural time was 45 minutes. Complementary surgery was performed in three patients for severe bowel ischaemia. Eight patients (18%) died during the acute phase from multivisceral failure (2), cardiac failure (4) and bowel ischemia (2); one died at a later period. Symptoms resolved rapidly in 93% of remaining patients.
Conclusion: Fenestration is a technically feasible and effective method for the treatment of acute peripheral malperfusion in aortic dissection.

38.4.2.

BEST-BTK trial: first experience in humans with the Biotronik absorbable metal stent below the knee

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Purpose: To evaluate safety and performance of a new metal absorbable stent for the treatment of infrapopliteal occlusive disease.
Materials/Methods: From December 2003 to January 2004, 20 patients with chronic critical limb ischemia (CLI) for infrapopliteal occlusive disease were prospectively identified and included in a phase-I clinical trial. Patients were followed for adverse events with comprehensive laboratory analyses and clinical exams. Stent performance surveillance was investigated by computational fluid dynamics (CFD) and MR-angiography (MRA). Limb salvage was defined as the primary endpoint.
Results: All stents were successfully deployed, as confirmed by intraoperative angiography and intravascular ultrasound (IVUS). The alloy showed to be MRA-compatible, allowing MRA for vessel control. After one-month, CFD and MRA confirmed patency of all treated lesions and the beginning of the stent absorption process. Lab tests revealed no systemic toxicity from the implanted metal alloy. Complete data regarding mid-term limb salvage and vessel patency will be available in mid 2004.
Conclusion: This is the first study reporting the implantation of metal bio-absorbable stents in humans for treating arterial occlusive disease. Immediate results confirmed the expected good bio- and MRA-compatibility of absorbable metal stents, while mid-term limb salvage rates and vessel patency rates are to be established yet.

38.4.3.

Limb salvage in type 2 diabetic patients: percutaneous transluminal angioplasty and Rotablator combined technique

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Purpose: To reduce the amputation rate in type 2 diabetic patients.
Materials/Methods: From October 2001 to December 2003, 68 limb salvage procedures were performed in 38 type 2 diabetic patients. All the patients were scheduled for major amputation and presented with severe cutaneous ulcerating lesions or infected gangrene. Cutaneous oxygen tension measured at the foot was <20 mm Hg in all patients. All patients had Rotablator debulking procedures in at least one artery below the knee, including 18 popliteal antegrade approach and 50 CFA approaches. All the patients were treated using percutaneous transluminal angioplasty with 1.5 to 3 mm balloons after the Rotablator debulking procedure. Vascular accesses were closed with an Angio-Seal device.
Results: Only one major amputation was performed, due to an infected periprocedural popliteal hematoma. There were no distal embolizatons and 100% technical success, with oxygen tension >35 mm Hg in 100% at two-week, one-month, six-month, and one-year measurements ($p<0.05$); cutaneous ulcerations or infection healed in 89%, while 9% had no significant clinical improvement (p=ns).
Conclusion: A Rotablator/balloon PTA combined technique seems to be safe and effective in type 2 diabetic limb salvage.

38.4.4.

Safety and efficacy of ultrasound-guided arterial punctures for antegrade femoro-popliteal angioplasty

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Purpose: To establish the increased safety effectiveness of using ultrasound to guide antegrade punctures during antegrade femoro-popliteal angioplasty.
Materials/Methods: Three-hundred and fifty angioplasty procedures were assessed prospectively for 1) fluoroscopy time from skin puncture to placement of wire in the superficial femoral artery (SFA), 2) number of attempted arterial punctures before successful SFA wire placement, 3) puncture site-related complications during the 72 hours following the procedure.
Results: Successful arterial puncture was achieved in 349 cases: with a single puncture in 336, with two punctures in 13 cases, and a failed arterial access in one. A successful SFA wire placement was achieved in 345 cases without the need to resort to fluoroscopic aid. Total fluoroscopy time (FT) in these cases was 20 seconds. Total FT in the other five cases was 6.5 minutes. No clinically detectable antegrade dissection, retroperitoneal haematoma, pseudoaneurysm or arteriovenous fistula was identified during the follow-up period. A clinically detectable post-procedure haematoma was identified in 20 patients. Conservative treatment was used in all these patients.
Conclusion: Ultrasound guidance for antegrade arterial punctures improves the safety margin for patients with regards to puncture site-related complications and significantly reduces FT for the operator.

38.4.5.

GP IIb/IIIa blockade and drug-eluting stents with below-the-knee arterial interventions. Results of the first randomized patients of the BELOW-study

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Purpose: Percutaneous transluminal angioplasty (PTA) below the knee is limited because of subacute reocclusions and uncertain long-term results. This study was designed as a feasibility trial to compare two new treatment modalities: drug-eluting stents and GP IIb/IIIa blockade.
Materials/Methods: Forty patients with ulcers (Rutherford 5) are randomly assigned to one of the treatment groups: [1] ReoPro + Sirolimus-coated stent, [2] ReoPro + bare stent, [3] ReoPro + PTA, [4] PTA without ReoPro. Angiographic controls will be at two and six months with block-wise randomization to the treatment groups.
Results: Currently (12/03), four patients were randomized in group [1]. In all cases, recanalization and stent insertion were successful.
Conclusion: At the time of CIRSE 2004, we plan to have availability of data of the group who received ReoPro and Sirolimus-coated stents. In addition to safety aspects (therapy in multi-morbid patients) patency rates and success according to limb salvage will be discussed.

38.4.6.

Development of novel microporous covered stents with differential drug coating

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Purpose: Novel stents covered with a micropored elastomeric film, whose luminal surface was immobilized with heparin and its outer one immobilized with FK506 or simvastatin, were developed. Whether the stents prevent thrombus formation and neointimal hyperplasia after stenting is evaluated.
Materials/Methods: Segmented polyurethane film was formed among the struts, by the dip-coating method, with pre-dilation of 2 mm in diameter, and subsequently micropored by laser processing (diameter 100um, distance 250um). Heparin (1 mg/cm2) for the luminal surface, and FK506 (0.14-1.4 mg/cm2) or simvastatin (230 ug/cm2) for the outer surface were photochemically immobilized on the covered film. The stents, mounted on a PTA balloon, were deployed in rabbits arteries. Covered stents without drug were used in controls.
Results: All affected arteries were patent up to 3-months post-implantation. At 1 month, intensive inflammatory cells around the stents and neointimal hyperplasia (ca. 300 um) were observed in the control group. In the FK506 group there were few inflammatory cells around the stent strut, no significant neointimal thickening (ca. 140 um), and the luminal surface was covered with confluent endothelial cells.
Conclusion: The differential drug-eluting covered stents developed here are effective in prevention of neointimal thickening with marked suppression of inflammatory response.

38.4.7.

Treatment of femoropopliteal stenotic lesions using a cryoplasty device: early results of a pilot study

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Purpose: To simultaneously dilate and chill stenotic lesions in superficial femoral (SFA) and popliteal arteries as primary treatment.
Materials/Methods: A catheter-based, software-driven, battery-operated device (PolarCath CryoPlasty system; CryoVascular Systems, Inc., Los Gatos, CA), was used for dilatation and to expose the vessel wall to a temperature of -10°C (pressure 8 atm, dwelling time 25 sec). Patients were followed for 3-18 months.
Results: In ten patients 29 of the 31 target lesions were successfully dilated with the CryoPlasty device (94% primary technical success rate) without pre-dilation or need for stenting. All patients showed significant ($p < 0.001$) improvement in ABI measurements, with a mean post-treatment ABI of 0.84 ± 0.09 versus a mean pre-treatment ABI of 0.64 ± 0.15. At one to three months the mean ABI was 0.73 ± 0.15 ($p = 0.044$), and at 6-9 months the mean ABI was 0.66 ± 0.06 ($p = 0.427$). Six to nine months after cryoplasty clinical success was 63% (seven of 11 treated limbs) and and re-intervention or bypass-surgery was performed in five limbs.
Conclusion: The CryoPlasty system safely dilated stenotic and occluded lesions in the SFA and popliteal arteries with optimal acute results and improved ABIs, minimizing the need for stenting.

38.4.8.

Percutaneous treatment in iliac artery occlusion: long-term results

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Purpose: To evaluate long-term outcomes after recanalization of chronic iliac artery occlusion with primary stenting and to underline predictive factors of clinical success.
Materials/Methods: From January 1995 to August 2001, 128 consecutive patients (104 men, mean age 68.2yrs), with occlusive iliac artery disease (12 bilateral occlusions), underwent recanalization with primary stenting. Pre-procedure evaluation was made according to Fontaine classification, ecocolorDoppler, digital subtraction angiography (DSA) findings and ankle-brachial pressure index (ABI). The mean ABI at hospitalization was 0.52 (range: 0.23-0.72). Follow-ups included ABI measurements, vascular clinical control, ecocolorDoppler and, from September 2000, CT-multislice angiography at one, three, six months and every year thereafter. In case of significant ABI reduction (>0.15) or worsening of clinical conditions, a DSA was performed. Length of occluded vessels ranged from 2 to15 cm (mean, 10.5).
Results: Technical success was 98.5%. A clinical improvement was present in all patients in whom a technical success was achieved. Primary patencies were 91.2, 85, 80, 73.7, and 68% at one, two, three, four, and five years; secondary patencies were 97, 94, 90.7, 85.9, and 80.4%, respectively.
Conclusion: Primary stenting is safe and effective in case of chronic occlusion, with long-term results of primary and secondary patencies similar to traditional surgery.

38.4.9.

Long-term results after endovascular treatment of iliac aneurysms: experience with 47 cases

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Purpose: To evaluate short- and long-term results of endovascular treatment of iliac aneurysms.
Materials/Methods: Forty-seven iliac aneurysms (24 common, 13 hypogastric, six common and hypogastric, four external) in 38 patients were treated with covered endoprosthesis (n=15), embolization (n=14), or an association of these two techniques (n=18). Clinical follow-up and CT-angiograms were performed at 22 months (maximum eight years) in 30 patients. Size of the aneurysm and presence of endoleaks were specifically analyzed.
Results: A technical success of the endovascular treatment was obtained in 46/47 cases, with a failure of a combined approach. Three immediate complications were at the level of the puncture site and two deaths were recorded. Helical-CT angiograms showed a mean of 12% decrease in the aneurysms diameter. A complete regression was observed in false aneurysms, whereas true aneuryms were stable or with a slow diameter decrease. Long-term CT-angiograms detected one type-2 endoleak (treated by secondary embolization), three type-1 endoleaks (with an increase in the diameter size), and one iliac thrombosis.
Conclusion: Endovascular treatment of iliac aneurysm appears to be efficient if a dedicated endovascular treatment is performed to avoid rupture. CT-angiograms are essential for pre- and post-evaluation of endovascular procedures.

38.5.1.

Patients prefer catheter to magnetic resonance angiography

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Purpose: To determine whether patients prefer catheter (CA) or magnetic resonance angiography (MRA) to investigate carotid disease.
Materials/Methods: Fifty-five patients underwent both MRA and arch CA as part of the work-up of symptomatic carotid disease. Patients were randomly assigned to receive MRA or CA first. They received written instruction as to the nature of each procedure prior to investigation and were subjected to a standard health economics tool - the 'willingness-to-pay' questionnaire - after both investigations to determine their preferred choice and the magnitude of the preference.
Results: Eighteen patients preferred MRA, 23 preferred CA and four had no preference. Patients were willing to spend £ 3528 to receive CA rather than MRA, and only £ 708 to receive MRA rather than CA.
Conclusion: There is a clear weight of preference amongst patients for CA rather than MRA and this should be considered when developing imaging strategies.

38.5.2.

Diagnosis of fibromuscular dysplasia of the renal arteries: comparison of spiral computed tomography angiography, magnetic resonance angiography and conventional angiography

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Purpose: To test the accuracy of magnetic resonance angiography (MRA) and computed tomography angiography (CTA) techniques in the assessment of renal artery fibromuscular dysplasia.
Materials/Methods: As part of the Dutch multicenter RADISH-study, image data of phase-contrast MRAs (PC-MRA), contrast-enhanced MRAs (CE-MRA), and CTA examinations of 29 consecutive patients with angiographically proven renal artery fibromuscular dysplasia were analyzed. Detection rate, location and extent of fibrodysplastic lesions (n=40) were recorded, supplemented with a lesion-to-lesion analysis by comparing PC-MRA, CE-MRA and CTA images with intra-arterial subtraction angiography (ia-DSA).
Results: A total number of 26 PC-MRAs, 27 CE-MRAs, and 29 CTAs were available for evaluation. In terms of detection rate CTA (81.6%) performed better than CE-MRA (42.9%), which performed better than PC-MRA (26.5%). The detection rate of renal artery abnormalities decreased with the increase of their distance from the aortic ostium in all three imaging techniques. The extent of fibromuscular dysplastic lesions considerably influenced the detection rate in all three imaging modalities: mild manifestations were seen in only 10, 29, and 60% of cases with PC-MRA, CE-MRA and CTA respectively, whereas severe lesions were detected in 60, 91 and 100%, respectively.
Conclusion: PC-MRA, CE-MRA, and CTA cannot reliably diagnose renal artery fibromuscular dysplasia.

38.5.3.

Risks of outpatient angiography and interventional procedures: a prospective study

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Purpose: Assessing complications in outpatient diagnostic and interventional angiographic procedures.
Materials/Methods: Data were collected prospectively for 2683 procedures performed in 2248 patients from March 1997 to March 2002. Patients were assessed within four hours and again via telephone within 48 hours. The collected data were summarised into four main groups: (i) aortofemoral, (ii) cerebral, (iii) interventional, (iv) others. Complication frequency distribution was calculated for each procedure type with interim rates for the first period 1997 to 1999, and compared with a second period ending in 2002.
Results: Ninety-one percent of cases completed the follow-up; 561 complications were identified. The majority of complications were puncture site haematoma or local pain. In 1128 diagnostic aortofemoral studies, 211 complications occurred (19%). In 359 cerebral studies there were 87 complications (24%). This included one cerebrovascular accikdent (0.3%) and six transient ischemic attacks (1.7%). There were 441 interventional procedures resulting in 146 complications (33%). Major complications including five of bleeding requiring transfusion (1%); one of anaphylaxis (0.2%); and one of pulmonary oedema (0.2%). There was a statistically significant improvement in complication rate between the first and the second study periods.
Conclusion: A low incidence of complications requiring treatment or causing permanent deficit was observed.

38.5.4

Vascular closure device versus manual compression in peripheral vascular interventions: a prospective, color-Doppler ultrasound controlled comparison

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Purpose: To determine reliability of a vascular closure device (CD) as compared with manual compression (MC) after a wide range of peripheral vascular interventions (PVI), in particular in high-risk patients (antegrade access, obese, peripheral vascular disease, and various coagulation conditions).
Materials/Methods: One-hundred and twenty-two prospective, unselected patients were included in the study. Sixty-eight received an Angio-Seal, 54 MC. Patients' demographic data, diagnostic conclusions, laboratory analyses, risk factors, intervention details, and access site complications were all recorded. Color-Doppler ultrasound and clinical examination of the access site were conducted 24 hours after intervention, when the patients also completed a "comfort score" for the bedrest period.
Results: The two groups were comparable, but with more difficult accesses and more antegrade interventions in the CD group. Rates were: technical success: CD 96%; patient immobilization: CD 93% at 2 hours, MC 89% from 6 to 8 hours; manual compression: CD mean 1.3 min, MC mean 11 min; local hematoma: CD 7%, MC 17%; aneurysm (small): CD 2%, MC 2%; comfort score: CD 79%, MC 46%.
Conclusion: The CD is a reliable device even in difficult, antegrade PVI, and in high-risk patients.

38.5.5

Large digital flat panel technology in interventional radiology: *in vitro* study and first clinical experiences

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Purpose: The intent of this work was to provide an overview of digital flat panel technology in angiography and interventional radiology.
Materials/Methods: A 41x41-cm digital detector (Innova 4100, GE Medical Systems) was evaluated *in vitro* for dose monitoring and image quality. The entrance dose measurement was compared with a conventional image intensifier-based system (LCA, GE) in an ionization chamber of plexiglas. Animal studies on pigs, with 3D reconstructions, were also performed.
Results: In fluoroscopy, the digital flat panel showed a significant (up to 42% on normal-dose mode) lower entrance exposure dose (75% on low-dose mode) as compared with the LCA. In digital subtraction angiography (DSA), it showed a reduction of 42% (on normal-dose mode) and 72% (on low-dose mode). Image quality measurements were consistently superior (90% higher resolution in fluoroscopy and 41% in DSA) with significant lower contrast iodine targets and moving wires detected and a larger dynamic range or working thickness range. The results of our first clinical investigations give further evidence of superior image quality.
Conclusions: On all modes, dose monitoring and image quality of the digital flat panel system compared favorably with the conventional image intensifier system.

38.5.6.

Multi-detector row CT-angiography of the pelvis and lower extremities using matched masked bone elimination

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Purpose: Problems in maximum intensity projection (MIP) reconstructions of the pelvis and lower extremities may occur in small vessels adjacent to bones. To avoid nondiagnostic images, a time-consuming manual segmentation is necessary. Aim of our study was to establish a new method (matched masked bone elimination, MMBE) in the clinical routine. With this technique bony structures will be automatically removed.
Materials/Methods: Noncontrast and contrast-enhanced CT-scans were initially performed with identical technical parameters. After transfer of the DICOM-data to a PC-based workstation, postprocessing was started. A global threshold-value identified bones and arteries on each data set; the voxels of both CT-scans were then compared and classified. Additional motion artefacts were reduced with a special algorithm.
Results: First clinical results showed a high correlation between digital subtraction angiography (DSA) and MIP reconstructions based on the MMBE technique. Especially in the lower leg, a complete elimination of bony structures is possible without additional reconstruction artefacts by the segmentation method. The mean time spent on data transfer, segmentation and postprocessing is 12 minutes.
Conclusion: First results show that the MMEB method is suitable for the clinical use. It is a fast tool and enables high-quality MIP reconstructions without time-consuming segmentation by the radiologist.

38.5.7.

MR-fluoroscopy with intra-arterial injections of gadolinium-chelates in humans: a feasibility study

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Purpose: To demonstrate the feasibility of intra-arterial MR-fluoroscopy based on a time resolved two-dimensional projection MR angiographic (2D-projection-MRA) technique in lower extremities of patients suffering peripheral arterial occlusive disease.
Materials/Methods: Six patients underwent 2D-projection-MRA in a 1.5 T clinical MR-scanner after endovascular digital subtraction angiography (DSA) of the lower extremity. Over a 6-F femoral introducer sheath remaining in the common femoral artery after DSA, 20 ml of gadolinium were administered at a flow rate of 1 ml/s and a concentration of 50 mM. Intra-arterial administration was performed separately for each level because of the short half-life of gadolinium-based contrast agents.
Results: MR-fluoroscopy was successfully applied at a temporal resolution of 2-3 frames per second in all six patients. A good luminal contrast-enhancement was observed at thigh and calf levels. After 10-12 seconds, only a mild venous contamination was observed at both levels. Information on the visualization of the vascular bundle and its local hemodynamical flow condition could be rapidly assessed. Furthermore, road-maps could be reconstructed from the same data set.
Conclusion: Aimed at offering endovascular interventions by MR-guidance, this study demonstrates the feasibility of intra-arterial MR-fluoroscopy of the lower extremity in patients with administration of low dosages of gadolinium chelates.

38.5.8.

Stenosis detection in dysfunctioning hemodialysis access fistulas and grafts: clinical value of magnetic resonance angiography compared with digital subtraction angiography

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Purpose: Determine the clinical value of high-spatial resolution 3D contrast-enhanced magnetic resonance angiography (3D CE-MRA) in the evaluation of malfunctioning hemodialysis accesses of the complete vascular tree.
Materials/Methods: 3D CE-MRA and digital subtraction angiography (DSA) were performed in 51 dysfunctioning accesses. MRAs and DSAs were interpreted by two MR radiologists and two interventional radiologists, respectively, blinded to any information from each other and from other studies. DSA was used as the standard of reference for stenosis detection.
Results: Two-hundred eighty-two vascular segments were evaluated by both modalities. CE-MRA depicted all but two of the 70 significant ($\geq$50%) stenoses detected at DSA, plus three false positives. Sensitivity, specificity, positive and negative predictive values of CE-MRA for stenosis detection were 97% (95% CI = 90%-99%), 99% (95% CI = 96%-100%), 96% (95% CI = 88% 99%), and 99% (95% CI = 97%-100%), respectively. CE-MRA demonstrated a significant stenosis in 4/5 non-diagnostic DSA segments; DSA showed no significant stenosis in four non-diagnostic CE-MRA segments.
Conclusion: 3D CE-MRA is reliable in detecting stenoses, but has a limited clinical value for the current inability to perform MR-guided access interventions. MRA should therefore be considered only if a non-diagnostic vascular segment is present at DSA.

38.5.9.

Comparison of intraarterial magnetic resonance angiography with digital subtraction angiography in patients with peripheral vascular occlusive disease: a first step towards magnetic resonance-guided intravascular interventions in humans

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Purpose: To evaluate the diagnostic value of contrast-enhanced intraarterial magnetic resonance angiography (ia-3D-MRA) in order to assess the feasibility of future MR-guided interventions. Artifacts and number and severity of arterial lesions were compared to routinely performed intraarterial digital subtraction angiography (DSA) in patients with peripheral arterial occlusive disease of the lower limbs.
Materials/Methods: Twenty patients (48-86 years, median age 71) underwent either direct antegrade or crossover intraarterial diagnostic or therapeutic DSA. Within the same session ia-3D-gradient-echo-MRA with gadopentate-dimeglumine was performed using the intraarterial introducer sheath. In all 600 segments were evaluated by three blind readers, distinguishing mild stenoses (25-50%), severe stenoses (51-99%), and vessel occlusion. Other criteria were technical or movement artifacts.
Results: Data acquisition has been finished. Complete statistical analysis will be presented. Ia-MRA and ia-DSA were well tolerated by all patients. Preliminary analyses revealed a good correlation between ia-MRA and ia-DSA in grading severe arterial occlusive disease at the pelvic and femoral level. In the crural runoff, ia-MRA was mildly affected by venous overlay, DSA by motion artifacts.
Conclusion: Ia-3D-MRA is effective for diagnosing peripheral arterial occlusive disease in the femoropopliteal region and correlates well with DSA.

38.6.1.

Embolization procedures in newborn and infants: approach and catheterization variants

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Purpose: To discuss different variants of vessel approach for optimized conditions of superselective coil embolization in newborns and young infants with arteriovenous (AVS) and portovenous shunts (PVS).
Materials/Methods: Sixteen patients aged from six days to eight years underwent superselective coil embolization of AVS and PVS via transfemoral arterial (12), transfemoral venous (9), transjugular venous (2) or umbilical venous approach (2). For the puncture we used either Doppler assisted needles or duplex-sonography guidance. In newborns, 3F-introducer systems and a microcatheter technique without the guiding catheter were used; in infants, 4F-guiding catheters and microcatheters were employed. Fifty iE/kg heparin were applied intravenously. Six AVMs with a hemodynamic critical shunt volume, four coronary fistulas, four aortopulmonary fistulas, and two sinus venosus persistens were embolized with Guglielmi detachable coils and fibered microcoils.
Results: Embolization was primarily sufficient in all the patients. In three patients coils dislocated during intervention and were immediately retracted. Only temporary spastic vessel reactions were detected, without serious puncture-related complications. Long-term observation (11 months- 7 years) showed sufficient shunts occlusion and a normal development of children.
Conclusion: With the right approach choice, optimized puncture techniques, and small catheter diameters embolization in newborns and infants is very safe and efficient without complications.

38.6.2.

Trans-arterial chemoembolization: advantages for patients undergoing liver transplantation?

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Purpose: To evaluate the efficacy of trans-arterial chemoembolization (TACE) prior to liver transplantation (LTX) to avoid intrahepatic tumor recurrence.
Materials/Methods: Thirty-four of 303 patients with HCC were selected for orthotopic LTX. TACE was performed every 6 weeks before LTX using a suspension of mitomycin C (10mg) and 10-15ml of lipiodol. Results were compared to n=19 incidentalomas. Followup consisted of multislice CT and laboratory controls.
Results: Between 05/98 and 06/03 we performed 34 orthotopic LTX in patients with HCC (alcoholic=14; hemochromatosis=2; hepatitis B=7; hepatitis C=11). Milano criteria for LTX were fulfilled in 11/34 patients and exceeded in 22/34 patients. Bridging-time for LTX was 3-23 months (mean 11). 5.2 TACE (total 175; SD 3.3) were performed in each patient. 3/33 patients showed tumor progression before LTX; 30/33 had stable disease. 32/33 patients are alive. 5-year recurrence-free survival (3/34 patients) was 84% vs 34% in incidentalomas ($p<0.003$). Time for relapse was 4-12 months. Significant prognostic parameters ($p<0.005$) were vascular invasion and no progression undergoing TACE.
Conclusion: TACE is a safe and effective method to bridge the time to LTX with a moderate frequency of complications. It significantly increases recurrence-free survival in patients undergoing LTX because of HCC.

38.6.3.

Therapeutic embolization in hepato-splenic traumatic arterial injuries

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Purpose: To present our experience with therapeutic embolizations in the treatment of hepato-splenic traumatic arterial lesions.
Materials/Methods: From March 1999 to December 2003, 18 patients (age range: 19-63 years), were admitted to the emergency department for blunt abdominal trauma with arterial hepatic (10) or splenic (8) injuries, detected by contrast-enhanced helical computed tomography (CT)-scans (CT injury grades from 2 to 4), absent or moderate quantity of hemoperitoneum, and no other intraperitoneal injuries. All the patients were hemodinamically stable without ongoing aggressive resuscitation and underwent selective or superselective transcatheter arterial embolization using 2- to 6-mm diameter platinum or fibered coils associated, in some cases, with embolic particles or gelfoam.
Results: We angiographically detected 13 (72.2%) active bleeding sites and five (26.8%) pseudoaneurysms. A successful transarterial embolization was achieved in all the patients with one session only. A combination of embolic materials was employed in seven cases (38.8%). There were no complications following the procedure; in particular, no abscess formation. In the follow-up, no further treatments or surgery to control vessel injuries were needed.
Conclusion: Hemodynamically stable patients with blunt traumatic hepato-splenic arterial injuries can be successfully managed nonoperatively by transcatheter arterial embolization, also to prevent any possible life-threatening hemorrhage.

38.6.4.

Ethanol embolization of arteriovenous malformations of the body and extremities: ongoing assessment

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Purpose: To assess clinical results and complications of ethanol embolization of arteriovenous malformations (AVMs) in the body and extremities of 52 patients.
Materials/Methods: Under general anesthesia, 52 patients with AVMs were treated with ethanol. One patient had multiple AVMs. Periodic injections (1-24, median = 3) of 50-100% ethanol mixed with nonionic contrast by transcatheter and/or direct puncture techniques were performed. Fourteen patients underwent additional coil deployment during ethanol embolization. Therapeutic responses were evaluated by symptoms improvement and degree of devascularization.
Results: One-hundred ninety-eight ethanol embolizations were performed in 52 patients. In 36 cases (69.2%), symptoms were resolved or improved. More than 75% of AVMs were devascularized in 33 patients (63.5%). We failed to treat five patients (9.6%). Twenty-seven patients (51.9%) had complications. Thirty-three minor complications (16.7% per procedure) occurred in 23 patients (44.2% per patient). All these minor complications were healed with conservative management. Five major complications (2.5% per procedure) occurred in five patients (9.6% per patient). Four of them recovered completely.
Conclusion: Ethanol embolization was effective and has potential for cure in the management of AVMs of the body and extremities, but with substantial risk of minor and major complications and accompanied morbidity.

38.6.5.

Transcather embolization of male varicocele with Fibro-Vein mousse infusion: experience with 230 patients

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Purpose: The aim of the study was to evaluate efficacy and safety of the Fibro-Vein mousse in the treatment of male varicocele.
Materials/Methods: From January 2000 to December 2003, 230 men(mean age: 28.2 years; range 15-44) were treated by sclerotization of the pampiniform plexus venous dilatation. All patients had infertility, pain or both; the diagnosis was routinely obtained by physical examination and Doppler ultrasound. Phlebography was performed under local anesthesia with access through the basilic vein using 4-F Simmons II catheters. In all patients, embolization was perfomed with 3% Fibro-Vein mousse and air (ratio: 1:4). Follow up was routinely perfomed by Doppler ultrasound and clinical examinations.
Results: A technical success was obtained in all but 23 patients (10%); of the 65 patients (28.2%) with infertility, 30 (46%) became again fertile; of the 135 (58.6%) patients with pain, 117 (86.6%) had pain relief; of the 30 (13%) patients with pain and infertility, 24 (80%) had a pain relief and improvement of sperm count alteration, while six (20%) had pain relief but still sperm count alteration.
Conclusion: Male varicocele treatment by Fibro-Vein mousse and air is a safe and very effective technique that allows an easy pampiniform plexus sclerotization.

38.6.6.

Ethanol and polyvinyl alcohol mixture for renal angiomyolipoma embolization

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Purpose: To demonstrate results of ethanol and polyvinyl alcohol mixture embolization as the treatment for renal angiomyolipomas.
Materials/Methods: Fourteen symptomatic and six asymptomatic patients with 21 renal angiomyolipomas larger than 4 cm were treated with transcatheter embolization during a eight-year period using a mixture of ethanol and polyvinyl alcohol (PVA) particles. Follow-up angiography was performed (mean: 13 months).
Results: All angiograms showed the characteristic tortuous, hypervascular and aneurysm formation angiogenic component. Immediate complete obliteration was observed in 20 tumors. Angiography follow-up was performed in 13 patients at mean of 20 months. A reduction of the angiogenic component was seen in all tumors.
Conclusion: Ethanol and PVA mixture is an efficient embolizing material for renal AML with a long-term durability.

38.6.7.

Bronchial artery embolisation for severe hemoptysis

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Purpose: Bronchial artery embolisation (BAE) is an established procedure in the managment of massive hemoptysis. We present our experience in diagnostic angiography and embolisation techniques for this method.
Materials/Methods: Between July 1996 and December 2003, 72 patients (mean age: 59.2 years) were referred to our department for diagnostic angiography and/or embolisation of bronchial arteries. Etiologies of hemoptysis were: bronchial carcinoma (n=26), tuberculosis (n=9), chronic infiltration (n=6), recurrent tumors (n=5), metastasis (n=4), bronchiectasia (n=2), angiodysplasia (n=2) and others. In all patients, angiography was performed via the femoral route. PVA particles (150-500 microns) in combination with pushable microcoils (2-3 mm) were used as embolic agent in most cases.
Results: In 49/72 (68%) patients, a bleeding origin was found and embolisation was performed simultaneously. In ten patients recurrent bleeding occurred. There was no need for conversion to open surgery and there were no procedure-related complications.
Conclusion: BAE is a safe and effective method in managing bronchial artery bleeding and hemoptysis. Angiographic work-up is essential in detecting the bleeding origin.

38.6.8.

Peripheral embolization therapy with ethylene vinyl alcohol copolymer (Onyx)

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Purpose: Onyx is a new liquid embolic agent which showed promising results in the therapy of cerebral arteriovenous malformations. We report our initial experience in peripheral embolization therapy with Onyx.
Materials/Methods: Onyx is a radio-opaque nonadhesive casting agent containing tantalum, dissolved in dimethyl sulfoxide. Five patients underwent embolization therapy in peripheral vessels. Two patients were treated with Onyx for acute hemorrhage of visceral arteries, one patient had acute hemorrhage of a lumbar artery. The other two patients underwent embolization of portal veins and esophageal varices.
Results: Embolization was successful in all five patients. Application of Onyx was easily feasible and no complications occurred. In the three cases with acute bleeding less than one milliliter of Onyx was injected. No recurrent bleeding occurred in the follow-up. Onyx was combined with coil embolization in the two other cases because of their larger vessel size. Two to 4 ml of Onyx were applied in esophageal varices and the portal venous system.
Conclusion: Onyx is a new nonadhesive liquid embolic agent which was easy to apply and which showed excellent potential for peripheral embolization therapy.

38.6.9

Embolization of experimental wide-necked aneurysms with polyvinyl alcohol polymer (PVAP), a new, nonadhesive, iodine-containing liquid embolic agent

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Purpose: Evaluation of polyvinyl alcohol polymer (PVAP), a new liquid embolic agent synthesized by the authors for embolization of experimental wide-necked aneurysms in swine.
Materials/Methods: Ten broad-based carotid side-wall aneurysms were constructed surgically. PVAP (40%) in dimethyl sulfoxide (DMSO) was injected over a microcatheter into the aneurysm under temporary balloon occlusion. Multi-detector row CT angiography (CTA) and control angiography were performed 4 weeks later. Harvested aneurysms were investigated by high-field MRI (3.0 T).
Results: PVAP can be used without prior preparation. Seven aneurysms were completely occluded (70%), whereas in 2 cases minimal protrusion of PVAP was observed. One aneurysm was embolized almost completely (90%), and another was partially embolized (~80%). During one embolization leakage of PVAP from a DMSO-incompatible microcatheter resulted in carotid artery occlusion without clinical sequelae. Aneurysms embolized with PVAP could be well discriminated on CTA. MRI demonstrated liquid embolic distribution within the aneurysm as well as neointimal formation. Histologic evaluation revealed only mild foreign-body reaction in 2 embolized aneurysms.
Conclusion: Liquid embolization of experimental wide-necked aneuryms with PVAP is technically feasible, while handling is facilitated as compared with Onyx. The liquid embolic agent is well visible under fluoroscopy and enables artifact-free evaluation with CT and MR angiography.

38.7.1.

Is initial neck diameter predictive of outcome following endovascular repair of abdominal aortic aneurysms?

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Purpose: To determine whether presenting aneurysm neck diameter (d2) is associated with differences in EVAR outcomes.
Materials/Methods: All patients undergoing EVAR between 12/1995 and 06/2003 were included. Data were collected from a prospective endovascular database and case-note review. Patient division was d2<22mm (Gp1) and d2≥22mm (Gp2). Any first re-intervention (surgical or endovascular) constituted primary device failure. Late cumulative survival and intervention-free curves were generated using Kaplan-Meier estimations.
Results: Of the 213 endovascular AAA repairs in this period, 205 patients (M:F=183:22, median age 74.1) had an initial d2 documented (median 22 mm, range 15-31). Eighty-six Gp1 patients had a median d2=20 mm (IQR 2 mm) and the remaining Gp2 cases (n=119) had a median d2=23 mm (IQR 3 mm). Thirty-day mortalities were 5.8% (Gp1, 5/86) and 4.2% (Gp2, 5/119), p=NS. For operative survivors, four-year cumulative survival probabilities were 0.73 (Gp1, n=28) and 0.67 (Gp2, n=38), p=NS. There was no variation in the number of graft migrations (Gp1:Gp2=4:6), endoleaks (19:16) and stent occlusions (8:6) requiring re-intervention (all p=NS, chi^2). Four-year cumulative intervention-free survival probabilities were 0.72 (Group 1, n=27) and 0.79 (Group 2, n=36), p=NS.
Conclusion: Initial aneurysm neck diameter appears not to be predictive of outcome following EVR for AAA.

38.7.2.

Endovascular repair of abdominal aortic aneurysm: analysis of aneurysm volumetric changes on medium-term follow-up

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Purpose: To assess volumetric changes after endovascular abdominal aortic aneurysm (AAA) repair (EVAR).
Materials/Methods: We evaluated volume modifications after EVAR in 59 consecutive patients. Computed tomographic angiography datasets at one, six,12 and 24 months were post-processed through semiautomatic segmentation to isolate the aneurysmal sac and calculate its volume. Maximum transverse diameters (Dmax) were also obtained. The relationship between volume and diameter modifications and significance of volume changes were analyzed statistically.
Results: Mean reconstruction time for each dataset was 7 minutes. Mean volume reduction rates were 7%, 9% and 10% at six, 12, and 24 months' follow-up, respectively. Corresponding mean Dmax reduction rates were 5%, 7% and 13%; correlation between Dmax and volumes was imperfect (0.7-0.79). Endoleaks were found in 17 patients, significantly more often (p=.04) in patients with higher preprocedural Dmax. The strongest predictor of aneurysm size reduction was absence of endoleaks (p=.01), although in 5/17 (29.4%) patients with endoleaks AAA shrank, and in 10/42 (23.8%) cases without evident endoleaks the aneurysm enlarged. AAA shrinkage was also associated with stentgraft type (p=.08), being more frequent in AneuRx (27/38, 71%) compared with other stents (8/21, 38%).
Conclusion: Compared with Dmax, volumetric AAA assessment is a more reliable predictor of EVAR results.

38.7.3.

Endovascular treatment for ruptured abdominal aortic aneurysms: our experience

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Purpose: To describe safety and efficacy of primary endovascular repair of ruptured abdominal aortic aneurysms (RAAA).
Materials/Methods: In the last 12 months, 20 patients with RAAA were treated. Their mean age was 76 years (range: 65-88), mean AAA diameter was 71 mm (range: 40-100). Each hemodinamically stable patient underwent preoperative helical CT with 3D reconstructions; eight patients with hemodynamic shock underwent immediate emergency repair.
Results: Primary technical success rate was 100%; overall mortality rate was 20% (four patients): two old men died for cardiac failure, one patient for multiple organ failure, and one 84-year-old patient for rupture of an unknown ascending thoracic aneurysm. Average surgical time was 124 minutes and mean blood loss was 238 cc. Mean hospitalization time was 11 days (range 2-48, median: 5). Mean follow-up was six months (range 1-12). with one iliac branch occlusion treated with femfem bypass and two endoleaks: one from the lumbar artery spontaneously thrombosed four months after diagnosis and one type-I endoleak was treated with a proximal aortic cuff.
Conclusion: Endovascular repair of RAAA is feasible and effective; it will probably become the first treatment choice, particularly when a wide selection of endografts will be available.

38.7.4

Perclose Prostar® supports true percutaneous endovascular aneurysm repair: experience from two centers in Sweden

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Purpose: To evaluate safety and benefits of the endovascular suture technique for endovascular repair of the aorta.
Materials/Methods: From December 2002 to June 2003, 60 (Center 1) and 15 (Center 2) endovascular aneurysm repairs (EVAR) were analyzed. At the meeting an update will be presented.
Results: (Center 1): in 73% (n=44: 26 AAA, 15 thoracic aneurysms/dissections, three miscellaneuos cases) of cases, femoral artery puncture sites were closed with Perclose Prostar®. Deployment was successful in 98%. Sheaths sized >18F were used in 93%. Six complications occurred in the first 23 cases: minor complication rate (3%) included two minor hematomas. Three significant complications occurred (4%). A distal embolus indicated by a reduced ABI required no further treatment and a thrombus at the puncture site required open repair due to a damaged arterial wall. In the third case, the suture application system was not possible due to technical inexperience. No operative deaths occurred. (Center 2): in 100% of cases (15 AAA) the percutaneous technique was employed. One arterial thrombosis and two minor hematomas were reported.
Conclusion: The percutaneous technique decreases the invasiveness in EVAR and represents a safe and effective method for arterial closure.

38.7.5.

An eight-year review of abdominal aortic stent graft repair at a single centre

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Purpose: To report the immediate and long-term outcomes of eight years' experience with endovascular abdominal aortic stent graft repair (EVAR).
Materials/Methods: All abdominal aortic EVAR procedures between December 1995 and June 2003 were included. Data collection was from both the endovascular database and case-note review. Any delayed indication for re-intervention (surgical or endovascular) defined EVAR-device failure. Late cumulative and intervention-free survival curves were generated using Kaplan-Meier analysis.
Results: There were 218 patients (M:F, 195:23), median age 74 years (range 45-90 years). Of the total number of procedures, 213 (97.7%) were for abdominal aortic aneurysm repair (median size 63mm; range 41-145mm). The entire series' 30-day mortality rate was 4.6% (10/218). Median follow-up was 31.7 months (IQR 38.4 months). For operative survivors, cumulative survival probabilities at 3 and 5 years were 0.74 (n=91) and 0.60 (n=43) respectively. Sixty-five procedures for device failure were recorded in 40 patients (18.3%). Indications for re-intervention included: endoleak [non-type II (n=24), type II (n=11)]; migration (n=10); occlusion (n=14); kinking (n=2) and stent/graft infection (n=4). Entire series 3 and 5-year intervention-free cumulative survivals were 0.82 (n=78) and 0.73 (n=29) respectively.
Conclusion: EVAR is associated with acceptable early outcome and late survival.

38.7.6.

Device migration after endovascular abdominal aortic aneurysm repair: four-year experience with a Talent stent-graft

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Purpose: To establish the incidence and predictive factors for device migration (DM).
Materials/Methods: Between 1998 and 2001, 55 patients underwent abdominal aortic aneurysm (AAA) repair with a Talent stent-graft with suprarenal fixation. Two observers, blinded to each other's observations, reviewed follow-up CT-scans. DM was defined as either changes of 10 mm or more in the distance between a reference vessel and the proximal portion of the device or any clinically significant migration.
Results: Thirty-eight patients completed a minimum two-year follow-up (mean 3, range 2-5 years), six (15.8%) showed DM at two years. There were no new cases of migration in the 19 patients at three years and one new case of migration in the six patients at four years (16.6%). Mean migration at two years was 4.8 mm (SD: 4.16). Of the patients with DM, one developed a type-I endoleak which required proximal cuff insertion. This patient developed a further type-I endoleak with rupture, and died following attempted conversion. Statistical analysis found no significant predictive factors, however, top neck enlargement was seen in 66.7% of cases with DM.
Conclusion: DM occurred in a small proportion of our patients, closer follow-up intervals may be necessary in patients with short/enlarging aortic necks.

38.7.7.

Endovascular stent-grafting of thoracic aorta: procedure related complications

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Purpose: To report our experience of complications of endovascular stent-grafts for thoracic aortic disease using commercially available devices.
Materials/Methods: Between 1997 and 2003, 86 patients (52 males,17-90, mean 73) underwent elective (n=55) or emergency stent-graft repair for aneurysms (n=43), dissection (n=20), transection (n=5); others 18. Median follow-up with CT was 24 months, range 1-75.
Results: Thirty-day mortality was 8/86 (9%) (arch rupture=1, intestinal ischaemia=3, MI=2, proximal dissection=1, rupture of untreated false aneurysm=1). Some patients had >1 complication. Complications included bronchopneumonia (n=2), endocarditis (n=1), groin haematoma(n=2), perforated duodenal ulcer (n=1), pulmonary embolism (n=1) and intestinal ischaemia (n=3). Paraplegia was seen in 3 cases (2 resolved with CSF drainage). Neurological problems were seen in 3 cases including 1 with residual deficit. Type I endoleaks were seen in 14 cases (proximal in 11, distal in 4 and both in 1) of which 5 spontaneously sealed, 4 were treated with a cuff, 2 underwent open repair, 2 await treatment and 2 died. There was 1 type II and 2 type III endoleaks. Access related complications were seen in 4 and device related or technical problems in 13 cases (discussed elsewhere).
Conclusion: Complications are not infrequent but many can be further treated without open surgery.

38.7.8.

Fenestrated stent grafting of AAA using the Zenith graft. Planning, graft design and deployment

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Purpose: To report our experience of fenestrated stent-grafts as an alternative to open surgery in patients unsuitable for conventional endovascular aneurysm repair.
Materials/Methods: A composite modular stent-graft system composed of a proximal tube with fenestrations including an uncovered barbed anchor stent for suprarenal fixation and a distal modified bifurcated Zenith system with standard extension pieces. Contrast angiography and multislice CT was used for accurate endograft and procedure planning. Radiopaque markers on the proximal graft allow anterior/posterior orientation and alignment of the fenestrations with the target vessels. Until final deployment, reducing ties constrain the diameter during target vessel cannulation. Alignment is then fixed with stents.
Results: Thirty-five cases have been performed. The technique is illustrated and described. A single-vessel fenestration is suitable for asymmetrical renal artery origins to extend the suitable neck. Severe angulation and tortuosity will distort anatomy during deployment and may cause a mismatch with preplanning, especially with multiple fenestrations.
Conclusion: Fenestrated endoluminal grafts offer a suitable alternative to open surgery. Patient selection and meticulous planning are essential.

38.7.9.

Endovascular stent-grafting of the thoracic aorta: technical problems and device related complications

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Purpose: We report our experience of technical and device-related complications encountered with commercially available stent-grafts for thoracic aortic disease.
Materials/Methods: Between 1997 and 2003, 152 devices were placed in 86 patients (52 males, mean age 73, range 17-90 years). The devices used were Gore (n=42), Talent (n=16), Endofit (n=16), Aneuryx (n=6), Endomed(n=2) and others (n=4). Median follow-up was 24 months.
Results: Access-related vascular injury occurred in 4 cases. Problems with device tracking was seen in 4, of which three had embolic intestinal ischaemia, leading to arch rupture in 1 and proximal extension of dissection in 1. There were 14 type I and 2 type III endoleaks (one due to fabric tear and one due to migration). One patient died of aneurysm rupture at 21 months due to endotension. Pseudoaneurysm formed in 1 due to bare metal barb of the Talent endoprosthesis. Device or fabric crumpling occurred in 2 cases. Distal movement during deployment occurred in 2 cases (Endofit). Re-intervention was required in 15 cases: 5/16 Endofit (FU 14m), 3/16 Talent (FU 15m) and 6/42 Gore (FU 39m). 2/11 late deaths were device related.
Conclusion: Current stent grafting has technical problems that need to be addressed to realise its full potential.

46.1.2.

Percutaneous transluminal angioplasty of the common femoral and the profunda femoral arteries: long-term patency rates

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Purpose: To evaluate efficacy and long-term patency rates of percutaneous transluminal angioplasty (PTA) of the common femoral artery (CFA) and the profunda femoral artery (PFA).
Materials/Methods: In a prospective study, 89 patients with occlusions or high-grade stenoses of the CFA (n=67) or the PFA (n=22) were treated with PTA. Follow-up examinations were carried out the day after the intervention and every three months for two years, including measurements of the ankle-brachial index (ABI), colour-duplex ultrasounds, and treadmill tests.
Results: The technical success rate was 84.6% for CFA lesions and 95.5% for PFA lesions. Primary, primary assisted, and secondary patency rates after one year were 17.1, 51.4, and 92.9% for CFA lesions and 61.4, 77.8, and 83.3% for PFA lesions, respectively. The patients showed an improvement of their walking distance from 148 to 230 m for CFA lesions and from 114 to 273 m for PFA lesions. The ABI increased significantly in both groups.
Conclusion: PTA of CFA and PFA lesions seems to be a viable treatment option because of its high recanalization and high secondary patency rates after 24 months. A certain number of reinterventions was necessary, especially for CFA lesions.

46.1.1.

Endovascular placement of an extraluminal bypass graft in the superficial femoral artery of human cadavers

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Purpose: To evaluate technical feasibility of an extraluminal femoropopliteal bypass graft (EFPBG) with endovascular technique in human cadavers.
Materials/Methods: The endovascular placement of EFPBG was undertaken in three cadaver legs prepared utilizing a preservation method that provides soft tissues and vascular lumen to remain with a texture similar to that in live humans. Through a percutaneous popliteal (2) or common femoral (1) access, a Rosch-Uchida needle was used to traverse the vascular wall at two consecutive sites, eight centimeters apart for the Hemobahn proximal and distal connections with the vascular lumen and to establish an extraluminal tract along the femoral artery. A 7-mm x 10-cm Hemobahn was deployed to establish the EFPBG.
Results: Technical success was achieved in all three legs. A patent graft lumen was found on postprocedural angiogram without kinking nor leakage. Macroscopic examination revealed no macroscopic evidence of damage to either nerve, vein, or SFA and good connections with the native vascular lumen.
Conclusion: The endovascular placement of EFPBG in cadaver legs is technically feasible. It may offer a minimally invasive alternative to traditional surgical bypass grafts.

46.1.3.

PTA versus Carbofilm-coated stents in infrapopliteal arteries in critical limb ischemia. A prospective, randomized, multicentric, pilot study

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Purpose: To evaluate the patency rate of PTA versus stents in infrapopliteal artery obstructions causing clinical limb ischemia (CLI).
Materials/Methods: Inclusion criteria were: CLI due to infrapopliteal artery obstruction, >70% stenosis/occlusion, up to three lesions, length <3 cm. Pre-intervention evaluation included: clinical status, ABI, DSA. Post-intervention evaluation included: clinical condition, ABI at discharge, at three and six months, MS-CTA at six months, DSA if indicated. In 59 patients (95 lesions) treatment was performed by PTA (n=53) or primary stent placement (n=42)(Carbostent, Sorin, IT). Follow-up with MS-CTA and DSA at six months was available in 31 patients (57 lesions, 32 PTAs, 25 stents). Lesions were assessed by two blinded readers (kappa 0.82). Life-table analysis was calculated on the basis of >50% stenosis and >70% stenosis.
Results: The primary technical success rate per lesion was 100% (53/53) for PTA and 98% (41/42) for stent placement. The calculated six-month patency rates based on MS-CTA and DSA were: subcritical stenoses (>50%) 45.6% vs. 79.7% for PTA vs. stent (p=0.02), critical stenosis (>70%) 61.1% vs. 83.7% for PTA vs. stent (p=0.02).
Conclusion: Primary stenting of short infrapopliteal obstructions in patients with CLI showed significantly better six-month patency rates as compared with PTA alone.

46.1.4.

Infrapopliteal recanalization in diabetic patients with critical limb ischemia

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Purpose: To evaluate clinical efficacy of endovascular recanalization of infrapopliteal arteries in diabetic patients with lower limb ischemia considered for amputation.
Materials/Methods: Seventy-two diabetic patients, presenting lower limb ischemia (Fontaine IV) underwent recanalization and percutaneous transluminal angioplasty (PTA) of infrapopliteal arteries. Indication for treatment was represented by a transcutaneous oxygen ($TcPO_2$) of <30 mm Hg. $TcPO_2$ evaluated one, two, three, and four weeks after the procedure was considered as the ideal technique for the assessment of clinical results. Thirty-eight patients presented an inflow reduction, treated before the infrapopliteal treatment.
Results: During post-procedural follow-ups, all patients presented a gradual increase of $TcPO_2$ levels, with a peak during the third week followed by a plateau phase. $TcPO_2$levels decreased during the first week remaining stable thereafter. During follow-up, five patients (6.9%) underwent leg amputation and one (1.4%) died of acute myocardial infarction. In the remaining 66 patients, $TcPO_2$ evaluated 12 months after the procedure confirmed the clinical results.
Conclusion: Endovascular revascularization is effective in lower limb salvage of those patients considered for amputation. Evaluation of $TcPO_2$ is an excellent indicator of the clinical efficacy of this procedure.

46.1.5.

Below-the-knee angioplasty: review and clinical follow up

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Purpose: To determine clinical outcome and success rate following percutaneous transluminal angioplasty (PTA) in elderly patients with below-the-knee stenotic lesions.
Materials/Methods: Over two years, 44 patients underwent PTA. Limb salvage (LS) (55%) and intermittent claudication (IC) (45%) were the indications for revascularisation. The population comprised of smokers (61%), diabetics (DM) (43%), elderly (mean age 76 years) and long-standing claudicants (41% had previous intervention).
Results: Balloon dilatation was performed on 46 lesions, 61% mid-popliteal, 20% distal popliteal, 15% tibioperoneal trunk and 4% common peroneal. Complications (9%) included one thrombus, one tibioperoneal rupture and two groin haematomas. Ankle-brachial indices improved from a mean of 0.63 pre-PTA (range 0.30-1.12) to 0.87 (range 0.49-1.21) post-PTA. In the IC group, IC improved in 80% at six-month follow-up. Successful LS and ulcer healing were seen in 54% of the LS group. Most failures were in the limb salvage group (29% versus 15% IC), including amputation (16% LS versus 5% IC) and persistent ulceration (13% LS).
Conclusion: Primary below-the-knee PTA is the preferred therapeutic option in this elderly population with multiple comorbidities and cardiovascular risk factors.

46.1.6.

Intentional subintimal angioplasty of infra-inguinal arteries: long-term results

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Purpose: To report our long-term results following subintimal angioplasty (SAP) of occluded infra-inguinal arteries.
Materials/Methods: SAP of occluded infra-inguinal arteries was performed in 200 lower limbs of 95 men and 105 women (median age: 80.3 years); 33% of them had diabetes. Symptoms included: ulcers in 115 patients, rest pain in 47, gangrene in 21, severe claudication in three; no information were available in 14. Follow-up included clinical evaluation with ABI measurement and Duplex at discharge and one, three, six, nine, and 12 months post-procedure.
Results: Median follow-up for open vessels was 11 months. Median time to occlusion was three months. A technical success was achieved in 83% of limbs. ABI significantly improved at one-month follow-up: pre-op 0.35 to 0.87. SAP remained patent in 62% during follow-up. Thirty-day mortality was 1%. Symptoms recurred in 22.5%. SAP was repeated in eight patients, PTA was done in three, femoro-distal bypass surgery in 16; 18 patients were treated only conservatively. In 8.5% of cases, limbs were amputated.
Conclusion: SAP of occluded infra-inguinal arteries is feasible and safe. Patency may be limited, but symptom relief is achieved in the majority of patients, thus making SAP a first-line treatment for critical leg ischemia in elderly patients.

46.1.7.

Early results of angioplasty using a cutting-balloon for femoropopliteal artery stenosis and mechanisms of dilation evaluated using intravascular ultrasound

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Purpose: To evaluate early results following cutting balloon-angioplasty for femoropopliteal artery stenosis and mechanisms of dilation using intravascular ultrasound (IVUS).
Materials/Methods: The study group included seven patients (17 lesions) with femoropopliteal artery stenosis treated using a cutting-balloon (CB group) and eight patients (19 lesions) treated using a plain balloon (PB group). The severity of dissection after angioplasty was graded using angiography. Vessel (VA), lumen (LA), and plaque areas (PA) were calculated using IVUS; changes in values after angioplasty were compared.
Results: The technical success rate was 100% in the CB group and 75% in the PB group. No major dissections were observed in the CB group, while the PB group displayed four major dissections. After PTA, PA reduction was greater in the CB group (7.2 ± 3.9 versus 0.84 ± 3.4 mm^2; $p<0.001$), and LA increase also was greater in the CB group (11.2 ± 3.90 versus 6.69 ± 4.59 mm^2; $p=0.003$). PA reduction accounted for 64.3% of LA increase and VA expansion accounted for 35.7% in the CB group, and for 12.6% and 87.4% in the PB group, respectively.
Conclusion: Cutting-balloon angioplasty for femoropopliteal artery stenosis successfully enlarges the lumen by decreasing PA, suggesting that this technique is useful and safe.

46.1.8.

PTA versus stent in femoropopliteal arteries: results of a multicenter prospective randomized study (REFSA)

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Purpose: To evaluate if stent placement is superior to PTA in the treatment of short femoropopliteal arterial lesions.
Materials/Methods: One-hundred twenty-four limbs in 116 patients were randomized to PTA (n=53) or stent placement (Palmaz-long-medium). Patients with claudicatio or chronic critical limb ischemia, short stenosis or occlusion (<5 cm) and one patent run-off vessel at angiography were included. Clinical assessment, measurement of ankle/brachial index, color duplex ultrasound, and/or angiography were done at six,12 and 24 months.
Results: In the PTA group, initial technical success was achieved in 50/53 limbs (94%) versus 70/71 (99%) limbs in the stent group. There was no difference between groups of treatment: clinical success at one and two years in the PTA group was 81% and 77% versus 78% and 71% in the stent group. Cumulative one- and two-year angiographic primary patency rates were 66% and 49% in the stent group versus 76% and 66% in the PTA group. Secondary one- and two-year angiographic patency rates were 89% and 53% in the stent group versus 83% and 76% in the PTA group.
Conclusion: After stent placement, the primary success rate was slightly higher than after PTA. However, one-year angiographic, clinical and hemodynamic success was not improved.

46.1.9.

Hemostasis with Clo-Sur PAD™ after antegrade puncture of the femoral artery. A new effective closure device?

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Purpose: To evaluate a hemostatic, hydrophilic, non-woven wound dressing (Clo-Sur PAD) after antegrade femoral artery puncture.
Materials/Methods: Fifty-three patients in whom interventional procedures of the superficial femoral artery (SFA) were performed using 5-F sheaths were prospectively evaluated. After sheath removal, manual compression with interposition of the Clo-Sur PAD was applied for 5 minutes. In case of hemostasis, a light compression bandage was applied for 24 hours; patients were mobilized after six hours. If initial hemostasis was not achieved, compression was extended to another 3 and 5 min, respectively. Puncture site was evaluated sonographically after 24 hours and one week.
Results: Mean compression time was 6 min, with hemostasis in 50 patients (94%). Three additional compressions of 3 and 5 (n=2) minutes were necessary. Complications occurred in five patients (9.4%; three hematomas with surgical revision, two pseudoaneurysms), with a difficult access (high or repeated puncture) as risk factor. Elevated body mass index, blood pressure, or platelet aggregation inhibition were not risk factors for local complications. No late complications were observed.
Conclusion: Mean compression time was reduced as compared with manual compression. In our hands, complication rates were comparable. This cheap device could be advantageous for patients undergoing SFA antegrade puncture.

46.2.1.

Percutaneous gastrostomy: an eleven-year series

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Purpose: Interventional radiologists have witnessed the technical evolution of gastrostomy from first surgical/endoscopical approaches to percutaneous interventional procedures. The aim of this study is to evaluate the results of an eleven-year series.
Materials/Methods: From December 1992 to December 2003, 217 new consecutive gastrostomies and 239 replacement procedures were performed. All the cases were treated by T-fastener gastropexy and tube placement. The procedures were monitored by analyzing indications, patients' selection, procedure duration, type of sedation, morbidity and mortality.
Results: All the procedures were successful. One patient with severe neurologic disorders (0.46%) died after the procedure without signs of procedure-related complications. Six (2.7%) major complications occurred (three duodenal lesions with peritoneal leakage, two gastric bleedings, and one gastric lesion). Minor complications were easily managed and two tube ruptures were resolved.
Conclusion: This long-term series and follow-up confirm that a group of interventional radiologist can provide an excellent service for gastrostomy placement and long-term tube management. Percutaneous gastrostomy is less invasive when compared with other approaches and it matches the need even in high-risk patients.

46.2.2.

Malignant esophageal-tracheobronchial strictures: parallel placement of covered retrievable expandable nitinol stents

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Purpose: To assess safety and clinical effectiveness of parallel placement of covered expandable metallic stents in the palliative treatment of both malignant esophageal and tracheobronchial strictures.
Materials/Methods: Under fluoroscopic guidance, double stents were placed in ten patients with both malignant esophageal and tracheobronchial strictures. An esophagorespiratory fistula (ERF) was combined in eight of them. Technical success, symptoms improvement, ERF closure and complications were evaluated.
Results: A total of 26 esophageal and tracheobronchial stents was successfully placed in all patients. Improvement of dysphagia and dyspnea was achieved in 90% and 100% of patients, respectively. After stent placement, ERF was closed in all the eight patients. Complications included migration of esophageal (n=2) or tracheobronchial (n=2) stents, new fistula development after esophageal stent placement (n=1), tracheal compression by esophageal stent (n=2), and massive hemorrhage (n=1). Nine of the ten patients died from two to 375 days (mean, 76 days) after and one patient was alive for 42 days after double-stent placement.
Conclusion: Use of parallel placement of covered expandable metallic stents for both malignant esophageal and tracheobronchial strictures is a safe and effective palliative treatment for relieving dysphagia, dyspnea, and ERF with improvement of the life quality.

46.2.3.

Intra-arterial chemotherapy for treatment of pancreatic adenocarcinoma

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Purpose: Effective treatment of pancreatic adenocarcinomas must be chosen on the basis not only of biological status but also of clinical condition. Basing upon the relationship between pharmacological concentration and *in vitro* tumor reduction, some authors have proposed transarterial chemotherapy with different drugs to overcome mechanical neoplastic barriers increasing local drug uptake.
Materials/Methods: We performed transcatheter arterial chemotherapy in 30 patients with unresectable locally advanced pancreatic adenocarcinomas, someone with liver metastases, all previously treated with gemcitabine alone or associated with 5-fluorouracil. Our protocol consisted of three courses of transarterial chemotherapy every three weeks after careful arteriographic study. We prepared patients with antiemetic prophylaxis and gastro-protection and used a pharmaceutical cocktail of folinic acid, 5-FU, carboplatin and epirubicin, distributing doses in each arterial branch according to tumoral localization and metastatic occurrence.
Results: We observed reduction in tumor size on post-treatment CT, with clinical benefits including pain relief, excellent palliation of hormonal symptoms, and weight increase in all patients, with median survival after first therapy of 8.3 months.
Conclusion: In our experience, transarterial chemotherapy in advanced tumors is a safe, well tolerated procedure with brief hospitalization, that deserves further testing for more active drugs and assessment.

46.2.4.

Colorectal anastomotic strictures: treatment by means of fluoroscopic double-balloon dilation

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Purpose: To evaluate therapeutic efficacy and complications of fluoroscopy-guided double-balloon dilation in the treatment of colorectal anastomotic strictures.
Materials/Methods: Under fluoroscopic guidance, 17 patients with colorectal anastomotic strictures underwent transanal double-balloon dilation. Thirteen patients underwent resection for malignant disease, and four patients for benign conditions. Sixteen of 17 patients had difficult or frequent defecation due to a partial obstruction. In one patient, the stricture was detected by endoscopy and barium enema after total proctocolectomy and a temporary ileostomy for ulcerative colitis. Therapeutic efficacy and complications were evaluated at follow-ups.
Results: Seventeen patients received double-balloon dilation in a single session. The diameter of each balloon catheter was arranged from 14 to 20 mm. Technical success was achieved in all 17 patients. After balloon dilation, a complete (n=12, 71%) or incomplete (n=5, 29%) improvement of symptoms was achieved in all patients. Major complications, such as perforation or severe hemorrhage, did not occur. During the mean follow-up of 23 months (range, 1-62 months), one patient (6%) developed a recurrent stricture and needed second balloon dilation six months after.
Conclusion: Fluoroscopy-guided double-balloon dilation is an effective and safe method for treating colorectal anastomotic strictures.

46.2.5.

Percutaneous gastrostomies in newborns with pure esophageal atresia

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Purpose: To describe our experience with percutaneous gastrostomies in patients with pure esophageal atresia in a pediatric centre.
Materials/Methods: Gastrostomy in patients with esophageal atresia requires an open procedure performed by general surgery. We report five cases of percutaneous gastrostomies in these patients. These newborns weighed 2-3.2 kg and presented with a gasless abdomen and an inability to pass an NG tube. All procedures were performed under general anesthesia. Access to stomach was obtained trans-hepatically under US guidance with 25-G spinal needles. The position is confirmed by the injection of contrast followed by air. In most patients the stomach is small and cannot be fully distended. US and fluoroscopy is therefore used to guide a Chiba needle into the stomach, followed by a wire and a 4-F peel away sheath. A retention suture is introduced through the sheath followed by dilatation and placement of an 8-F Dawson Mueller Mac-Lok catheter.
Results: The procedure was successful in all cases.
Conclusion: This is a safe and good alternative for gastrostomy in patients with esophageal atresia who would otherwise require an open surgical procedure. However, the procedure can be technically difficult due to the small size of the stomach.

46.2.6

Hepatic arterial port systems for the treatment of liver metastases: factors affecting patency and adverse events

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Purpose: To assess the outcome of interventional hepatic arterial port placement in a prospective phase II trial.
Materials/Methods: One-hundred and five consecutive patients were included in this study. Primary endpoint was port patency. Exclusive access route was the femoral artery. Subgroup analysis compared a) 4-F catheters (n=58) with 2.2-F (n=33) and 2.7-F (n=20) microcatheters, b) different strategies in anatomic variants of the celiac branch: neglect (n=10) or embolization of minor hepatic feeders (n=11), splenic arterial port (n=8), double port (n=7).
Results: Technical success was 99%. Port patency after six months was 93%. Complications demanding port revisions were significantly lower in patients receiving 4-F versus 2.2-F and 2.7-F systems ($p<0.001$) with disconnection as the major problem in microcatheters. Hepatic artery thrombosis occurred in ten patients (9%) with successful lysis in two; 4- and 2.2-F catheters did not show differences with respect to catheter occlusion or hepatic thrombosis. No differences were noted in complications or outcome applying four different strategies in celiac branch variants. Patients with liver metastasis and salvage therapy demonstrated a median survival of 16 months.
Conclusion: Interventional hepatic arterial port placement overcomes terminal port failures as frequently encountered with open surgical procedures.

46.2.7.

Radiofrequency ablation of colorectal liver metastases: use of positron emission tomography/computed tomography for post-interventional follow up

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Purpose: The aim of this study was to determine efficacy, accuracy and sensitivity of the dual modality positron emission tomography/computed tomography (PET/CT) in the follow up of colorectal liver metastases.
Materials/Methods: Seven patients (mean age: 64 years) with ten hepatic lesions were evaluated. The patients underwent PET/CT before and after radiofrequency (RF) ablation. CT and PET images were read alone and fused PET/CT images were read in consensus. For all three imaging techniques sensitivities and accuracies for the detection of residual tumors were evaluated.
Results: Mean follow up was 293 days. The overall procedure-based sensitivity for the detection of residual tumor was 67% for PET and PET/CT and 34% for CT alone. The accuracy for PET and PET/CT was 67% and 41% for CT alone. PET/CT proved of benefit over PET alone by accurate anatomical background in all cases with a residual tumor. PET/CT data served for planning and performing subsequent RF ablations to areas of local recurrent tumors.
Conclusion: PET and PET/CT demonstrated to be superior to CT imaging after RF ablation. Advantages of PET/CT over PET alone relate to a more accurate localization of areas of residual tumors, thus guiding subsequent interventional procedures to areas of viable tumors.

46.2.8.

Percutaneous transhepatic beta-cell transplantation using a combined ultrasound- and fluoroscopy-guided technique

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Purpose: To evaluate safety and feasibility of a combined ultrasound- and fluoroscopy-guided technique for percutaneous transhepatic beta-cell transplantation in patients with type-I diabetes mellitus.
Materials/Methods: Between December 2001 and November 2003, 15 patients underwent 31 percutaneous beta-cell transplantation procedures. In all procedures, a percutaneous access to the right portal vein was made under ultrasound guidance; subsequently the main portal vein was catheterized under fluoroscopic control. Clinical, biochemical, and radiological evaluation was performed before and after the procedure.
Results: In all the cases, access to the portal vein was achieved (median number of seeker needle passes = 1; IQR 1-2). The recorded procedure time (from puncture to catheter withdrawal) was 19 minutes (IQR 15-38). Clinically, two patients presented with transient abdominal pain immediately after the procedure; post-procedural duplex ultrasound of the liver revealed a patent portal vein and end branches in all cases and a discrete perihepatic fluid collection in three patients. Transient increase of liver tests, with normalization after 14 days, was detected in all but one patients.
Conclusion: The combined ultrasound and fluoroscopic monitoring of percutaneous transhepatic injection is a new, safe, and reproducible radiological procedure for transplantation of beta-cell grafts in diabetic patients.

46.2.9.

Comparison of the effectiveness of PAIR and catheterisation techniques for the percutaneous treatment of liver hyatid cysts: a prospective randomized study

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Purpose: To compare the effectiveness and complications of the PAIR and catheterization techniques for percutaneous treatment of liver hydatid cysts.
Materials/Methods: Twenty-five patients (18 females, 7 males; age range, 5-72 years; mean: 23.2 years) with 48 liver hydatid cysts underwent percutaneous treatment by either catheterization or the PAIR technique after randomization. Thirty-one liver hydatid cysts of 13 patients were treated by PAIR and 17 cysts of 12 patients were treated by catheterization under sonographic and fluoroscopic guidance with conscious sedation. Hypertonic saline (20% NaCl) and absolute alcohol (95% ethyl alcohol) were used to inactivate the viable components of the hydatid cyst.
Results: The average volume reduction of the cysts were 58.7% and 57.1% in the PAIR and catheterization groups, respectively. No mortality, serious anaphylactic shock, or abdominal dissemination were encountered in either group. The frequencies of other major complications (angioneurotic edema, biliary fistula, and infection) were not significantly different between groups. One cyst recurred 6 months after percutaneous treatment in the PAIR group and was re-treated. The duration of hospitalization was significantly shorter in the PAIR group (2.5 vs 8.8 days)
Conclusion: PAIR and catheterization techniques are both effective with almost the same low rates of complications.

46.3.1.

Percutaneous nucleoplasty in the treatment of contained disc herniation

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Purpose: To assess the effectiveness of percutaneous nucleoplasty in the treatment of lumbar pain due to contained disc herniation.
Materials/Methods: Thirty patients with positive visual analogue scale (VAS) (mean: 7.5) and lumbar pain were selected for treatment. In all patients, a lumbar MR revealed a contained disc herniation (four patients: L2-L3; ten patients: L3-L4; 16 patients: L4-L5). All patients were refractory to both medical and rehabilitation therapies for more than three months. The main physical principle of this procedure is a bipolar radiofrequency energy emitted by an electrode-needle, with consequent volumetric reduction of the nucleus polposus and elastic return of the anulus fibrosus. The treatment was performed under fluoroscopic visualization in anteroposterior and laterolateral projections.
Results: Post-procedural evaluations confirmed a mean VAS reduction of 3.5. MR performed six and 12 months after the procedure demonstrated the complete resolution of the treated discal patology in all patients. No post-procedural complications or recurrences were recorded.
Conclusion: In our experience, percutaneous nucleoplasty proved to be an effective and feasible technique. This minimally invasive procedure is ideal for the treatment of patients with painful contained disc herniation refractory to conservative medical therapies and not candidated for surgery.

46.3.2.

Cement volumetry after balloon kyphoplasty: comparison of biocement versus polymethylmethacrylate with computed tomographic volumetry

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Purpose: To measure the volume of intravertebral cement after ballon kyphoplasty with high resolution computed tomographic (CT) volumetry. To compare changes of biocement versus polymethylmethacrylate (PMMA) during 12 months' follow-up.
Materials/Methods: Twenty vertebrae (ten biocement, ten PMMA) were examined with high resolution CT volumetry (Somatom Plus 4, Siemens, Germany) using an identical imaging protocol. CT-scans were obtained immediately after kyphoplasty and at six and 12 months (collimation 0.5 mm, slice thickness 1 mm, in-plane resolution 0.5 mm). To quantify the volume in sub-voxel resolution we analyzed each cement fragment with a density-weighted algorithm.
Results: There was no significant difference in volume changes of biocement versus PMMA during 12 months' follow-up. However there was a significant difference in measures of bone resorption, with biocement showing a decrease of border density between 1.5-6% and bone absorption up to 15%. These data were confirmed by histological analysis, where biocement showed border vascularization after 12 months.
Conclusion: Although there is no volumetric change of biocement or PMMA after 12 months, measurable signs of bone resorption in biocement can be obtained using high resolution CT volumetry. Histological data of bone specimens support this new finding.

46.3.3.

Percutaneous kyphoplasty: one-year experience

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Purpose: To assess the effectiveness and safety of percutaneous kyphoplasty as a new treatment for pain due to vertebral compression fractures (VCF).
Materials/Methods: Twenty-three patients with unremitting pain--without neurological signs and refractory to conventional medical therapy--were treated by percutaneous kyphoplasty, a new interventional radiology technique consisting in the administration of polymethylmethacrylate (PMMA) into the collapsed vertebral body under fluoroscopic guidance, after compaction of the cancellous bone with dedicated balloon-catheter. Indications were: recent vertebral fractures due to osteoporosis, myelomas, metastases, and vertebral hemangiomas. Contraindications included coagulative disorders, unstable fractures, or complete vertebral collapse.
Results: An immediate pain relief was obtained, together with an evident increased resistance and restoration of vertebral bodies' physiological shape. PMMA leakages were not observed in epidural spaces or foraminal areas. Complications such as pulmonary embolism, infection, and toxicity due to PMMA did not occur.
Conclusion: Kyphoplasty has proved to be an effective and safe method for the treatment of intractable pain due to vertebral collapse with reduction of hospital stay and immediate improvement of the patient's life quality.

46.3.4.

Percutaneous reduction with internal fixation of unstable sacroiliac joint fracture-dislocations using CT-guidance

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Purpose: To describe image-guided percutaneous treatment and review outcomes of unstable fracture-dislocation of the sacroiliac (SI) joint in children.
Materials/Methods: Between 2000 and 2003, three children (2F, 1M) aged 9-14 years were referred for treatment of unstable SI joint fracture-dislocation not adequately treated with external fixation.
Results: The three affected SI joints (two left, one right) were treated in a combined approach by pediatric interventional radiologists and orthopedic surgeons, using a percutaneous approach under CT-guidance. Over a 7.3-wire, 7.3-mm cannulated screws were used to achieve stable reduction of the affected SI joint. No neurovascular or other complications occurred. All patients had a good outcome, although recovery of the youngest was delayed by associated spinal injury.
Conclusion: Compared with open surgical alternatives, percutaneous reduction with internal fixation under CT-guidance allows reduced operating time, decreased blood loss, early definitive fixation and immediate non-weight-bearing mobilization with a low rate of complications for unstable pelvic ring fractures.

46.3.5.

Treatment of intermetatarsal Morton's neuroma with alcohol injection under sonographic guide

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Purpose: To evaluate the efficacy of neuroma alcohol-sclerosing therapy (NAST) under sonographic guidance in Morton's neuromas (MN) after 2 years' follow-up.
Materials/Methods: Sixty-two neurointermetatarsal neuromas were treated with alcohol-sclerosing therapy under sonographic guidance. Preprocedural sonographic evaluation of dimensions and echotexture was performed. After subcutaneous anesthesia, a sclerosing solution composed of anesthetic (carbocaine-adrenaline 70%) and ethyl alcohol (30%) was injected into the mass under sonographic guidance. The procedure was repeated at intervals of 15 days until resolution of symptoms. Follow-up was performed with the aid of a visual analogue scale.
Results: Complete or partial symptomatic relief was obtained in 88% of cases. No procedure-related complications were observed. Transitory plantar pain, due to the flogistic reaction induced by the sclerosing solution, occurred in 15% of cases. Two years of follow-up revealed a 20-30% mass volume reduction and a fatty-like change in echotexture. In 12% of cases the treatment failed; baseline sonography in these patients demonstrated a hypoechoic echotexture with strong beam attenuation corresponding to a highly fibrous neuroma. These patients were treated surgically.
Conclusion: Alcohol-sclerosing therapy is a feasible and cost-efficient procedure with high rates of therapeutic success.

46.3.6.

Kyphoplasty: work and outcome analysis. The Heidelberg experience

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Purpose: Effects on pain relief and vertebral stabilization with polymethylmethacrylate (PMMA) and biocement were evaluated.
Materials/Methods: CT-/fluoroscopic-guided kyphoplasties were performed from December 2001 to December 2003 in 166 patients (aged 18-88) under general anesthesia.
Results: PMMA was used in 109 patients, biocement in 57; 316 vertebral bodies were treated with injections of 3.5-9.9 ml. In 68 patients one vertebral body, in 70 cases two, and in 38 patients three vertebral bodies were treated. Twenty-three of the 166 patients with fresh fractures were successfully treated. The traumatized vertebral body could be reconstructed to up 41% of its original height. Good results of the treated vertebral column and pain relief were achieved immediately in 90% of cases, persisted for three months in 75%, for six months in 62%, and for 12 months in 58%. Vertebral height enlargement of the osteoporotic vertebral body could be achieved in 59% of patients. Recurrency of pains occurred in 25% of cases after six months and in 30% after twelve months. A minor cement leakage occurred in 15.2% of cases.
Conclusion: The Heidelberg interdisciplinary experience in treating osteoporotic and fresh traumatic fractures is very promising in terms of stabilization, pain relief, and functional and clinical benefits.

46.3.7.

Role of dynamic MRI after percutaneous CT-guided radiofrequency ablation of osteoid osteoma

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Purpose: To evaluate the role of dynamic gadolinium-enhanced MRI (D-MRI) in the assessment of results of radiofrequency (RF) thermal ablation of osteoid osteoma (OO).
Materials/Methods: Twenty-three patients with histologically proven OO underwent MRI before and six months after percutaneous CT-guided RF ablation. MRI protocol included a conventional study (C-MRI: SE-T1w, GRE-T2w and FSE-IR) and D-MRI (FastSPGR-T1w) obtained after gadolinium injection. MRI images were evaluated by two blinded readers to assess bone edema and joint effusion on C-MRI, and degree of contrast uptake on D-MRI.
Results: Preprocedural C-MRI revealed specific abnormal findings in all cases, with clear nidus delineation only in three; at D-MRI, early and high contrast uptake allowed accurate nidus identification in 20/23 cases. After treatment, eight patients reported persistent pain. In these cases, persistent edema and nidus contrast uptake were identified and patients underwent further treatment. In asymptomatic patients and in patients reporting residual discomfort not requiring medical therapy after treatment, D-MRI did not demonstrate residual nidus contrast uptake and C-MRI showed a reduced bone edema and joint effusion, thus allowing the definition of success.
Conclusion: MRI is reliable in nidus detection and allows accurate follow-up after RF ablation, particularly when D-MRI is performed to delineate the nidus.

46.3.8.

Mid-term results of percutaneous vertebroplasty for osteoporotic compression fractures

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Purpose: To evaluate clinical mid-term results and occurrence of new compression fractures after vertebroplasty.
Materials/Methods: Two-hundred and sixty-six vertebroplasties in 131 treatment sessions in 108 patients were investigated. Clinical and radiological evaluations were performed one day, one month, four months, and ten months after vertebroplasty. Clinical evaluations were done using the visual analog scale (VAS; range: 0-10) and radiological evaluations by plain X-ray films and MRI.
Results: A pain reduction was achieved in 125/131 treatment sessions (95.4%). VSA score improved from 7.1 before the procedure to 3.0 at one day, 2.3 at one month, 2.1 at four months, and 2.1 at ten months. Cement-leakage was found in 83 of 216 vertebrae (38.4%). One patient with a large cement leak into the disk experienced a radicular pain and a surgical decompression was needed. New compression fractures occurred in 27 vertebrae in 18 cases (17 adjacent vertebrae, eight distant vertebrae, two treated vertebrae).
Conclusion: Percutaneous vertebroplasty was an effective treatment for painful osteoporotic compression fractures. In 16.7% of the study population, however, new fractures following vertebroplasty.

46.3.9.

Percutaneous vertebroplasty using CT-fluoroscopy in osteoporotic vertebral fractures

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Purpose: To evaluate vertebroplasty using CT-fluoroscopy in osteoporotic vertebral fractures.
Materials/Methods: Spiral CT was used for classifying fractures. The procedure was performed in conscious sedation using CT fluoroscopy for puncture and cement application. Results were documented by spiral CT with sagittal reconstructions.
Results: Fifty-eight patients with 123 vertebral bodies were treated, 39 thoracic and 84 lumbar, 2.1 ± 1.3 per patient (range 1 to 6). 5.9 ± 0.6ml (range 2 to 14 ml) of cement was applied using unilateral access in 79.7% and bilateral in 20.3%. Cement leak into the vertebral canal caused a 30% diameter reduction in one case. In two other cases, leakage from the puncture site migrated retrograde via neuroforamen into the epidural space. All patients were discharged without neurologic complications. In CT, the incidence of small extraosseous cement leaks was 4.1% in epidural veins, 6.5% in paravetrebral vessels, and 17.9% and 11.4% in upper or lower endplates. At discharge, 25 patients (43.1%) were painfree and 28 were significantly improved (48.3%) with considerable reduction of analgesic drugs.
Conclusion: Percutaneous vertebroplasty is effective for stabilisation and pain management of osteoporotic vertebral fractures. The procedure can be safely performed in concious sedation. CT fluoroscopy provides an excellent monitoring and contributes to safety.

46.4.1.

Percutaneous intrahepatic transplantation of pancreatic human islet cells in type 1 diabetes: the role of ultrasonography

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Purpose: To assess the role of ultrasound (US) in various phases of intraportal percutaneous intrahepatic pancreatic human islet cells (PHIC) transplantation.
Materials/Methods: Fifty-eight PHIC-transplantation procedures were performed in 34 diabetic, uremic patients, previously kidney-transplanted, using a combined US- and fluoroscopy-guided technique; the number of puncture attempts for each procedure was evaluated. Portal vein patency and liver sonographic texture were preliminarily assessed by color-Doppler US. US was used to assess early complications and focal steatosis (FS). FS presence or absence 6 months after PHICtransplantation was correlated to C-Peptide (CP) levels (ng/ml) and range.
Results: Procedures were technically successful in all cases, with a single puncture attempt in 89%. Complications occurred after 3 procedures (2 bleeding, 1 thrombosis) and were conservatively treated. FS was ultrasonically detected in 12/34 patients and not seen in 22/34 patients, with CP levels and range corresponding to 1.61 (1.13-2.74) and 5.30 (0.03-5.30), respectively: no statistically significant differences in CP-levels were found, while a large spread was demonstrated only in the second group of patients.
Conclusion: Percutaneous PHIC transplantation using a combined US- and fluoroscopy-guided technique is a safe procedure with a low complication rate. FS is probably caused by high insulin concentrations due to some hyperfunctioning PHIC.

46.4.2.

Transjugular portosystemic shunt placement in patients with occluded portal veins

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Purpose: To determine the safety and efficacy of transjugular intrahepatic portosystemic shunt (TIPS) placement in patients with portal vein thrombosis.
Materials/Methods: This study reviewed 15 cases of TIPS placement in 15 patients with partial or total portal vein thromboses at our institution between 1995 and 2003. There were two women and 13 men with a mean age of 53 years. Indications for TIPS placement were refractory ascites, variceal bleeding, and refractory pleural effusion. Clinical follow-up was performed in all patients.
Results: The technical success rate was 75% (3/4) in patients with complete portal vein thrombosis and 91% (10/11) in patients with partial thrombosis. Complications included post-procedure encephalopathy and a localized hematoma at the access site. In patients with successful shunt placement, the total follow-up time was 223 months. The 30-day mortality rate was 13%. Two patients underwent liver transplantation at 35 days and seven months respectively after TIPS insertion. One patient had an occluded shunt at four months with an unsuccessful revision. The remaining patients had functioning shunts at follow-up.
Conclusion: TIPS placement in a partially or totally occluded portal vein is possible. In patients with portal vein occlusion, TIPS may be a treatment option.

46.4.3.

Transjugular intrahepatic portosystemic shunt using e-PTFE covered stentgrafts maintains lower portal pressure and requires less re-interventions than bare stents

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Purpose: To evaluate feasibility and effectiveness of ePTFE-covered transjugular intrahepatic portosystemic shunts (TIPS) in patients with liver cirrhosis.
Materials/Methods: Thirteen patients with an ePTFE-covered TIPS were prospectively evaluated and compared with matched controls with mesh-wire uncovered TIPS. Clinical conditions, porto-caval pressure gradients (PCPG) and patencies by portography, as well as costs, were recorded at six and 12 months.
Results: Patients with ePTFE-TIPS showed a significantly lower PCPG: 9 (3-13) versus 15 (1-21) mm Hg, p=0.006; a lower rate of dysfunction: 8% versus 54%, p=0.03; and required fewer reinterventions: 2 versus 13, p=0.02. This resulted in reduced median costs for angiographic surveillance in the covered TIPS group at six and 12 months: Ɇ 215 (215-3245) versus Ɇ 599 (215-4396) and Ɇ 215 (215-215) versus Ɇ 384 (215-767), respectively, p=0.002; but total procedure-related costs were increased at six months: Ɇ/patient 3730 (3245-6759) versus Ɇ/patient 1850 (1466-5479) and at 12 months: Ɇ/patient 3945 (3460-6759) versus Ɇ/patient 2295 (1728-5694), due to the higher cost of ePTFE-stents.
Conclusion: TIPS with ePTFE-covered stents achieved a better maintenance of lowered portal pressure and needed fewer reinterventions than bare stents. Since ePTFE-covered stents do not require a regular surveillance to obtain primary patency, they may improve cost effectiveness.

46.4.4.

Transjugular intrahepatic portosystemic shunt versus endoscopic treatment plus propranolol for variceal rebleeding

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Purpose: The aim of our study was to compare elective transjugular intrahepatic portosystemic shunt (TIPS) with the endoscopic treatment (ET) as secondary treatment of variceal bleeding in patients with cirrhosis.
Materials/Methods: From April 1994 to December 2000, 96 patients with recurrent variceal bleeding were randomly assigned either to TIPS or to ET.
Results: The median follow-up was 35.5 months in the TIPS group and 19.6 months in the ET group. Cumulative rates of rebleeding were 6.25 % in the TIPS group and 45.7% in the ET group (p=0.001; $\chi 2$ test). The mortality rate due to rebleeding was higher in the ET group (57% versus 15%). Mortality was 45.6% in the ET group and 27.1% in the TIPS group. Cumulative survivals after TIPS were 83% at one, 79.9% at two, and 73.5% at four years; after ET they were 69.8%, 53.3%, and 39.8%, respectively (p=0.013 log-rang). Incidence of new or worsening hepatic encephalopathy was less common in the ET group (2.2% versus 8.2 %; p=0.316; $\chi 2$ test).
Conclusion: Elective TIPS is significantly better then ET in preventing rebleeding and in improving survival; it is also associated with similar rates of encephalopathy.

46.4.5.

Portosystemic shunt reduction for the treatment of hepatic encephalopathy after transjugular intrahepatic portosystemic shunt performed with e-PTFE covered stent-grafts

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Purpose: To assess the rate of hepatic encephalopathy (HE) in patients in whom transjugular intrahepatic portosystemic shunt (TIPS) was performed with polytetrafluoroethylene (PTFE) covered stent-grafts.
Materials/Methods: From January 2000, 98 TIPS were performed using extended-PTFE covered stents (Viatorr, W.L.Gore). In ten cases, stent-grafts measured 8 mm in diameter, in 88 patients a 10-mm stent-graft was implanted. After a mean follow up of 1.2 months, 46 patients developed HE, not responding to medication in 12 cases. In these cases, a shunt reduction was performed by inserting balloon-expandable PTFE-covered stents in a hourglass shape (Jostent, Jomed) inside the shunt.
Results: Technical success was achieved in all cases with an immediate increase of the porto-systemic gradient and disappearance of symptoms.
Mean pressure value increased from 7 to 14.8 mm Hg. After a mean follow-up of 7.75 months, eight patients are alive without further episodes of HE or bleeding. In 1/12 patient (8%), a shunt re-dilation was necessary for reappearance of ascites. Three patients died after one, five, and six months for rebleeding (n=1) and cardio-vascular failure (n=2). No statistical correlations between the shunt diameter and the incidence of HE were recorded.
Conclusion: TIPS performed with the Viatorr presented an increased rate of HE.

46.4.6.

Transjugular intrahepatic portosystemic shunt vs transcatheter sclerotherapy for gastric varices

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Purpose: To compare transjugular intrahepatic portosytemic shunt (TIPS) with transcatheter sclerotherapy (TS) for gastric varices on variceal bleeding and survival.
Materials/Methods: One hundred and four patients with GV underwent endovascular treatment. Twenty-seven patients were treated by TIPS, and 77 patients by TS. GV bleeding and survival were compared between the TIPS and TS groups, based on the Kaplan-Meier method. Multivariate analysis was used to identify prognostic factors for GV bleeding and survival. Changes in liver function were evaluated in each group.
Results: The cumulative GV bleeding rate at 1 year was 19.7% in the TIPS group and 1.7% in the TS group ($p<0.001$). The prognostic factor most associated with GV bleeding was the treatment method. The cumulative survival rates at 1, 3, and 5 years were 81.0%, 63.8%, and 40.1%, in the TIPS group, and 95.7%, 83.0%, and 75.5% in the TS group, respectively ($p<0.01$). Prognostic factors for survival were the treatment method and the Child-Pugh classification. Liver function tended to improve in the TS group.
Conclusion: Transcatheter sclerotherapy may be more useful for gastric varices than transjugular intrahepatic portosytemic shunt.

46.4.7.

Cost effectiveness of n-butyl-2-cyanoacrylate (histoacryl) glue injection versus transjugular intrahepatic portosystemic shunt in the management of acute gastric variceal bleeding

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Purpose: Determine cost-effectiveness of transjugular intrahepatic portosystemic shunt (TIPS) and endoscopic treatment of bleeding gastric varices (GV).
Materials/Methods: Retrospective review of patients with bleeding GV treated either by TIPS or cyanoacrylate glue injection. Economic analysis was based on direct costs for fixed financial year. The two groups were compared to six-month follow-up, liver transplantation, or death.
Results: No significant differences between the groups in patient characteristics, transfusion requirement and GV anatomy; 15/20 TIPS patients had the procedure within 24 hours of haemorrhage with 90% technical success. Complications comprised two cases each of pulmonary oedema and severe encephalopathy; 15% stenosis rate at six months. The glue group underwent 3+/-1.5 endoscopies (2+/-1 injections per patient) with 96% of initial haemostasis. There was one case of (glue) pulmonary embolism and one blocked endoscope lens requiring repair. Initial re-bleed rate was significantly lower in TIPS patients (15% versus 30%, $p=0.005$). Glue patients had a shorter inpatient stay (13+/-1 versus 18+/-2 days, $p=0.05$). No difference in overall mortality rate. Median cost within six months of initial GV bleeding was $4138 (3009-8290) for glue versus $11906 (8200-16770) for TIPS ($p<0.0001$).
Conclusion: Cyanoacrylate glue injection is more cost-effective than TIPS in the management of acute GV bleeding.

46.4.8.

Percutaneous US-guided direct transportal-transcaval TIPS in Budd-Chiari

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Purpose: To evaluate direct percutaneous transportal-transcaval transjugular intrahepatic portosystemic shunt (TIPS) creation in Budd-Chiari patients.
Materials/Methods: Two patients with Budd-Chiari, portal hypertension, and intractable ascites were included in this study. Direct percutaneous US-guided puncture was performed with an 18-G Chiba needle initially into the portal vein branch and then--without changing the needle angle--advanced into the inferior vena cava. A guide-wire is advanced into the vena cava and snared through the right jugular vein. An 8-F vascular sheath was then placed into the jugular vein and the liver tract dilated. The sheath was advanced into the portal vein branch and the guide-wire and the catheter positioned into the mesenteric vein. Standart procedural steps followed.
Results: In both patients, ascites disappeared completely. Shunts were patent at nine- and six-month controls.
Conclusion: If the anatomy of the portal vein and the vena cava is suitable, direct percutaneous puncture of both is feasible and makes the procedure easier.

46.5.1.

Experimental evaluation of early and long-term effects of microparticle embolization in minipig livers and kidneys

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Purpose: To evaluate a spheric embolic agent for tissue ablation in kidneys and livers.
Materials/Methods: Embospheres (40-120 µm) were used in 30 minipigs. In group A (17 animals) upper or lower kidney poles were superselectively catheterized from a femoral approach (microcatheters). In group B (13 animals) left upper liver segments were embolized. Four group-A animals and three of group B were euthanized immediately after. All the others survived one, four, or 14 weeks.
Results: In all animals target regions were embolized. Remarkable differences between kidney and liver embolizations were found. Neither necrotic nor inflammatory reactions were found in the livers at any time. Tissue necrosis was always present in the kidneys without inflammation at four weeks. A distinct foreign body reaction with sparse leucocytic infiltration and giant cells was seen at 14 weeks. Vessel walls were usually disintegrated as a result of widespread tissue necrosis. The spheres remained unchanged. Some recanalizations were seen in both organs in segmental arteries.
Conclusion: Small Embospheres are associated with mild giant cell reactions when used for organ ablation like in the kidney. In liver embolization, the parenchyma will be preserved by the portal inflow. It might therefore be ideal for chemoembolization.

46.5.2.

Embolizor: a new device for arterial embolization. First experience in humans

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Purpose: To report initial experience with a new occlusion device for arterial embolization.
Materials/Methods: The Embolizor (B. Braun) is a self-expandable nitinol occluder covered with a thin polyethylene film. It can be compressed into a .035-guidewire compatible catheter. Over a ten-month period, 12 consecutive patients (mean age: 63.5 years) referred for arterial occlusion were treated by the Embolizor device. Indications were: flow redistribution before intraarterial chemotherapy by occlusion of a branch of the hepatic artery (n=6), exclusion of internal iliac artery branches before endovascular treatment of iliac aneurysm (n=5), or occlusion of a lumbar artery to prevent endoleak before abdominal aneurysm repair (n=1).
Results: One to three devices (mean 1.4/patient) were used to occlude the target artery. In all cases, immediate occlusion of the target artery was obtained. In one case, a distal migration of the device (<20 mm) was successfully overcome by implantation of a second device. Migration was due to underestimation of the calibre of the target artery. The device was easily pushed to the pre-selected location with no problem even in case of severe curvature of the catheter.
Conclusion: The Embolizor is very effective in occluding small-caliber arteries.

46.5.3.

Vessel wall damage induced by cerebral protection devices: an *ex vivo* evaluation in porcine carotids

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Purpose: To determine vessel wall damage and embolization induced by cerebral protection devices in porcine carotids.
Materials/Methods: In a bench-top vascular model with inserted porcine internal carotid arteries (n=85) five different protection devices were used (Angioguard™, FilterwireEX™, Trap™, Neuroshield™, Percusurge™). An adverse movement of activated devices was simulated. For device deployment, movement, and retrieval, the amount of debris from the vessel wall was determined. Carotids were histologically analyzed.
Results: All protection devices were cause of emboli. The amount of debris captured for the entire procedure revealed differences among the different devices (lowest: 4.8 mg Angioguard™ and 5.1 mg FilterwireEX™, highest: 7.5 mg Trap™; for all $p<0.05$). All devices caused histologically visible wall damages, with degrees of intimal denudation correlating with the debris weight. Trap™ yielded most severe intimal and subintimal wall damage. Adverse movements showed no increased risk for embolization as compared with deployment and retrieval of the protection device.
Conclusion: Cerebral protection devices cause visible and measurable intimal vessel wall damages. Based on these data, cerebral protection devices have a potential influence on embolization rates during carotid stenting, and might also have an effect on restenosis. This raises concerns regarding the safe use and design of these protection devices.

46.5.4.

Sirolimus-coated stent implantation in the prevention of carotid artery restenosis in pigs

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Purpose: Stent implantation in the carotid artery (CA) has shown to be feasible in the treatment of CA stenosis. Although restenosis rates are reported to be lower than in coronary and peripheral arteries, problems may arise with increasing numbers of treated patients and longer follow-ups.
Materials/Methods: After 8-mm predilatation, eight Goettinger minipigs were randomly assigned to receive a Sirolimus-eluting nitinol self-expanding stent (7x80 mm) and another stent, but without Sirolimus/polymer coating, in the contralateral CA. Three days before the intervention, aspirin was given for four weeks and clopidogrel was administered for ten days.
Results: After six weeks, two subacute occlusions were observed in both groups. In the remaining vessels, the neointima was significantly reduced by Sirolimus/polymer-coated stents (5.9 ± 2.5 mm^2 vs. 0.7 ± 1.0 mm^2)
Conclusion: Sirolimus self-expanding nitinol stents may be an effective tool to reduce the restenosis rate in CA. The high incidence of subacute thrombosis may be attributed to an insufficient antiplatelet therapy in a highly thrombotic setting with overstretched predilatation and long-stent implantation.

46.5.5.

Reduction of late in-stent restenosis using the new poly[bis(trifluoroethoxy)phosphazen] nanocoat technology in a porcine renal artery model

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Purpose: To demonstrate reduction of late in-stent restenosis using the new poly[bis(trifluoroethoxy)phosphazen] (PTFEP) nanocoat technology in a porcine renal artery model.
Materials/Methods: Fifteen minipigs (25 kg) were divided into three groups (1 wk, 4 wks, and 12 wks), 5 animals/group. PTFEP is a non-carbon highly pure, antiinflammatory and antithrombotic biopolymer. A coat thickness of 40-50 nanometers was applied on newly designed nitinol stents (proprietary manufacturing, 5/20 mm). Bare and coated stents were implanted via a transfemoral approach, randomly side-assigned. Heparin was administered for anticoagulation (150 U/Kg). Before sacrifice, magnification angiography was performed. Explanted stents were examined by light microscopy and SEM. Inflammatory and injury score were determined.
Results: Coated stents showed no thrombus or significant late luminal loss, the average intimal thickness measured 66µm at 4 wks and 71µm at 12 weeks. In bare stents significant restenosis (luminal loss >30%) occurred in all. Near total occlusion (>70%) was found in 7. Average intimal thickness measured in all animal at all intervals > 800µm (statistically significant at all intervals $p < 0.01$).
Conclusion: PTFEP nanocoating achieves reliable prevention of late in-stent restenosis of nitinol stent in a porcine renal model. Bare nitinol stents generate unacceptable late in-stent restenosis.

46.5.6.

Relationship between stent expanding force and neointimal formation in porcine veins

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Purpose: To study the relationship between stent expanding force and neointimal formation in porcine veins.
Materials/Methods: Animals were divided into two groups according to their follow-up: one month (1M) and three months (3M) post-intervention follow-up. Twelve (n=12) Wallstents were placed in each group in the external jugular and the common iliac veins. Different expanding forces were determined with intravascular ultrasound (IVUS), ranging from 114 to 221% the size of the native vessel. Neointima was evaluated with IVUS as a ratio of neointima-to-stent area at center (C), distal (D), and proximal (P) portions of stents. Pearson's correlation and Fisher's Z test were used to find associations between expanding force and neointima formation (a "p<0.05" value was defined as statistically significant).
Results: No significant correlation between the expanding force and neointimal growth could be found in the 1M group (C: $p = 0.332$; D: $p = 0.11$; P: $p = 0.28$) or in the 3M model (C: $p = 0.612$; D: $p = 0.081$; P: $p = 0.308$). Six jugular stents migrated and were excluded from the study.
Conclusion: Although there was no statistical significance, neointimal thickness tended to increase with expanding force.

46.5.7.

Robotic system for MR-guided percutaneous interventions: an experimental evaluation

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Purpose: To overcome the spatial limitations of MR-guided interventions, a compatible telerobot was developed and experimentally tested *in vitro*.
Materials/Methods: Based on MR-compatibility studies of materials, drives, mechanical elements, sensors, switches and different kinematics, an interventional robotic systems was designed and tested. *Ex vivo* phantom experiments using jelly models and animal specimens of organs were performed to determine puncture precision with a 19-G cannula under MR-guidance in a 1.0-Tesla Philips NT MR equipment.
Results: MR-compatible piezo- and pneumatically-driven robot provides translation into the gantry as well as articulation and rotation of the front end in 5 DOF in X, Y, and Z axis. Cannulae can be advanced manually or automatically under MR-guidance. In *in vitro* and *ex vivo* settings, planning and MR image-guided puncture precision of +/-10 mm and +/- 12 degrees was achieved for the manual insertion. The robot arm provides access to the preplanned puncture site in +/-1 mm and +/-1 degree precision.
Conclusion: An MR-compatible 6-DOF single-arm robot for MR-guided percutaneous procedures was developed and successfully tested experimentally. Clinical trials are prepared for MR-guided biopsy, sciatic nerve injection, and interstitial tumor treatment.

46.5.8.

Comparative study of two different swine models of abdominal aortic aneurysm

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Purpose: The aim of this study was to compare the evolution of two surgically created abdominal aortic aneurysm (AAA) models using angiography and ultrasonography.
Materials/Methods: Ten healthy pigs underwent infrarenal AAA creation. A peritoneum patch was used in group A (n=5) and a gastric serosal patch in group B (n=5). Angiographic studies were performed immediately before and after surgery. On days seven, 14, 30, 45, 60 and 90, both DSA and ultrasonography were performed, measuring aneurysmal diameters. Differences in diameters (with times and groups) were studied using the Wilcoxon test ($p<0.05$).
Results: Two animals in group B and one in group A died of aneurysmal rupture. Immediate post-operative measurements were significantly larger in group A. Both imaging techniques evidenced an increase in diameter during the first third of follow-up (reaching 243% of the original diameter in group A and 216% in group B). These diameters subsequently stabilized. AAA diameters obtained during whole follow-up were consistently but not significantly larger in group A.
Conclusion: Both models can be useful in the short-term development, training and evaluation of new endoprostheses, but the peritoneum model exhibits a higher rate of postoperative dilatation, so it could be more useful than the serosal model.

46.5.9.

Pathologic evaluation of the behaviour of a new embolic agent (superabsorbent polymer microspheres) administered with two different contrast media

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Purpose: Superabsorbent polymer microspheres (SAPM) alter their shape and size when in contact with different contrast media. This behaviour is advantageous, as the embolic agent may be adapted to the type of embolisation and therapeutic objective required.
Materials/Methods: The study was conducted in four swine (25-30 Kg). SAPM (53-106 µm) were mixed with Ioxaglate in five arterial embolisation procedures (four kidneys, one liver) and with Iodixanol in a further five (same procedures). In each swine, each kidney was embolised with a different SAPM-contrast combination. The organs were extracted following the order of embolisation. Samples of the kidneys stained with hematoxyline-eosine were evaluated.
Results: The findings were similar in kidneys and liver. The SAPM mixed with Iodixanol maintained their ovoid shape (mean diameter 250 µm), partially deforming the arterial wall. The SAPM mixed with Ioxaglate, stretched and deformed (maximum diameter 300 µm) conforming to the lumen shape, with less damage to the arterial wall.
Conclusion: This new embolic agent is capable of altering its properties, and hence its therapeutic effect, depending on the type of contrast media with which it is mixed. Clinical applications should be evaluated with new studies (some ongoing) in different territories.

46.6.1.

Ultrasound-guided brachiocephalic (innominate) vein puncture for central venous access in children

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Purpose: To evaluate ultrasound-guided puncture of the brachiocephalic veins for central venous access in children, when conventional sites are not available.
Materials/Methods: Non-randomized observational study in a children's hospital. Procedures were performed by a paediatric interventional radiologist or fellow. A brachiocephalic vein was punctured with a 21-gauge needle from a supraclavicular approach, using ultrasound guidance. Central venous catheters were then inserted using standard techniques.
Results: One-thousand seven-hundred and four central venous access procedures (excluding peripherally inserted central catheters) were performed over a 53-month period. Brachiocephalic vein puncture (right=18, left=18) was attempted in 36 (2.1%) procedures in 31 children (16 female, ages two months to 17 years, median 16 months). Catheter insertion was successful in 35 procedures (97.2%, 95% confidence interval 85.8% to 99.5%). The catheters inserted were 22 Hickman, six non-cuffed tunnelled, three permanent haemodialysis, two venous ports and two others. Sizes were 4 to 12.5 F (median 6.6 F). Indications included antibiotic therapy (14), parenteral nutrition (11), chemotherapy (6) and haemodialysis (4). There were no immediate complications. A catheter was inserted using the contralateral subclavian vein in the patient with unsuccessful brachiocephalic vein access.
Conclusion: Brachiocephalic vein puncture is an acceptably safe and successful technique for central venous access.

46.6.2.

The endovascular treatment of deep vein thrombosis

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Purpose: To evaluate the efficacy of endovascular treatment of deep vein thrombosis (DVT).
Materials/Methods: Seventy-seven patients (37 men, 40 women; mean age, 55 years) with DVT were retrospectively analyzed. All patients had acute (n=40) or chronic (n=37) symptoms of pain and swelling of the lower extremities. An endovascular treatment (thrombolysis with urokinase: 75 patients, aspiration thrombectomy: 75, angioplasty only: two) was performed. Placement of an IVC filter was combined in 13 cases. Patients were followed-up with venography, computed tomography, or ultrasonography. The subjective symptoms of the patients were also assessed.
Results: Initial technical success rate was 95.4% (73/77). The overall patency rate at one and two years was 93.85% and in 90% of patients the symptoms had completely or partially improved (follow-up: 2-43 months, mean = 26 months). Minor bleedings occurred in ten patients. Immediately after the treatment, a complete resolution of symptoms was achieved in 70 patients. During follow-up, five patients underwent repeated thrombolysis and angioplasty due to reocclusion of the iliac vein three months after the initial treatment and in one patient the iliac stent reoccluded and a pulmonary thromboembolism occurred.
Conclusion: The endovascular treatment of DVT is effective and safe.

46.6.3.

MRI-angiography of hemodialysis access shunts before and after percutaneous transluminal angioplasty. Comparison with digital subtraction angiography

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Purpose: The intention of this study was to evaluate the quality of MRI-angiography in comparison with digital subtraction angiography (DSA) in patients with stenosis of hemodialysis accesses concerning stenosis grade and post-interventional changes.
Materials/Methods: During the last 12 months, 20 patients were examined before and after shunt percutaneous transluminal angioplasty (PTA) in addition to DSA by MRI-angiography with TOF-sequences (1.5 Tesla, Siemens, Symphony). No contrast medium was injected during MRI examinations. The stenosis grades at MRI-angiography were compared with DSA findings.
Results: MRI-angiographies overestimated the grade of stenoses both before and after PTA, especially long-distance stenoses.
Conclusion: MRI-angiography can be, in some cases such as preterminal renal insufficiency, a method to detect and visualize stenoses of the vascular access, especially when ultrasound findings are not clear.

46.6.4.

Insertion-site thrombosis with inferior vena cava filters: does size matter?

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Purpose: Since the description of percutaneous placement of inferior vena cava (IVC) filters in the early 1980's, manufacturers have attempted to make the profile smaller. This study was undertaken to determine the incidence of insertion-site thrombosis amongst the different sized filters.
Materials/Methods: A filter registry was maintained for the past two years at a level 1 Trauma Center. The filter type was randomized for each patient. Insertion-site was evaluated with ultrasound for thrombosis at the date of placement, day one, three, seven, and 21.
Results: Seventy-five filters were placed. Sixty-nine are included in this study; six patients were excluded (five discharged before day-one ultrasound and one deceased before day one). Five patients had thrombosis at day one and two patients had thrombosis at day three (total: 10.2%). No new findings of thrombosis were found on day-seven or day-21 ultrasound. Thrombosis was present in Greenfield (2), Venatech (2), Tulip (1), Simon Nitinol (1) and Trapeze (1).
Conclusion: This small prospective study suggests that insertion-site thrombosis can occur with most all filters regardless of their size. Routine ultrasound surveillance of the insertion-site is probably not warranted past day three. More patients will need to be studied to obtain significance.

46.6.5.

Two years' experience with the new peripheral cutting balloon for stenoses of native fistulas

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Purpose: To demonstrate the effectiveness of a new peripheral cutting balloon (PCB) (Boston Scientific) to treat stenoses within native arteriovenous fistulas (AVFs).
Materials/Methods: From February 2002, 17 patients (14 men), aged 26-77 (mean 57 years), had 20 PCB procedures to treat venous stenoses affecting eight above-wrist and nine above-elbow AVFs. Multiple sites included nine post-anastomotic, eight mid-fistula and nine cephalic arch lesions.The majority of lesions (24 of 30) were less than 2 cm long. PCBs of 6 mm diameter were used in most cases (14 of 20).
Results: All procedures were technically successful and were well tolerated. Three lesions were re-treated at seven, 12 and 20 months. At follow-up between two and 22 (mean = 9) months, four of 17 AVFs were lost and two patients had died. Eleven fistulas are still functioning. Primary patency at six months is 80% and at 12 months 55%. Four of five rescued thrombosed fistulas are functioning an average of eight months later.
Conclusion: The PCB is proving to be an effective and less painful balloon device for treating recurrent stenoses. Multi-centre data collection may show prolonged re-intervention intervals.

46.6.6.

Insertion and retrieval of the Gunther-Tulip filter: experience in 143 patients

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Purpose: Retrievable IVC filters have led to an expansion in both insertions and indications for caval interruption. In an ongoing clinical study we describe our experience with this permanent/ retrievable filter.
Materials/Methods: One hundred forty-seven retrievable Gunther Tulip Filters (William Cook Europe) were inserted in 143 patients (M:F 69:42, mean age 48.79 years) from November 2001 to February 2004. A custom-designed database was completed at the time of insertion and retrieval for each filter, and all patients were followed for complications.
Indications for insertion included: primary prevention of PE in high risk patients (n=83); recent PE (n=19); extensive DVT (n=27); contraindication, complication, or failure of anticoagulant therapy (n=36).
Results: Retrieval was attempted of 94 filters, with 78 successfully removed. There was 1 insertion complication with the apex of the filter perforating the IVC wall. Three retrieval complications included 1 pulmonary embolization of a small filter fragment and 2 IVC stenoses. Mean implantation time for temporary filters was 38.11 days (range 1-191 days).
Conclusion: Reported retrieval periods for the Gunther- Tulip filter has continued to lengthen, despite the manufacturers recommendation (10 days). Although our data agrees with this, it suggests that this may be at the expense of successful retrieval rates.

46.6.7.

Percutaneous retrieval of intravascular foreign bodies and repositioning of misplaced catheters: personal experience in 48 cases

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Purpose: Placement of central venous catheters/venous catheter-port systems has increased the occurrence of intravascular intravascular foreign bodies (FB) and repositioning of misplaced catheters (MC). We report our experience in techniques and success rate of FB retrieval and MC repositioning.
Materials/Methods: From 1990 to 2003, percutaneous retrieval of intravascular FB (27 cases) and repositioning of MC (21 cases) was attempted, with a right transfemoral venous approach in 45/48 cases. FB were catheter fragments (26/27 cases) or guidewire (1/27), located in right heart (n=12), proximal pulmonary artery (n=8), distal pulmonary artery (n=4), superior (n=1), inferior vena cava (n=1), or subclavian vein (n=1). MC were misplaced in internal jugular (n=16), subclavian (n=2), anonyma (n=2), or anterior jugular vein (n=1). Color Doppler assessment was performed in jugular or subclavian misplacements to evaluate vein patency. FB extraction or MC replacement were obtained using a combination of multipurpose catheters and nitinol snare loop or pig-tail catheters, respectively.
Results: Percutaneous extraction of FB was successful (96.2%) except for one catheter fragment in the distal pulmonary artery. MC repositioning was successful in 20/21 cases (95.2%) No complications were recorded.
Conclusion: Percutaneous techniques for intravascular FB retrieval or MC repositioning are highly effective, with low complication rates.

46.6.8

SafeFlo™ retrievable inferior vena cava filter: an open, multicenter study

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Purpose: To evaluate safety, retrievability, and effectiveness of the SafeFlo™ inferior vena cava (IVC) filter.
Materials/Methods: This nitinol filter has a self-aligning non-tilt design, with a hookless double-ring for fixation. It can be inserted through 6-F introducer system through the brachial, the jugular, or the femoral vein. Filter retrieval is performed with a multi-loop snare through a 7-F sheath. *In-vitro* tests were performed in a flow model for clot- trapping efficiency, migration, stability. Until February 2004, the filter was implanted in 12 patients. Follow-up studies by clinical exam, duplex ultrasound and abdominal x-ray will be performed after six months.
Results: *In-vitro study:* 20 delivery and retrieval procedures were performed successfully; 225/248 clots (90.7%), 2-4 mm in size, were trapped. Caudal or cranial migrations were not observed. *Clinical study:* the filter was inserted in four patients through the jugular and in eight patients through the femoral vein. In eight patients the filter remained *in situ* due to their clinical conditions while four filters were retrieved after 13-22 days. Follow-ups between two and 24 weeks demonstrated no DVT, migration, PE, or caval thrombosis.
Conclusion: These preliminary results demonstrate an accurate placement and retrievability and a high effectiveness of this low-profile IVC filter.

46.6.9

Tunneled peripheral venous port insertion in children: an eight-year experience

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Purpose: To review technique and outcomes related to tunneled peripheral venous ports (PVP) in children.
Materials/Methods: Since 1995, 73 PVP were placed in 65 patients (37F, 28M) aged 6-36 years (mean=15). Indications included malignancy (n=47), hematological disorder (n=16), osteomyelitis (n=2), Gaucher's disease (n=2), fibromatosis (n=2), other (n=4). Most were placed without GA (n=20), under conscious sedation (n=46) or local anesthesia (n=7). The left arm (n=54) and the basilic vein (n=52) were preferred to the right arm (n=19) and brachial vein (n=21).
Results: The catheter tip was usually placed at the SVC/RA junction (n=64), with the remainder in the proximal RA (n=8) or proximal subclavian vein (n=1). Paresthesia of the forearm required port removal in two children. Delayed complications included site infection (n=2), catheter infection (n=3), cellulitis or necrosis (n=2), thrombosis (n=1), and phlebitis (n=1). Thirty ports were removed electively after 60-1620 port-days (mean= 321) and 11 non-electively after 15-150 port-days (mean=60). Thirty-two ports remain functioning after 15-1440 port-days (mean=450).
Conclusion: Peripheral tunneled venous port insertion is safe and effective in children, and is a cost-effective alternative when done with conscious sedation in Interventional Radiology.

46.7.1.

Sensitivity of MRI and CT for endoleak detection after endovascular aneurysm repair

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Purpose: Diagnostic accuracy of MRI and spiral CT for endoleak detection.
Materials/Methods: Follow-up of 52 patients (age 71.1±6.9) after endovascular aneurysm repair (EVAR) using CT (slice thickness 3mm, reconstruction interval 2 mm, unenhanced and biphasic contrast enhanced) and MRI (1.5 Tesla, T2w-TSE, T1w-Flash-2D unenhanced, Flash-3D-angio, T1w-Flash-2D contrast enhanced) at 48 hours, 3, 6, 12 months and yearly. Endoleak size was categorized as A <3%; B 3%-10%; C 10%-30%, D >30% of the cross-sectional aneurysm area. Consensus reading of CT and MRI was the standard of reference.
Results: 141 of 252 data sets demonstrated endoleaks: Type I, II, III, IV, and combined endoleaks in 3.2%, 40.1%, 6.7%, 2.0%, and 4.0%. Sensitivity for endoleak detection was 92.9%, 43.3%, 34.0%, and 37.6% for MRI, biphasic CT, uniphasic arterial CT, and uniphasic late CT, respectively. The negative predictive values were 91.7%, 58.1%, 54.4%, and 55.8%. The overall accuracy of endoleak sizing was 95.2%, 57.5%, 55.2%, and 56.8%, respectively.
Conclusion: MRI is significantly superior to biphasic CT for endoleak detection and rating of endoleak size, followed by uniphasic late and uniphasic arterial CT scans. Endoleak rates reported after EVAR substantially depend on the imaging modalities used. Reporting standards for endoleak detection should be defined.

46.7.2.

Stent-graft repair for traumatic thoracic aortic injury

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Purpose: The purpose of this study was to evaluate medium and long-term outcome in patients treated for thoracic aortic injuries by means of endovascular repair.
Materials/Methods: Sixteen consecutive patients (mean age 39 years, range 19-82) with traumatic rupture of the otherwise unremarkable descending aorta, were treated by implantation of Talent (n=8), Vanguard (n=5), and Excluder (n=3) self-expanding devices between January 1996 and January 2004. Thirteen patients had acute traumatic dissection and three patients chronic traumatic aneurysms. The efficacy of the procedure was assessed at radiological and clinical follow-up studies at 6 and 12 months after intervention and yearly thereafter.
Results: The immediate technical success rate was 94% (15/16). One patient showed a proximal type I endoleak which was treated successfully by an additional stent-graft procedure. Secondary success rate was 100%. The mortality rate was 0%. Two additional stent-graft procedures were performed due to type I endoleaks after 18 and 28 months. There was no other intervention-related morbidity or mortality during the mean follow-up time of 29 months (range 4-96).
Conclusion: Endovascular stent-graft repair of traumatic thoracic aortic injuries is a safe, effective, and low morbidity alternative to open surgery and has promising medium-term and long-term results.

46.7.3.

Medium-term results after endovascular repair of arteriosclerotic descending thoracic aortic aneurysms

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Purpose: The purpose of this study was to assess morbidity and mortality rates after endovascular stent-graft treatment in atherosclerotic (non-dissecting) arteriosclerotic descending thoracic aortic aneurysms (TAAs).
Materials/Methods: Thirty-five patients with symptomatic or progressive atherosclerotic TAAs underwent endovascular stent-graft repair between May 1997 and January 2004. Procedures were performed on an emergency basis in 15 patients and elective in 20 patients. Patients were assessed clinically and by routine CT-scan postoperatively, at 6 and 12 months, and yearly thereafter.
Results: Stent-graft placement was successful in all but 1 patient. Perioperative mortality rate was 20% including 3 bleeds, 3 cardiac events and 1 respiratory failure (7/35). Technical success rate was 55%. Completion CT scans performed in 33 patients within 2 days post stent-grafting showed type I leaks in 8 patients (24%), type II leaks in 4 patients (12%) and type III leaks in 2 patients (6%). Further complications included 1 stroke, 1 paralysis, 1 anterior spinal syndrome. New onset endoleaks were observed in 7 patients. Seven type I leaks occurred after 3, 4, 7, 8, 17, 25 and 26 months. Mean follow-up was 18 months (range 2-76 months).
Conclusion: Thoracic aortic atherosclerotic aneurysm stent-grafting is feasible but not without relevant morbidity and mortality.

46.7.4.

Indications, morbidity and mortality of thoracic stentgrafting: experience with 83 patients

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Purpose: To report indications, intervention strategies, morbidity, and mortality of thoracic stengraft implantation in a monocenter since 1997.
Materials/Methods: Eighty-three patients (28 aortic dissections, 16 thoracic aneurysms, 15 false aneurysms, five dissecting hematomas, 11 isthmic ruptures, seven aortic ulcers, one post-surgey rupture) were treated with implantation of a stentgraft (77 Medtronic devices; five Cook devices, one Gore device). Indications were drawn by a multidisciplinary consensus and contraindications to surgery were present.
Results: A technical success was achieved in 100% and technical experience will be reported. At early follow-up, additional intervention with a new stentgraft implantation was performed in five cases because of persistent signs of rupture. Associated procedures were necessary in five cases (renal stenting, embolization, carotid-subclavian bypass). Immediate complications were iliac ruptures (n=3), extensions of aortic dissection (1), muscular hematoma (1), paraplegia (1 patient with abdominal aneurysm repair at the same time). Late complications were stentgraft migration (two cases) and endoleaks (seven cases). Post-operative mortality occurred in 7/83 (8%) patients and within one year in 13/83 in total.
Conclusion: Thoracic stentgrafting is a life-saving in emergency and should be recommended for thoracic aortic disease when contraindications to surgery are present.

46.7.5.

Stent-grafting of acute traumatic aortic rupture: medium-term results

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Purpose: To evaluate retrospectively our experience with endovascular treatment of traumatic rupture of the thoracic aorta with various stent-grafts.
Materials/Methods: Fifteen men were treated for acute traumatic rupture of the thoracic aorta using endovascular prostheses. Depending on size of the lesion, age, and comorbidity, endovascular prostheses were chosen for the procedures. Fourteen patients received a commercially available graft (Excluder n=7, Talent = 7, Corvita = 1), and a single patient received a specially tailored graft.
Results: The delay between accident and treatment was 14 hours (range, 5-32). Seven patients were treated under local anesthesia and six under general anesthesia. There were no procedure-related complications. During a mean follow-up of 29 months (range, 3-52 months) the aneurysm size of the ruptured aorta remained unchanged or became smaller in all except one patient who died on the third day after the intervention due to secondary aortic rupture. Reintervention was necessary in one patient.
Conclusion: Acute traumatic rupture of the thoracic aorta may be successfully and safely treated under local or general anesthesia using an endovascular prosthesis in both young and elderly patients. Computed tomographic imaging follow-up is necessary, especially in the early postoperative days.

46.7.6.

Endovascular repair of ruptured or symptomatic abdominal aortic or iliac aneurysms compared with open surgery

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Purpose: To assess the proportion of patients presenting ruptured or symptomatic abdominal aortic or iliac aneurysms (AAIA) in whom endovascular repair (EVR) is applicable and compare outcomes with open surgery (OS).
Materials/Methods: Between 2001 and 2004, 38 patients presenting ruptured or symptomatic AAIA were treated in our institution. EVR was attempted whenever possible. In all other cases (adverse anatomy, severe hemodynamic instability, device or operator unavailability), patients were treated by OS.
Results: Sixteen patients were treated using adapted designed aortoiliac endografts (12 bifurcated, four digressive); 12 patients had ruptured AAIA with retro/intraperitoneal hematoma, and four had a symptomatic AAIA. Twenty-two patients (15 ruptured and seven symptomatic AAIA) were treated by OS. Retrospectively, of the overall number of 38 patients, 77% had a suitable anatomy for EVR, although 42% of them only underwent EVR. No early conversion from EVR to OS was performed. The 30-day mortality rate was 5% for EVR and 41% for OS (p=0.07). Among those patients with a ruptured AAIA, 30-day mortality rates were 8% for EVR and 60% for OS (p=0.04).
Conclusion: EVR is feasible in the majority of patients with ruptured or symptomatic AAIA. The gain in overall survival compared with OS seems to be significant.

46.7.7.

Ruptured abdominal aortic aneurysms treated with bifurcated stent-grafts: medium-term follow-up

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Purpose: To analyze clinical/morphological outcomes of bifurcated stent-grafts in patients with ruptured abdominal aortic aneurysms (rAAA) at medium-term follow-up.
Materials/Methods: Thirty-seven patients with rAAA (four women, mean age=73, mean AAA diameter=77 mm) were identified in a single-center prospective database of patients who underwent endovascular abdominal aneurysm repair between June 1997 and July 2003. Inserted devices were: Vanguard® (n=7), Excluder® (n=25), Talent® (n=2) and Zenith® (n=4). Except for an additional post-implantation CT-scanning, imaging follow-up was the same as for non-ruptured AAAs.
Results: Mean follow-up was 24 (1-59) months; technical success rate 81%. Mean intensive care unit stay was 3.1 days; 30-day mortality 10.8%. Three patients died during the follow-up of unrelated causes. One patient was early converted for a presumed renal overstent-grafting. There were nine early or late type-I or type-III endoleaks requiring stent-graft extension and two type-II leaks requiring embolization. Percutaneous thrombolysis was performed in two patients with limb thrombosis. Late conversion rate was 9%: stent-graft migration (n=2) or infection (n=1). Maximal AAA diameter increased in 8% and decreased in 36% of patients during follow-up.
Conclusion: Although reintervention rate for rAAAs treated with bifurcated stent-grafts is relatively high, AAA re-rupture at medium-term follow-up can be prevented with these devices.

46.7.8.

Endovascular stent-graft placement in patients with traumatic rupture of the thoracic aorta

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Purpose: To evaluate effectiveness of the endovascular treatment in patients with traumatic rupture of the thoracic aorta following vehicle accidents.
Materials/Methods: Between March 1998 and January 2004, 14 patients (ten men, four women, mean age 37.5 years) were hospitalized for traumatic rupture of the thoracic aorta with associated visceral lesions and bone fractures. All cases were managed endovascularly, by implanting one or more stent-graft segments (Medtronic-Talent) in the ruptured thoracic aorta. Two patients also required concomitant procedures for associated cardiovascular or visceral lesions. One patient with a concomitant traumatic pseudoaneurysm of the brachiocephalic trunk underwent aortic and supraortic vessel stenting.
Results: The endovascular procedure was technically successful in all cases. In a mean follow-up time of 2.5 years, 12/14 patients are alive and in good health. One patient died two days after stent-graft implantation for post-traumatic multiorgan failure, while another patient died for a non-related cause (pulmonary cancer).
Conclusion: Our experience suggests that stent-graft placement, a minimally invasive procedure, can be proposed as an emergency procedure in patients with traumatic rupture of the thoracic aorta at risk of massive hemorrhage.

46.7.9.

Endovascular thoracic aortic stent-graft: a five-year experience

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Purpose: To evaluate effectiveness of the endovascular stent-graft treatment for thoracic aorta aneurysms.
Materials/Methods: In a five-year period, 67 patients (mean age 58.2 years) underwent thoracic aorta stent-graft placement. Patients were classified into three groups, according to the lesion type: atherosclerotic aneurysms (26), traumatic isthmic pseudoaneurysms (14), type-B aortic dissections (27). Access routes were: the common femoral artery in 42 cases, the common iliac artery in ten, and the abdominal aorta in 15 cases, for a coexisting peripheral arteriopathy. A femoral access is not always possible in deseased peripheral vessels, an iliac or abdominal aortic surgical route is therefore suggested. Stent-grafts superimposed the left subclavian artery in 15 cases. The devices employed were Medtronic Talent and Gore Excluder.
Results: A procedure-related mortality occurred in three patients, while unrelated deaths occurred in two. No major complications occurred in the remaining 62 cases. In a mean follow-up period of 16.2 months, CT scans showed a type-I endoleak in three patients.
Conclusion: Thoracic aorta stent-graft placement, which carries less morbidity and mortality than surgery, can be proposed as a possible therapeutic option for aortic aneurysms of different etiology.

P1.

Radiological placement of peritoneal ports under sonographic and fluoroscopic guidance for the palliative treatment of malignant ascites

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Purpose: To report and describe a minimally invasive method for palliative drainage of symptomatic malignant ascites by placing a peritoneal port in the interventional suite, allowing paracentesis to be performed by the palliative care team at home.
Materials/Methods: Since 2002, 750 patients have received chest/brachial ports in radiology. The procedure was modified for the placement of tunnelled multiple-sided holed peritoneal ports using a modified Seldinger technique. To date, no description in the literature of how to perform the procedure in the interventional suite was found. Ultrasound evaluation of the vasculature of the abdominal wall and of the peritoneal cavity to find a large pocket of ascites is initially performed. All procedures were performed on an outpatient basis using only buffered 2% xylocaine without conscious sedation. Unlike previously described methods, the procedure does not require surgical intervention.
Results: Patients with symptomatic ascites were able to be drained at home with improvement in symptoms attributable to the ascites. Currently, the complication rate is much lower than with tunnelled peritoneal catheters and with surgery.
Conclusion: Percutaneous placement of peritoneal ports in the interventional suite appears to be a viable and safe technique in patients who have symptomatic ascites that requires frequent therapeutic paracenteses.

P2.

The North Staffordshire experience of enteral stents in palliation of inoperable malignant obstructing colonic strictures

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Purpose: To evaluate the effectiveness of enteral stents in the management of inoperable malignant colonic strictures.
Materials/Methods: All patients who were managed with colonic stent insertion from November 2000 to February 2003 were included in the study. The notes were reviewed and patients followed to discharge/death. There were 18 patients in our study. Twelve were men and six women. Fifteen had primary colonic malignancy and three had secondary metastatic peritoneal disease causing extrinsic compression. Seventeen patients had incomplete and one had complete obstruction. There were 16 lesions in the rectosigmoid and two in the descending colon.
Results: Nineteen procedures were performed: 18 were radiological and one dual. Primary deployment was successful on 18 occasions and failed once with a success rate of 94.7%. There were no immediate complications. There were delayed complications in two patients (one stent passed PR at day six, and one ingrowth at 4.5 months). The survival ranged from 7 to 345 days (mean: 85 days) including one alive patient.
Conclusion: Radiological insertion of colonic stents is successful in palliation of inoperable malignant obstructing colonic strictures. They are associated with fewer complications compared with surgical options.

P3.

Subphrenic hepatic lesions: is percutaneous treatment with radiofrequency ablation technically feasible?

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Purpose: To assess technical peculiarities and feasibility of radiofrequency ablation (RF) of subphrenic hepatic lesions.
Materials/Methods: Nineteen patients with focal subphrenic hepatic lesions [eight hepatic cell carcinomas (HCC), 11 metastases] underwent percutaneous CT-guided RF ablation. Electrodes with seven or nine active tips were used. Although technically difficult because of the great needle angulation and penetration of a long hepatic portion, a transhepatic route through subcostal or intercostal spaces was applied in all cases. Transpulmonary penetration was considered at high-risk for complications due to the large diameter of the electrode.
Results: All the lesions were successfully approached and presented a cystic appearance immediately after the procedure thus suggesting their necrosis. Patients experienced only a mild discomfort. Three complications developed: two small subcapsular hematomas and one pleural effusion, treated conservatively. During follow-up, 75% of HCCs and 81.2% of metastatic lesions presented signs of complete necrosis. In four cases of residual non-necrotic tumor and two tumor recurrences, repeated RF sessions were required.
Conclusion: Hepatic dome lesions can be successfully treated with RF ablation, but should be carefully planned and performed by skilled radiologists.

P4.

Percutaneous radiological gastrostomy: new modifications

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Purpose: To describe percutaneous radiological gastrostomy (PRG) and to detail new developments in gastrostomy tube placement.
Materials/Methods: PRG involves the placement of a tube into the stomach for feeding. T-fastener gastropexy is routinely performed. Because of difficulties with catheter clogging and displacement, recent trends include placing pull-type PEG tubes radiologically or placing gastrostomy button catheters *de novo*. Advantages of percutaneous endoscopic gastrostomy (PEG) tubes include their robust nature and good retention. Button advantages include lack of clogging and patient preference.
Results: Technical success rate is close to 100%, though a significant number requires replacement. Complications include peritonitis, due to leakage or intraperitoneal siting of the tube, and puncture of colon or liver.
Conclusion: From a large experience, standard gastrostomy tube replacement, button PG tubes and percutaneous placement of PEG-type tube will be discussed.

P5.

The value of marking the upper GI bleeding site with metallic clips or wolfram powder during gastroscopy before arterial embolization

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Purpose: The purpose was to evaluate a new technique to mark the bleeding site during gastroscopy. With a radiopaque marker that can be detected with flouroscopy it should be easier to find the bleeding site during the arterial embolization of upper GI bleeding.
Materials/Methods: In 15 patients with upper GI bleeding 10 bleeding sites were marked with metallic clips and 5 with wolfram powder (Tungsten) during gastroscopy. All bleeds were severe and the patients were referred for arterial embolization of the bleeding vessels.
Results: In all patients the marker could be detected with fluoroscopy and made it easier to find the bleeding vessel during the embolization procedure. The marker seemed to make the procedures quicker with more accurate embolization of the bleeding vessel. No complications due to the marking procedure were found.
Conclusion: Marking the bleeding site during gastroscopy can be most helpful during subsequent arterial embolization, especially if there is no extravasation of contrast.

P6.

Colonic stents in acute malignant colorectal obstruction: 80 cases

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Purpose: To describe our experience with colonic stents in the treatment of acute obstruction from colorectal cancer. Results and complications of the procedure based on a series of 80 patients.
Materials/Methods: Between July 1997 and December 2003, 80 patients with acute colonic obstruction were treated with colonic stents in our department. Procedure, indications, contraindications, and results are described and illustrated. Before the procedure, a plain abdominal radiography and an abdominal CT-scan was performed in all patients. Two different types of colonic stents were used: enteral Wallstents (Boston Scientific) and Hanarostent (MI Tech. Co. Ltd.)
Results: A clinical resolution of the obstruction was achieved in 84% (67/80) of cases. Major complications developed in 13/80 (16%, five perforations, five obstructions, and three migrations). Palliative treatment was effective in all cases. Anastomosis was successfully performed in 60 (90%) of the 67 patients undergoing surgery.
Conclusion: The use of colorectal stents is a good method to resolve acute colorectal carcinoma obstruction and allows elective surgery to be performed in optimal conditions. It also represents a good alternative as a palliative option in unresectable malignant obstructions. We consider it a safe technique because of its low rate of major complications.

P7.

Palliative treatment of malignant dysphagia with self-expanding metallic esophageal stents: long-term results of a multicenter prospective study

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Purpose: To assess the effectiveness of self-expanding metallic endoprostheses in the palliative treatment of malignant dysphagia in a large multicentric study carried out during 12 years.
Materials/Methods: From January 1992 to January 2004, 321 patients (279 men/42 women, mean age: 70 years) received 434 prostheses to treat severa dysphagia. Three groups were created and compared, according to the stent used (uncovered Wallstents, 257; covered Wallstents, 158; non-Wallstent prostheses, 19). These groups were deeply studied by statistical methods (Kaplan-Meier survival curves, Fischer, Kruskal-Wallis and Log-Rank test).
Results: Dysphagia was effectively palliated in all cases (a decrease of 2-3 points). Complication rates were 27% (uncovered Wallstents), 14% (covered Wallstents), and 35% (non-Wallstents). Survival ranged from two to 780 days (mean =199 days). Thirty-day mortality was 20%. Until today, 314 patients have died and seven are still alive.
Conclusion: Self-expanding metallic endoprostheses provide a rapid and safe palliative treatment of malignant esophageal inoperable stenoses. Cumulative patency rates and long-term survival were similar between the first two groups, although covered Wallstents have a lower complication rate. Both Wallstent groups provided better results as compared with the non-Wallstent prostheses group.

P8.

Medium-term results of endovascular aneurysm treatment

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Purpose: To determine results and complications of endovascular aneurysm treatment (EVAR) at medium-term follow-up.
Materials/Methods: One-hundred twenty-two patients (age 70.9±7.9 years) were treated with stentgrafts (Vanguard/Stentor n=53, Talent=69). In 40, aortic tributaries of the aneurysm sac were occluded before stentgrafting (group I), spontaneously or by coil embolisation. Group II included cases with at least one patent vessel (n=82). Follow-up included spiral-CT, MRI and radiography postinterventionally, at three, six, 12 months, and yearly.
Results: Mean follow-up was 37±21 months. Thirty-day mortality was 0.8% (myocardial infarction). In 29 patients (23.8%) a total of 47 reinterventions were performed (percutaneous in 23, operative in 24). Eleven conversion operations were performed (damage to the membrane n=4, migration n=5, and two aneurysm rupture (Type I endoleaks). Compared with group II, the incidence and size of endoleaks was reduced in group I (incidence 19.2% versus 29.9%, $p<0.05$). Group I demonstrated significantly better aneurysm shrinkage (D diameter at 36 months -11.1±8.4 versus -4.9±6.2 mm, $p<0.05$).
Conclusion: Endovascular aneurysm treatment is an effective alternative to open surgery. It is safely performed in local anesthesia with low mortality and morbidity. Medium-term follow-up requires reintervention in approximately one-quarter of patients. Primary coil embolisation of all aortic side branches improves clinical outcome.

P9.

Contrast-enhanced ultrasonography (CEUS) with second-generation contrast agents to follow up patients with aortic endoprosthesis: an alternative to multidetector computed tomography (MDCT)?

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Purpose: To estimate contrast-enhanced ultrasound (CEUS) accuracy in evaluating aortic endoprosthesis and compare CEUS with multidetector-CT (MDCT) during follow-ups.
Materials/Methods: Sixteen patients with aortic endoprosthesis were blindly examined by colour-power-Doppler (CPD) and CEUS (Esaote Technos MPX and Bracco SonoVue); the results were compared with MDCT results (performed with a dedicated protocol), considered as the gold standard. We compared aneurysmatic sac diameters, detection and characterization of endoleaks (according to White's classification) and detection of any endoprosthetic thrombi. Diagnostic confidence of CEUS versus CPD was also compared.
Results: Sac measurements matched in all patients with both methods, as well as average values (CEUS: 53.9 mm, MDCT: 53.5 mm). CEUS correctly identified 10/10 patients without and 5/6 (sensitivity=83%) with endoleaks, also identifying endoleaks' type in all but one. One patient with a type-II endoleak from the lumbar artery was negative at US due to body habitus. In one case, both methods showed small endoprosthetic thrombi. Diagnostic confidence of CEUS compared with CPD was 90 versus 70%.
Conclusion: CEUS seems to be accurate enough to be introduced as a complementary imaging modality in the follow-up of patients with aortic endoprosthesis. It could reduce MDCT examinations, costs, and radiation exposures.

P10.

Emergency endovascular treatment of acute aortic pathology

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Purpose: To assess the safety and efficacy of emergency endovascular treatment of acute aortic pathology.
Materials/Methods: In 14 patients (median age: 53 years, range: 18-85) with acute pathology of the descending aorta emergency endovascular treatment was performed, implanting 18 stentgrafts (Talent n=14, Vanguard/Stentor n=4): traumatic rupture (n=6), penetrating ulcer with aortobronchial fistula or hematothorax (n=4), acute Type B dissection (n=3, one with penetration, one with subacute mesenteric ischemia), and symptomatic aneurysm of the thoracic aorta (n=1).
Results: Seventeen of 18 procedures were performed using a femoral or iliac approach. One required aortofemoral bypass grafting because of extensive arteriosclerotic stenosis, and the stentgraft was inserted via the bypass graft. Median follow-up is 36 months (range: 1-84). In all traumatic ruptures, bleeding was immediately stopped and follow-up was unremarkable. In aortobronchial fistulas results were satisfactory despite need for reintervention and graft extension. In one acute Type B dissection, retrograde dissection of the aortic arch occurred during stent release. In another Type B dissection, with mesenteric ischemia, blood flow was restored but the patient died with total necrosis of the small intestine.
Conclusion: Endovascular treatment is safe and effective for emergency treatment of life threatening complications in selected acute aortic syndromes.

P11.

Medium-term results of endovascular aortic stent-graft placement in treating aortic dissection

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Purpose: To describe our medium-term results with endovascular stent-grafts placement for the treatment of patients with aortic dissection.
Materials/Methods: Of 34 patients with aortic dissections with descending tears treated with endovascular stent-grafting, 24 patients were followed up over 24 months after stent-grafting. Two patients had acute type A, 14 patients had acute or subacute type B, and 8 patients had chronic type B dissection. The stent-grafts were composed of modified Z-stents or original curved Z-stents covered with woven polyester graft material. Stent-grafts were placed to close entry tears in all patients through delivery systems introduced from the common femoral artery using the tug of wire technique.
Results: The false lumen of the descending aorta was thrombosed completely in over 80 % and the false lumen disappeared in 40-70 % of cases. Late complications occurred in seven patients (29.2 %; 3 intimal injuries at the edge of stent-grafts, 3 newly appeared intimal tears, 1 false lumen enlargement). In all 7, secondary stent-grafting was performed.
Conclusion: Entry closure with endovascular stent-graft placement may be a safe and effective method in treating aortic dissection. However, strict patient selection and close follow-up seem mandatory.

P12.

Treatment of descending thoracic aortic aneurysms with endovascular stent-grafting

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Purpose: To present our results with endovascular stent-graft aortic repair (EVAR) in a treatment of descendent thoracic aortic aneurysms. Aneurysm of descending thoracic aorta is a life-threatening condition, with high morbidity and mortality rates despite improvements in the surgical treatment and post-operative care. EVAR has been recently introduced to treat thoracic aortic aneurysms.
Materials/Methods: Fourteen patients (mean age: 61.3 years) with descending thoracic aorta aneurysm underwent EVAR. Seven patients had a dissection aneurysm, six had a false aneurysm following a trauma, and one had a saccular aneurysm due to syphilis.
Results: The clinical success of EVAR was evaluated by spiral computed tomography angiography and clinical examination. The study period ranged between six months and four years (average: 12.4 months). In all the patients the aneurysm was successfully excluded and there were no signs of endoleaks or other complications. One patient with a Stanford-B dissection died 17 days following stent-grafting. One patient with post-traumatic aneurysm and multiorgans failure died three days following stent-grafting.
Conclusion: In patients with well-defined indications, EVAR is an alternative to aggressive open surgery repair for aneurysms of descending thoracic aorta, although further investigations are needed for final conclusions.

P13.

Endovascular repair of infrarenal abdominal aortic aneurysms: our experience

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Purpose: To present our experience after 2 years performing endovascular repair (EVR) of infrarenal abdominal aortic aneurysms (AAAs), including complications and methods for avoiding complications.
Materials/Methods: During a two-year period, 63 patients with infrarenal AAA were referred for EVR. Stent selection was done after abdominal helical computed tomography (CT) and angiography. The procedure was performed under local anesthesia. Available stents were both suprarenal and infrarenal fixation devices. An immediate postprocedural angiography was done, and follow-ups with CT done at one month, three months, six months, and yearly thereafter.
Results: There were 34 male and 29 female patients. Mean age was 73 years. In 28 patients an infrarenal fixation device was placed and in 35 a suprarenal device. No open conversions were necessary. Short term complications were one type I endoleak which was treated with an extension device, and three type II endoleaks, which resolved spontaneously. Also, in one patient a right common iliac artery thrombosis was treated with a femoro-femoral bypass.
Conclusion: After two years, our EVR program for AAAs shows an acceptable short-term success rate, probably based on strict patient selection criteria. More time is needed to evaluate our long-term success rate.

P14.

A review of percutaneous kyphoplasty for osteoporotic and metastatic compression fractures

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Purpose: Kyphoplasty is a fairly new interventional spine technique used to treat osteoporotic and metastatic compression fractures. By utilizing a bone tamp, a cavity is created within a fractured vertebral body. This allows the administration of a more viscous cement injected under lower pressure than compared with vertebroplasty. Plus, vertebral body height can be improved in most cases. Although kyphoplasty has been widely performed by orthopaedic surgeons and neurosurgeons in the United States, many Interventional Radiologists have been recently trained.
Materials/Methods: This scientific exhibit will discuss the techniques and tips involved in performing kyphoplasty. Numerous examples of kyphoplasty will be shown so that Interventional Radiologists will be more knowledgeable about this therapy for compression fractures and thus be able to offer this treatment modality for their patients.
Conclusion: Kyphoplasty is basically an extension and improvement over vertebroplasty for osteoporotic and metastatic compression fractures. Interventional Radiologists should become familiar with this treatment modality for osteoporotic compression fractures since more referring physicians and patients will be requesting this procedure.

P15.

Radiofrequency ablation therapy combined with cementoplasty for painful metastatic bone tumors

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Purpose: To evaluate the safety and efficacy of radiofrequency (RF) ablation therapy combined with cementoplasty for metastatic bone tumors.
Materials/Methods: Seventeen patients with 24 painful metastatic osteolytic tumors underwent this combined therapy between October 2001 and January 2004. The mean tumor size was 52×40×59 mm. Lesions' locations were the spine (n=9), the pelvic bone (n=10), and others (n=5). Percutaneous RF ablation was performed first and thereafter, bone cement was injected into the lesions under general anesthesia, computed tomography and fluoroscopic guidance. Face pain scale and reduction of analgesics were evaluated before and after the treatment.
Results: All procedures were successful. Fifteen out of 17 patients showed pain relief (88%) and analgesics reduction was achieved in six out of 17 patients (35%) after the treatment. No major complications occurred.
Conclusion: This combined therapy is safe and effective to alleviate pain caused by metastatic bone tumors. RF ablation has the advantage of treating those areas where bone cement cannot be injected, especially larger metastatic bone tumors.

P16.

Image quality and procedural safety in low- and ultra-low dose CT-navigated pelvic interventions

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Purpose: To evaluate image quality in CT-guided closed reduction and percutaneous screw fixation (CRPF) of pelvic ring fractures after step-by-step reduced radiation doses.
Materials/Methods: Patients with pelvic ring fractures treated with CT-guided CRPF were prospectively studied. They received two screws which were navigated over guide-pins. The imaging system used was a MSCT Somatom VZ (Siemens, Germany). Starting with 200 mA (routinely used for interventional procedures) the tube current was then subsequently reduced by 50% if the image quality was good.
Results: Fourteen patients with 17 fractures underwent CRPF. Dose reduction due to good image quality was possible in all patients. The lowest technique used resulted in good image quality in the following patients: 50 mA (n=4), 25 mA (n=4), 12.5 mA (n=9). There were no fallbacks to higher-dose levels due to image quality. No screw displacement occurred. Immediate procedural outcome was not affected.
Conclusion: By lowering scan doses to appropriate levels no relevant morphological information needed for a safe instrument or implant guidance is lost and procedural outcome is not affected. In light of these findings, scan protocols can be changed to lower mA values.

P17.

Diagnosis of coronary artery stenosis by 16-detector computed tomography scanner: effects of heart rate and ejection fraction

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Purpose: Heart rate and ejection fraction effects assessment in coronary arteries using a 16-detector computed tomography (CT) scanner.
Materials/Methods: Cardiac phantom studies using a 16-detector CT scanner, 0.625-mm thickness, 0.5-second/rotation with an electrocardiogram trigger were performed. The cardiac phantom reproduced the left ventricle and the coronary arteries and simulated cardiac motion with variable heart rate and cardiac output. To evaluate the effect of heart rate, CT studies using various heart rates and arrhythmia models were performed. To evaluate the effect of ejection fraction, CT studies using various ejection fractions were performed. Images were reconstructed with 0.625-mm thickness using cardiac half-reconstruction and multi-sector reconstruction. They were then compared and image quality was evaluated.
Results: In regular cardiac rhythm models, a decreased image quality was observed because of an increased heart rate. In arrhythmia models, image quality was lost as compared with regular cardiac rhythm models, due to banding artifacts. A decreased image quality was observed because of an increased ejection fraction. Multi-sector should be preferred to half-reconstruction to avoid banding artifacts.
Conclusion: The influence of heart rate and ejection fraction was confirmed. The employement of better imaging protocols to evaluate coronary arteries using a 16-detector CT scanner revealed to be useful.

P18.

Bovine jugular xenograft in pulmonary position: follow-up with multislice ECG-gated computed tomography

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Purpose: To evaluate outcome of bovine xenograft conduits in pulmonary position with multislice ECG-gated CT.
Materials/Methods: Fifty-six patients, mean age 16±15 years, were discharged after implantation of a bovine xenograft conduit. Xenografts were implanted for pulmonary valve replacement during Ross operation (n=21), pulmonary atresia with ventricular septal defect (n=6), tetralogy of Fallot (n=5), right ventricle double outlet (n=5), pulmonary valve regurgitation (n=5), truncus arteriosus (n=4), Taussig-Bing (n=2), or double discordance (n=1). Conduit sizes ranged from 14 to 22 mm. Fourteen of the 56 patients underwent follow-up study with ECG-gated multislice cardiac CT after IV injection of contrast media. Axial images as well as 2- and 3-D reformations were obtained for a combined analysis.
Results: The mean follow-up was 29.4 months (1-52 months). Three patients had conduit-related mechanical complications: in two patients, a kinked conduit was treated with surgery in one case and with endovascular stenting in the other one; one asymptomatic patient had a moderate stenosis. No dilatation were seen; calcifications were observed only in one young adult (2 mm).
Conclusion: Multislice ECG-gated CT provides high-quality images to assess dilatations, calcifications, and stenoses of bovine conduit xenografts.

P19.

MRI evaluation of early right ventricle volume and function changes following transcatheter atrial septal defect closure with Amplatz umbrella devices

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Purpose: To evaluate early effects of elimination of right ventricle (RV) volume overload, in terms of RV and left ventricle (LV) volume and function, after percutaneous transcatheter closure of secundum atrial septal defects (ASDs) with Amplatz umbrella devices.
Materials/Methods: Eighteen patients, (11 women, age range: 7-45 years) with ostium secundum ASDs were imaged prior and 1-3 months post-ASD closure with Amplatz umbrella device. MRI was performed on a 1.5T-scanner using a phased-array cardiac coil. MRI evaluation included RV and LV volume and ejection fraction, aortic and pulmonary blood flow measurements.
Results: All patients demonstrated increased RV volumes (EDV 237±72ml, ESV 100±33ml) and pulmonary artery flows (126±49 ml/min) on the preprocedural examination with left-to-right shunt 2±0.7 to 1 (range 1.2 - 3.9 to 1). Left-to-right shunt was eliminated after ASD occlusion (post-procedural left-to-right shunt 1±0.15 to 1) with RV EDV volume 152±58 ml and ESV 78±33 ml. ASD closure significantly decreased pulmonary stroke volume from 112± 42 ml to 64±2 ml ($p<0.05$) and significantly increased systemic stroke volume from 56±18 ml to 67±19 ml ($p<0.05$).
Conclusion: Transcatheter occlusion of ostium secundum ASDs results in obliteration of left-to-right shunt, early reduction of RV volume overload, and improvement of LV stroke volume.

P20.

Quantitative coronary arteriography: a new way to analyze progression of coronary stenoses to total occlusion

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Purpose: The aim of this study was to assess those risk factors determining the progression of coronary stenoses (CS) to total occlusion.
Materials/Methods: The study group included 110 patients (53±8 years) with 149 CS evaluated by quantitative coronary arteriography (QCA), including percent diameter stenosis (%DS) and obstruction diameter (OD). The influence of risk factors was assessed. Progression of coronary artery disease to total occlusion was identified in 19 lesions (17 patients=13%). Progression of CS to total occlusion was evaluated in regard to various groups of CS (mild and moderate: <50%DS, significant: 50-70%DS, severe: >70%DS).
Results: Progression of CS to total occlusion was found in eight (42%), four (21%) and seven (37%) in the three groups respectively ($p=0.03$). Smoking and high triglycerides were more frequently observed in the patients who showed progression to total occlusion. Increased cholesterol was present in 9/14 (64%) patients with progression to total occlusion, and in 22/91 (24%) patients without progression to total occlusion ($p=0.006$).
Conclusion: Progression of coronary artery disease may be associated with any degree of CS. In this group of patients, high cholesterol was also significantly associated with a progression of CS to total occlusion.

P21.

Carotid stenting combined with a distal filter protective device is safe and effective – the MAVErIC (evaluation of the Medtronic AVE self-expanding carotid stent system with distal protection in the treatment of carotid stenosis) international study

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Purpose: Embolization of atheromatous material during angioplasty and stent deployment is a risk during carotid artery stenting procedures. MAVErIC International evaluated the safety and feasibility of using the Medtronic self-expanding carotid stent (Exponent) combined with a distal filter device (Medtronic Interceptor Carotid Filter System) in patients with carotid artery stenosis at high risk for carotid endarterectomy.
Materials/Methods: Fifty-one patients [mean age 69, 84.3% (43/51) men] amenable to percutaneous treatment with stenting were enrolled. All patients received a clinical follow-up examination 30 days post-procedure.
Results: Fifty-two procedures were performed. Filter delivery success rate was 94.2% (49/52), and subsequent carotid stent delivery success rate 95.9% (47/49). Mean diameter of the target stenosis was reduced from 61.9±10.2% to 20.8±13.3%. All filters deployed and analyzed (n=45) contained particulate matter. Three major adverse events occurred (overall incidence 5.9%) during the 30-day follow-up: one peri-procedural stroke; one post-procedural stroke; onedeath (post-procedural myocardial infarction).
Conclusion: Treatment of carotid artery disease with the Exponent carotid stent combined with distal protection using the Interceptor filter system is effective and safe, with a 30-day major adverse events rate comparable with equivalent clinical studies. Data from six- and 12-month follow-up will be presented.
*for the MAVErIC International Investigators

P22.

Percutaneous vertebroplasty in multiple myeloma

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Purpose: Severe back pain is a frequent complication of multiple myeloma (MM), the most common primary osseous malignancy. Percutaneous vertebroplasty (PV) is a relatively new technique to stabilize and provide pain relief from fragile spinal lesions of several causes, including MM.
Materials/Methods: All cases of PV for treatment of back pain due to MM at our institution between 1998 and 2003 were retrospectively reviewed. A total of 114 vertebral levels and four pelvic lesions were treated in 31 patients (21 men, ten women) with a mean age of 65 years (range, 40-89). The maximum number of levels treated in a single patient was 12 over two sessions. Baseline and post-procedure pain levels and incidence of complications were determined from the medical record.
Results: Complete pain relief was achieved in 17 patients (54.8%), 70 to 90% pain relief in six patients (19.4%), 50% pain relief in three patients (9.6%), and no pain relief in five patients (16.1%). The only symptomatic complication was a transient L5 radiculopathy, related to a small local cement leakage that spontaneously resolved within three weeks.
Conclusion: Percutaneous vertebroplasty is a safe and effective treatment for pain due to axial MM lesions.

P23.

Therapeutic radiological approach to cavernous dural arteriovenous fistulas

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Purpose: To evaluate and document the efficacy of a therapeutic radiological approach in the management of cavernous dural arteriovenous fistulas (AVFs).
Materials/Methods: Orbital color-Doppler ultrasound (US) and cerebral angiograms were performed in ten symptomatic cases to confirm the diagnosis, assess treatment options and reveal the results. Transvenous coil embolization of the cavernous sinus via the inferior petrosal sinus was performed in three cases with severe chemosis. Embolization of the dural branches of the external carotid artery with PVA and US-guided carotid-jugular compression (n=2) and US-guided carotid-jugular compression alone (n=5) was applied in the remaining cases.
Results: Transvenous coil embolization resulted in complete thrombosis of the fistula in less than one week in all three cases. In the compression alone group, complete obliteration of the fistula was achieved 48 hours after diagnostic angiography in two cases and evaluated as spontaneous thrombosis. In the remaining five cases with compression, four to eight months were needed for thrombosis and complete resolution of symptoms.
Conclusion: A radiological approach is the treatment of choice in the management of cavernous dural AVFs.

P24.

Transcatheter embolization of peripancreatic splanchnic aneurysms: clinical results and technical problems

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Purpose: To evaluate clinical results and technical problems of transcatheter embolization for peripancreatic splanchnic aneurysms.
Materials/Methods: Sixteen patients (9 men, 7 women) with peripancreatic splanchnic aneurysms (13 true aneurysm, 3 pseudo-aneurysm) underwent transcatheter embolization. Location of aneurysms were splenic artery (n=13), gastroduodenal artery (n=1), anterior and posterior superior pancreaticoduodenal artery (n=2), including two emergency cases caused by ruptured aneurysms. Larger (> 2 cm) or rapidly growing aneurysms were indications for embolization. Splenic arterial flow was intercepted using a balloon catheter in case of embolization for splenic aneurysm.
Results: In cases of splenic aneurysm, a single and proximal or central aneurysm was embolized by packing coils. Multiple and hilar aneurysms were embolized by isolation and packing coils. In splenic hilar aneurysms, partial splenic infarction was inevitable. In case of three pseudoaneurysms, the packing method was selected in 2 cases and the isolation method was selected in 1.
Conclusion: All aneurysms were completely embolized, and the technical success rate was 100%. In multiple splenic hilar aneurysms, it is necessary to choose an optimal embolization method to preserve collateral arteries, such as the left gastroepiploic artery and the short gastric artery, for prevention of total splenic infarction.

P25.

Intraperitoneal hemorrhage from ruptured hepatocellular carcinoma: emergency chemoembolization

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Purpose: To evaluate the effectiveness of transcatheter arterial chemoembolization (TACE) in the treatment of ruptured hepatocellular carcinoma (HCC).
Materials/Methods: During the last 15 years, 323 patients with HCC were treated by TACE at our institution. Seventeen (5.2%) of them had hemoperitoneum due to a ruptured tumor and underwent emergency TACE. They were 13 men and four women with a mean age of 66 years. TACE was done with gelatin sponge after injection of an emulsion of Lipiodol and Adriamycin.
Results: On angiography, the tumor was hypervascular in 13 patients and hypovascular in four. Mean tumor size was 6.76 ± 2.54 cm. Angiographic extravasation of contrast medium was seen in three (17%) patients. After TACE, a successful hemostasis was achieved in 16 (94%) patients. The 30-day mortality rate was 41%. Cumulative survival rates were 52, 45, and 15% at three, six, and 12 months, respectively.
Conclusion: Emergency TACE is an effective treatment in patients with hemoperitoneum secondary to ruptured HCC.

P26.

Long-term behaviour of uterine fibroids after flow-guided spherical particle embolisation

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Purpose: To demonstrate the outcome of uterine fibroids after spherical particle embolisation.
Materials/Methods: Since January 2001, 47 women who had been treated by uterine fibroid embolisation underwent a strict pre- and post-procedural magnetic resonance imaging (MRI) protocol to determine the natural course of embolised fibroids. Embospheres in sizes between 500-900mμ were used.
Results: All procedures but one were technically successful; the technical failure occurred as a result of a rare anatomic variation. One procedure failed clinically, requiring late hysterectomy. Otherwise no major complications were recorded. Presently, follow-up longer than 12 months is available in 24 women. In seven fibroids were no longer seen. In the other 17 the residual size of the dominant fibroid measured 29% of baseline at the 12-month interval. Clinical symptoms diminished in all, based on standardized test questionnaires for pain and menstrual blood loss. Similarly, a general health score increased from an average of 37 to 95% (100% represents the maximum) after the procedure.
Conclusion: Size-adapted and flow-controlled particle embolisation of uterine fibroids provides effective control of symptomatic myomatous disease with a high probability of significant fibroid size reduction or even elimination on follow-up as demonstrated by MRI.

P27.

Recanalization of acute and subacute thrombotic occlusions: our experience in 40 patients using a new rotational thrombectomy device (Straub-Rotarex Thrombectomy System), percutaneous transluminal angioplasty and stenting

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Purpose: To evaluate efficacy and safety of a new device for mechanical thrombectomy, the Straub-Rotarex catheter, for the percutaneous recanalization of femoro-popliteal and iliac arteries.
Materials/Methods: Between March 2001 and December 2003, 51 obstructions in 50 patients (32 men, 18 women, mean age 67 years, range 47-82), were treated. The occlusion length ranged between 3 and 25 cm (mean: 11 cm) and the mean period of occlusion was three weeks. Leriche-Fontaine classification of these cases was: IIB: 78%, III: 16%, IV: 6%. In five cases, recanalization by Rotarex alone was sufficient; in the remaining 45, percutaneous transluminal angioplasty (30) and stenting (15) were perfomed.
Results: A technical success was achieved in all the patients. Complications included three distal embolizations occurred in the group of the first ten patients before the use of a distal protection device (Boston Scientific, EPI filter), one arterial rupture of the tibio-peroneal trunk treated with a covered stent (Jostent), two pseudoaneurysms at the puncture site. After one week, two reocclusions occurred and, after three months, three restenoses.
Conclusion: The Rotarex device is a promising tool in the treatment of acute and subacute obstructions. Long-term patency and late clinical effectiveness should be critically evaluated in further studies.

P28.

Transcatheter arterial embolization for postoperative hemorrhage after abdominal surgery

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Purpose: To evaluate the efficacy, safety and clinical outcome of transarterial embolization for postoperative hemorrhage after abdominal surgery.
Materials/Methods: Thirty'six patients with clinical, endoscopic, or scintigraphic evidence of postoperative hemorrhage were considered for transarterial embolization. Urgent angiography and embolization was performed in all patients. The clinical and angiographic features were retrospectively reviewed.
Results: We performed 48 angiographic examinations in 36 patients with postoperative hemorrhage after abdominal surgery. Angiography revealed a discrete bleeding focus in 29 (81%) of 36 patients and 34 (71%) of 48 angiographies. Transarterial embolization was technically successful in 27 (93%) of 29 patients with a discrete bleeding focus. Rebleeding occurred in four (17%) of 24 patients; they were successfully managed with repeat embolization. There was no procedure-related complications during the follow-up period.
Conclusion: Angiography has a high rate of detecting the bleeding site in patients with postoperative hemorrhage after abdominal surgery. Transarterial embolization is considered to be an effective and safe procedure in the management of postoperative hemorrhage.

P29.

Embolization of uterine arteries in patients with symptomatic uterine myomas

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Purpose: To determine the efficiency of uterine artery embolization with EmboSphere™ microspheres in the treatment of symptomatic uterine myomas.
Materials/Methods: Bilateral uterine artery embolization was performed in 78 women with a unilateral femoral approach using EmboSphere microspheres sized 300-500 micrometers and Marbagelane particles. Before embolization, all the patients underwent pelvic MR examinations for measurements of the uterus and the two largest myomas. Examinations were repeated during control assessments.
Results: Bilateral uterine artery embolization was successful in 74 patients (95%). After embolization, menorrhagia was improved in 87%, bulk-related symptoms in 70%, and urinary frequency symptoms in 84% of patients. Mean volume of myomas before embolization was 181cm^3. After one year, the mean reduction of myomas' volume was 49%. The greatest volume reduction was recorded in submucosal myomas and in myomas with a diameter smaller than 8 cm.
Conclusion: Uterine artery embolization significantly improved symptoms in the majority of patients, with reduction of baseline myomas' volume in half of them. The best results are obtained in small myomas with submucosal localization.

P30.

Transcatheter hepatic artery embolization for management of traumatic liver injury

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Purpose: To analyze the effectiveness of transarterial embolization in traumatic liver injury
Materials/Methods: Retrospective analysis was performed on 14 patients with diagnosis of traumatic liver injury on abdominal CT and by angiography. Clinical manifestations, CT and angiographic and clinical followup findings were analyzed.On CT exam, extravasation of contrast media was observed in all cases.
Results: Emergency angiography followed by CT exam was performed in 9/14 patients. Liver injury was suspected on followup CT and clinical manifestation after emergent laparotomy in 4 and on followup CT during conservative therapy in 1. On Mirivus classification, CT findings were grade 3 in 6 and grade 4 in 8. On angiography extravasation of contrast media or pseudoaneurysm were observed in 13, pseudo -aneurysm and parenchymal staining in 1 patient. Transarterial embolization was done in all patients. Embolizing coils were used in all cases and gelfoam in 3. Stabilization of vital signs and normalization of hematocrit were obtained immediately. Twelve patients were discharged after 10-30 days later with recovery, 2 died (renal failure in 1, cardiopulmonary failure in 1, respectively).
Conclusion: Transarterial embolization of the injured hepatic artery is an effective method for controlling the hemorrhage.

P31.

Percutaneous transcatheter aortic valve prosthesis implantation: a feasibility study. Step 2

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Purpose: Over the past 30 years, there have been experimental efforts at catheter-based management of aortic valve regurgitation with the idea of extending the treatment to nonsurgical candidates. A catheter-delivered aortic valve design is described and its efficacy tested in animal experiment.
Materials/Methods: The new catheter-delivered valve consists of a stent-based cage supporting a prosthetic flexible valve mimicking a bi-leaflet system delivered in one piece. In acute experiments, valve implantation was done in 12 pigs, in four of them a "native" aortic valve was destroyed before/during implantation.
Results: Valve implantation was successful in all animals. The implanted valve functioned well for the duration of the experiments (up to three hours), even in the animals where "native" valve was not functional.
Conclusion: The study showed the implantation feasibility and short-term function of the tested catheter-based aortic bi-leaflet valve. Further experimental studies are warranted.

P32.

Ultrasonographic and angiographic evaluation of a newly developed abdominal aortic aneurysm model created with autologous gastric serosa

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Purpose: To evaluate the behaviour of a newly developed abdominal aortic aneurysm (AAA) model created with a gastric serosa patch.
Materials/Methods: An infrarenal AAA was created with an autologous gastric serosa patch in 5 swine. Pre- and post-surgical digital subtraction aortograms (DSA) were obtained in lateral and dorsoventral views to document appearance and dimensions of the aneurysm. Animals were followed with DSA and ultrasonography (B-mode and Doppler) on days 7, 14, 30, 45, 60 and 90. Aneurysmal diameters were measured with both techniques in all examinations. Animals were euthanized on day 90. Wilcoxon test was used to assess any differences with time or imaging technique in measured diameters ($p<0.05$).
Results: Mean aneurysmal diameter increased from 8.14 ± 2.15 to 13.28 ± 1.18mm immediately after surgery ($p<0.05$), but no subsequent significant growth in the sacs was seen during follow-up. In this experimental setting, DSA measurements were slightly but not significantly larger than ultrasound measurements. Two animals died of AAA rupture on days 6 and 10 (40% rupture rate). AAA diameters obtained using DSA on day 90 were 17.25 ± 0.21mm.
Conclusion: This model could be useful for training in endovascular AAA therapies, but its usefulness in preclinical testing of stent-grafts is limited by its scant growth potential.

P33.

Target precision of manually and pneumatically driven cannulae: *in vitro* comparison

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Purpose: To achieve a more precise positioning and orientation during MR image-guided interventions, a pneumatically driven robotic system for instrument guidance within high-field MR scanners has been developed. The targeting precision of manually and pneumatically driven cannulae insertion has been compared *in vitro*.
Materials/Methods: Nineteen-gauge cannulae with different cuts (spoon, pencil, facet) were inserted through 45 mm of polypropylene foam and porcine abdominal walls placed between aligned graph paper. Insertion was performed by test persons and a pneumatic cannula driver. Insertion was performed ten times rectangular and equally distributed at a distance of 5 mm. The precision was determined by overlaying the upper and lower graph paper sheath.
Results: Depending on the specimen and the cannula cut, manually driven cannulae deviate from 3 (pencil in foam) to 5 mm (facet in abdominal wall) from the target point. The pneumatically driven cannula deviates only from +/-0.5 (pencil in foam) to 1 mm (facet in abdominal wall).
Conclusion: Pneumatically driven cannula insertion as part of a robotic system for image-guided percutaneous interventions improves target precision significantly. Pointed cannulae, such as spoon and pencil cuts, demonstrate less deviation during insertion.

P34.

A new stent made of ultraviolet curing material

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Purpose: Ultraviolet curing material is used industrially because it undergoes instant hardening on exposure to ultraviolet (UV) light and does not require a catalyst. We developed a stent made of such a material.
Materials/Methods: A balloon-catheter was inserted into an elastic tube (4 cm long) of UV curing material, and was inflated with air. A new optical fiber guidewire was then inserted into the balloon-catheter and the UV curing material was hardened by UV radiation derived through the optical guidewire.
Results: An UV wavelength of 365 nm was effective for curing and an optical guidewire is essential for this new procedure. The elastic tube was hardened by UV radiation after a few seconds and became a stent that was durable and resistant to deformation.
Conclusion: The hardened UV curing material formed a tube stent that could prevent tumor ingrowth if used in humans. It had a smooth lumen that could prevent accumulation of sludge. Incorporation of drugs into the resin may also be easy. This is still an experimental stent, but it may become widely used in the future.

P35.

A new embolization procedure using ultraviolet curing material

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Purpose: Ultraviolet curing material is widely used in industry because it undergoes instant hardening on exposure to ultraviolet (UV) light and does not require a catalyst. We propose a new embolization procedure using this material and an optical fiber guidewire.
Materials/Methods: A 0.025-inch optical fiber guidewire was made with an optical fiber core instead of a nitinol core. The UV wavelength was measured with a Handy-Lamda (Spectra Corp.), and its intensity was measured by a UVA-365 (Custom Inc.). High molecular weight acrylate resin was used as UV curing material. It was injected through a catheter with the optical fiber guidewire inside to allow UV irradiation. An aneurysm model was made of silicon to check the efficacy of embolization.
Results: An UV wavelength of 365 nm was effective for embolization. Acrylate resin with multiple functional groups may be suitable for intracorporeal use and an optical guidewire is essential for this procedure. The model aneurysm was instantly embolized without any problems.
Conclusion: This is still an experimental method, but it may replace conventional embolization in the future.

P36.

Energy metabolism of transformed cells and opportunities for radiologic interventions

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Purpose: The purpose of this presentation is to describe in the recently elucidated energy production pathways that are unique or heavily dependent upon by neoplastic cells, highlight research directions and suggest possible oncologic interventions.
Materials/Methods: Based on an extensive literature review on neoplastic cell energy production, we describe all pathways that have been elucidated and present the specific enzymatic steps along these pathways that are unique or heavily used by transformed cells. The interplay between energy metabolism and related factors (hexokinases, hypoxia-inducible factor, angiogenesis, etc) is also discussed. We further describe pharmaceuticals (2-deoxyglucose, 3-bromopyruvate, Gleevec, etc) that appear to inhibit such tumor-specific, energy-producing enzymatic steps and present preliminary results from the available literature.
Results: The elucidation of tumor-specific energy catabolism pathways provides opportunities for new research directions and interventions. Some of the above mentioned pharmaceuticals have already shown considerable promise in both animal and human applications. Delivery techniques used by radiologists can be used to further research and expand into patient care, especially in liver tumors using TACE.
Conclusion: Knowledge of percutaneous access techniques and imaging place radiologists at a unique position to further expand research in oncologic interventions, provided they keep up with related research developments.

P37.

Percutaneous renal cryoablation in a rabbit model: imaging aspects at follow-up and histopathological observations

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Purpose: To investigate magnetic resonance (MR) and ultrasonography (US) aspects and histopathological changes of cryolesions after percutaneous renal cryoablation (PRC).
Materials/Methods: Twenty-two New Zealand white rabbits were studied. Cryoprobes were inserted under MR-guidance. Using an argon-based cryotherapy system, PRC was performed in a double-freeze cycle with a -125°C target temperature. Eighteen animals were examined by MR and US and then sacrificed 2-3 hours (n=4), seven days (n=5), 45 days (n=5), and 90 days (n=4) after PRC; four died of complications.
Results: At MR follow-up, high-signal intensity and rim-enhancement had gradually lowered; echogenicity remained high and peripheral flow had disappeared at US. These findings were histopathologically (hemotoxylin and eosin) correlated with the coagulative necrosis from 2-3 hours to 90 days after PRC in four histopathological stages: acute hemorrhage, hemorrhage withdrawal, granulation, and fibrosis. Some living and injured tubules and glomeruli were distributed around the margin between the cryolesions and the unablated renal parenchyma at previous three stages but undetected within cryodestruction at the fibrotic stage.
Conclusion: MR and US can visualize post-PRC cryolesions associated with histopathological orderly changes. Viable tubules and glomeruli are not present within the cryolesions at the fibrosis stage, which may benefit the design of a safer margin.

P38.

MR-imaging guided percutaneous cryoablation for renal cell carcinoma. Short-term follow-up

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Purpose: To evaluate safety and efficacy of percutaneous cryoablation with MR-imaging guidance in the treatment of renal cell carcinoma (RCC).
Materials/Methods: Nineteen cases with 24 RCC lesions were treated. Complete ablation was performed in 18 cases with 21 tumors (12 men, six women); partial ablation was undertaken in two cases with three tumors to avoid the possible injury of adjacent organs. The patients' age ranged from 35 to 72 years (mean, 60.8 years). The tumors' size was between 1.5 and 4.8 cm (mean, 2.9 cm). An open-type MR equipment was used for the guidance of percutaneous insertion of MR-compatible cryoprobes. An argon-based cryotherapy system was used in cryoablation of RCC. MRI or CT were carried out in follow-up evaluations. Successful treatment was defined as the lack of tumor-enhancement with intravenous contrast material on MRI or CT.
Results: Patients were followed up for 1.4-24 months (mean, 14.6 months). There was no residual viability detected in 19 tumors. Partial nephrectomy was performed in two cases with two recurrent tumors. Serum creatinine remained unchanged before and after the cryoablative procedure.
Conclusion: MR-imaging guided percutaneous cryoablation may be an additional treatment option for RCC.

P39.

Intraluminal ultrasonographic assessment of two endourologic techniques for ureteral strictures. An experimental study

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Purpose: Intraluminal ultrasonography (ILUS) was evaluated to determine whether it allows proper follow-up studies after retrograde endourological therapy.
Materials/Methods: Twenty female pigs were used. The study was divided into three phases: I. an experimental ureteral stricture was created following ILUS pre-model documentation of the normal proximal ureter. II. ILUSs were performed four weeks later. The treatment of the stricture was performed by endoballoon rupture technique (A) or Acucise® device (B), and subsequent placement of 7-F pigtail stents for three weeks. III. An ILUS examination was carried out four weeks after stent removal.
Results: I. ILUS correctly demonstrated the normal ureteral anatomy. II. ILUS revealed decreased ureteral diameters associated with ureteral wall hyperechogenicity, that precluded ureteral wall layers depiction. III. Ureteral wall fibrosis disappeared allowing clear ureteral wall layers identification. All groups showed a remnant of periureteral fibrosis surrounding the lesion area, more evident in group A.
Conclusion: Endourologic interventions can be monitored by ILUS technique which clearly demostrates changes associated with ureteral, (especially the muscular layer) and periureteral fibrosis, a common cause of restenosis. Acucise® device promotes a low fibrosis rate at both muscle and serosa layers and periureteral tissues.

P40.

Percutaneous ureteral dilatation and stent placement after kidney transplantation

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Purpose: Ureteral stenoses and necrosis affect the lifetime of the transplanted kidney. Surgery or minimally invasive procedures are the therapeutic choices. In our Department, end-to side uretero-ureteral anastomosis is a routine surgical technique, but when ureteral complications occur, percutaneous or retrograde endourological management is difficult.
Materials/Methods: In the last four years, 18 patients (mean age: 47 years) were treated with 23 percutaneous nephrostomy placements. The therapy was stricture dilatation alone in one, dilatation with internal-external catheter placement in four, external-internal catheter implantation alone in three, dilatation with ureteral stent placement in 11, and double-J stent placement alone in six cases. One stent was implanted with a rendez-vous maneuver.
Results: Two restenoses were found after six and 14 months. One kidney was lost due to infection. Two patients had serum creatinine levels between 400 and 600 mmol/L. One ureteral rupture occurred during redilatation, and one pyelonephritis was treated by antibiotics. One ureteral stent had to be removed because of acute cystitis. The remaining patients maintained kidney function.
Conclusion: The mean follow-up time is 21 months. Our results with dilatation and stenting are promising. A complicated anatomy makes minimally invasive therapy difficult, but angiographic catheters and guidewires are helpful.

P41.

Assessment of clinical efficacy of pre-operative CT angiography for percutaneous transluminal angioplasty in hemodialysis access dysfunction

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Purpose: Precise assessment of the vascular anatomy and pathology is essential for percutaneous transluminal angioplasty (PTA) in hemodialysis access failure. Clinical efficacy of CT angiography (CTA) for pre-operative assessment of lesions and procedural planning of PTA in hemodialysis access dysfunction was evaluated.
Materials/Methods: Between October 2001 and February 2004, PTA was performed in 54 cases with 75 vascular lesions. CT was performed to obtain CTA of the affected arm in all cases prior to PTA. The following were evaluated: (1) Whether the puncture site determined by CTA was appropriate, and (2) Whether the location and degree of vascular lesions demonstrated with CTA matched the results of angiography.
Results: (1) PTA procedure was succeeded in all but one case and the puncture site determined by CTA was appropriate in 50/54. (2) Locations of lesions diagnosed with CTA matched angiographic findings in 70/75. There were four false-negative and one false-positive results. The degree of lesions was overestimated in 9 and underestimated in 11 with CTA compared to angiography.
Conclusion: CTA provided correct vascular anatomy and pathology in most patients with hemodialysis access dysfunction. CTA will aid in management and procedural planning of PTA in this patient group.

P42.

Upper limb venography with an automatic carbon dioxide injector: technique and initial results

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Purpose: To assess feasibility, safety, and diagnostic quality of CO_2 upper limb venography using an automatic injector.
Materials/Methods: A prospective study on venography before creation of a dialysis fistula was carried out using an automatic CO_2 injector (Caddi®, Grifols, Barcelona). Safety was evaluated by hemodynamic monitoring and occurrence of pain and complications were recorded up to two days after injection. All examinations were reviewed by two vascular radiologists who independently assessed the diagnostic quality of images obtained over eight venous segments per arm.
Results: Over a two-month period, 50 venographies were performed in 25 consecutive patients: 425 veins were studied, 343 (80.7%) were considered of satisfactory diagnostic quality. The average duration of examinations was eight minutes per arm (270 ml CO_2). Complications were a mild pain following injection (20%), nausea (12%), (cephalalgia 12%). No patients required additional treatments following the injection. In one case the study was stopped for 10 minutes because of vasovagal malaise but was then completed with good result. No serious events occurred in the two days following the examination.
Conclusion: According to this preliminary experience, CO_2 venography using an automatic injector appears to be safe and provides good diagnostic quality.

P43.

Contrast harmonic imaging with power-mode and coded harmonic angiography using Optison for assessing vascularization during chemoembolization in HCC. First experiences

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Purpose: To what extent does contrast-enhanced ultrasound enable recording of intratumoral vessels in hepatocellular carcinoma (HCC) as compared with selective digital subtraction angiography (DSA)?
Materials/Methods: In 20 patients (26 lesions) a perfusion assessment using vascular ultrasound (Logiq 700, 9, GE) was carried out immediately before and during selective chemoembolization. Using a multifrequency transducer it was possible to assess the blood flow using color-duplex sonography (CDS), power-mode (PM) and after intermittent contrast injection using coded harmonic angiography-mode (CHA) and contrast harmonic imaging with power-mode (CHI+PM). An evaluation was performed in comparison with selective i.a. DSA.
Results: By CDS it was possible to record intratumoral perfusion in only 11/26 lesions. PM was able to record intratumoral perfusion in 15/26 lesions. An injection of Optison permitted the recording of intratumoral vessels in 23/26 lesions using the CHA-mode and in all 26 cases using CHI+PM. One capillary perfusion only was possible with the CHA mode, which permitted subtraction of the surrounding tissue. With CHI+PM, it was possible to record sonographically the segmental vessels perfusing the tumor to perform the chemoembolization after contrast-enhancement in all cases.
Conclusion: An Optison injection in CHA and in CHI with PM enables the recording of intratumoral vessels in HCC.

P44.

Silicone-covered Wallstent in malignant biliary obstruction: results of a multicenter study

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Purpose: To present our initial technical and clinical results in the use of silicone-covered Wallstents to treat malignant biliary obstructions.
Materials/Methods: This prospective study included 55 patients with malignant biliary obstruction of the common bile duct. Causes of obstruction were pancreas carcinoma in 24 patients, hepatic hilar lymph nodes metastases in 11, cholangiocarcinoma in seven, gall bladder carcinoma in seven, ampullary carcinoma in three and other in three. Fifty-seven covered Wallstents were used; 26 patients received radiation therapy and/or chemotherapy. Stents were placed transhepatically in 28 patients and endoscopically in the remaining 27.
Results: Placements were successful in all cases. Thirty-day mortality rate was 1.8%. Survival rates were 44% at six and 26% at 12 months. Stent patency rates were 84% at six and 80% at 12 months. Reobstruction occurred in 11 cases (seven tumor overgrowth, one ingrowth, two sludge, and one for unknown reasons). Early complications were observed in ten cases (six acute pancreatitis, three cholangitis and one stent migration). Late complications were observed in ten cases (six cholangitis, one cholecystitis, one stent migration, one liver abscess, and one biliary bleeding).
Conclusion: Preliminary results suggest that placement of this silicone-covered Wallstent is feasible and effective in achieving biliary drainage.

P45.

Radiofrequency ablation of gallbladder polyps: an experimental feasibility study

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Purpose: To evaluate the feasibility of percutaneous radiofrequency (RF) ablation of the gallbladder (GB) wall for treating small polyps in *ex-vivo* porcine models.
Materials/Methods: Under US-guidance, RF energy was applied to 12 porcine GB walls using a 17-G electrode with a 1-cm active cooling tip. The GB wall was ablated for two minutes and for four minutes after inserting the distal 5-mm active electrode tip into the GB lumen (Groups 1 and 2, respectively); in Group 3, the GB wall was ablated for four minutes just by pushing the GB wall. Diameters of the ablated areas on the GB mucosal surface and depths of ablated liver parenchymas were measured post-ablation. In representative cases, the specimens were microscopically examined.
Results: Maximum diameters of ablated GB walls were 10.8 ± 1.7 mm (Group 1), 11.5 ± 1.3 mm (Group 2), and 7.5 ± 3 mm (Group 3). Depths of ablated liver parenchymas were 10.3 ± 1.5 mm, 9.0 ± 0 mm, and 10.5 ± 1.3 mm, respectively. Coagulation necrosis was noted in the GB wall as well as in the adjacent liver parenchyma, well correlated with macroscopic changes.
Conclusion: RF ablation of the GB wall was feasible in *ex-vivo* experimental models. This technique may be a new alternative to cholecystectomy for borderline-sized GB polyps.

P46.

Radiofrequency thermal ablation in high-risk localization hepatic lesions

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Purpose: To evaluate the efficacy of radiofrequency thermal ablation (RFA) in the treatment of liver tumors that are in high-risk locations, and to identify complications.
Materials/Methods: During a three-year period we performed RFA in 68 patients with tumors in a location that made application difficult. Eighteen tumors were subdiaphragmatic, 21 near large blood vessels, 14 adjacent to the gallbladder, 11 at the liver periphery (subcapsular), and four in proximity to the intestine. We used three different types of RF generators and electrodes depending on the type and site of the lesion (a RITA 1500, Medical Systems, Inc., CA, USA, with multiple extending 7- or 9-pin electrode, a Berchtold Electrotom 106 HITT, Germany, with straight, saline-cooled, electrode and a Fogazzi, Italy, with spiral extending electrode).
Results: In two patients a subcapsular hematoma occurred. Five patients complained of severe pain (among those with the peripheral lesions). Four showed residual tumor (among those in proximity with large blood vessels) and we proceeded to a second RFA session. We did not encounter cholecystitis as a complication.
Conclusion: Radiofrequency thermal ablation is a safe, minimally invasive technique with no severe complications for treatment of unresectable liver tumors, even with high-risk lesions.

P47.

Percutaneous management of iatrogenic bile duct injuries

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Purpose: To report our experience in the percutaneous management of iatrogenic bile duct injuries resulting in bile leakage or obstructive jaundice.
Materials/Methods: Between April 1995 and December 2003, in 20 patients (11 women, nine men) with iatrogenic bile duct injuries a percutaneous treatment was attempted. Lesions included: bile duct strictures (n=9), bile leakages either from the transection (n=3) or the hepaticoenterostomy anastomosis site (n=3) and obstructions of the hepaticoenterostomy anastomosis site which was surgically created to treat the transection (n=8). Three patients had two lesions. Balloon dilatation (n=14) or stent implantation (n=3) was applied to iatrogenic bile duct strictures and postoperative hepaticoenterostomy obstructions. External-internal biliary drainage was applied in all bile leakage cases.
Results: A technical success of 91% was achieved in all biliary interventions. Bilirubin levels of those patients with either strictures or obstructions of the anastomosis returned to normal, except in two cases. All cases with bile leakage with nondilated biliary system were treated or prepared to surgery by diversion of the bile with external biliary drainage. No complications occurred.
Conclusion: Percutaneous management of iatrogenic bile duct injuries is an effective and reliable method as a less invasive procedure. It is the only treatment alternative in certain cases.

P48.

Tissue biocompatibility of a poly(L-lactic acid) bioabsorbable biliary stent: an experimental study

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Purpose: To evaluate bile duct tissue biocompatibility of a bioabsorbable stent made of poly(L-lactic acid) (PLLA).
Materials/Methods: The stent is made of PLLA monopolymer filament, constructed in a zigzag pattern to create a cylindrical structure. It was inserted transpapillary and delivered into the common bile duct (CBD) of nine dogs, divided into three groups of three dogs each. Groups were followed for one, three, and six months, respectively. Finally, CBD patencies were analyzed radiographically and tissue reactions around the stent were assessed histopathologically.
Results: All the stents were placed successfully and there was no radiographically-evident biliary obstruction. All the dogs in each group had a minimal mononuclear cell infiltration. After one month, there was no epithelial hyperplasia; after three months, this was recorded in two dogs, and after six months, it was present in all dogs. Changes, however, were very small. As far as desquamation is concerned, there were no changes after one month; it was present in all dogs at three-month follow-up, and in two dogs after six months. These findings also were minimal.
Conclusion: PLLA stents proved to be biocompatible for the CBD tissue.

P49.

Covered metallic stents for malignant common bile duct obstruction

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Purpose: Retrospective assessment of outcomes of covered metallic stents in patients with common bile duct (CBD) obstruction.
Materials/Methods: One-hundred and one covered and 226 uncovered metallic stents were placed in patients with CBD obstruction. Stent patencies, patients survivals, reobstruction and complication rates were evaluated.
Results: Patency rates at six months were 87% for covered and 71% for uncovered stents; at one year, they were 58% and 52%, respectively. Survival rates at six months were 41% (covered) and 36% (uncovered), at one year 17% and 16%, respectively. Obstructive jaundice recurred in 17 (18%) and 48 (22%) patients, respectively. In the "covered stents group", reobstruction was caused by tumor growth in 11 patients (six over-, two in-growth, and three in- and over-growth), cholangitis in five, and unknown in one. In the "uncovered stents group", reobstruction was caused by tumor growth in 38 patients (five over-, 21 in-growth and 12 in- and over-growth), cholangitis in six, and unknown in four. Complications (expected reocclusions) rates were 15% and 10%, respectively.
Conclusion: Our results suggest that covered metallic stents provide a longer, although not statistically significant, patency than uncovered ones. Tumor overgrowth and cholangitis should be controlled to achieve a longer patency.

P50.

Liver tumors adjacent to large blood vessels: is this a contraindication to radiofrequency ablation?

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Purpose: Our experience with radiofrequency ablation (RFA) of liver tumors adjacent to large vessels was retrospectively reviewed. Complications were identified and efficacy evaluated.
Materials/Methods: In two years, RFA was performed in 21 patients with liver tumors adjacent to large vessels. Thirteen had metastases from colorectal cancer, two from breast cancer, and six were HCCs. Lesions sizes ranged from 3 to 7 cm and a RITA device with seven or nine electrodes was used. Three lesions were near the IVC, eight near the right or left PV, seven adjacent to the hepatic veins, and three between the PV and the IVC. Therapeutic response was assessed by dual-phase spiral-CT.
Results: The only complication was recorded in one patient who developed an infarction of the right lobe without clinical sequelae. A residual tumor was observed in four patients immediately post-ablation. In one patient the tumor was contiguous to the PV and the IVC, in one it was near the PV, and in one near the hepatic vein. In these three patients, a second RFA session was performed. The two-year follow-up showed no recurrence.
Conclusion: RFA is an effective method with minimal complications even in "high-risk" lesions adjacent to large vessels.

P51.

Percutaneous transluminal angioplasty for hepatic artery stenosis after living donor liver transplantation

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Purpose: To evaluate the usefulness of percutaneous transluminal angioplasty (PTA) for hepatic artery stenosis after living donor liver transplantation.
Materials/Methods: From October 1999 to October 2003, 18 patients who had hepatic artery stenosis after living donor liver transplantation, 9 males and 9 females, were treated by PTA. Ages ranged from 1 to 59 (average 39.6). At angiography, stenosis was considered to be clinically relevant if the lumen diameter was decreased by more than 50%. PTA was considered successful if a normal or near-normal lumen diameter was restored (<20% residual stenosis). We evaluated the success and complication rates of PTA.
Results: PTA was achieved successfully in 16 of 18 procedures (89%). In one case PTA was not effective and residual stenosis was evident. Complication occurred in one case (5%). Confirmative arteriography revealed hepatic artery occlusion, suggesting that dissection had occurred.
Conclusion: PTA for hepatic arterial stenosis after living related liver transplantation is effective and safe but in rare cases causes dissection.

P52.

Phase II results of CT-guided brachytherapy in patients with hepatocellular carcinoma

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Purpose: To assess safety and efficacy of CT-guided brachytherapy in hepatocellular carcinoma (HCC)
Materials/Methods: We recruited 27 patients with solitary intrahepatic HCC. All patients displayed clinical signs of liver cirrhosis, Child-Pugh stage A in 24 and stage B in 3. After CT-guided positioning of the brachytherapy catheters in the tumor, we used a ^{192}Iridium source with an activity of 10 Ci. By protocol, 33% of the liver tissue had to receive 5 Gy or less to ensure sufficient hepatic reserve capacity. Follow-up included MRI three days, six weeks and every three months after the intervention, accompanied by liver function tests.
Results: The median diameter of the 27 tumors was 5 cm (2-11 cm). The median minimal dose in the target volume was 20 Gy applied as a single fraction (range: 15-25Gy). No post-procedural liver function impairment was found. Local tumor control was 92.5% at 6 months' follow up. Intrahepatic progression was found in 4 patients (15%). Progression-free survival was 77% and overall survival was 92.6% after six months.
Conclusion: CT-guided single fraction brachytherapy is safe and effective in HCC. Liver function impairment up to Child-Pugh stage B is probably not a limiting factor if sufficient hepatic reserve is planned.

P53.

Extrahepatic collateral supply of hepatocellular carcinoma and transcatheter arterial chemoembolization (TACE)

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Purpose: Collateral supplies of HCC usually occur at advanced stages of the disease or after multiple TACE sessions. Our purpose was to evaluate CT and angiographic findings of extrahepatic collateral supply of HCC by left gastric, internal mammary, and inferior phrenic arteries and the efficacy of TACE.
Materials/Methods: CT and angiographic findings of six collateral supplies of HCC in four patients with hepatic artery occlusion from repeated TACE sessions were evaluated. TACE was performed via the left gastric (n=2), internal mammary (n=2), or inferior phrenic (n=2) arteries. Clinical outcomes and complications were evaluated.
Results: CT findings were in descending order: anterior subcapsular location(n=4), progression of HCC at the subcapsular region (n=2), and hypertrophied collaterals (n=1). Eight sessions of TACE of collaterals were performed in four patients. Shoulder pain (n=3) and fever (n=2) were the main complications. No cutaneous complications occurred. Follow-up angiography was performed in all embolized collaterals and showed a persistent obliteration in two and recanalization in four.
Conclusion: When CT findings such as an anterior subcapsular location are present, extrahepatic collaterals should be examined and embolized, if a significant tumor supply is demonstrated. Extrahepatic collaterals are important alternative routes for sequential TACE of HCC following hepatic artery occlusion.

P54.

Control of tumor perfusion with contrast harmonic imaging and coded harmonic angio during thermal ablation of liver tumors

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Purpose: The aim was to find out if it is possible to control tumor vascularization as well as defects that develop and then lead to tissue necrosis during percutaneous thermal ablations by the use of ultrasound with contrast agent enhancement.
Materials/Methods: Twenty-four patients with non-resectable malignant liver tumors underwent percutaneous radiofrequency thermoablation using a perfused probe (Elektrotom HF 106, Berchtold). While intermittent energy was supplied during thermal ablation, controls were carried out using the multislice-CT and ultrasound with a multi-frequency transducer (3-7 MHz, LOGIQ 700, GE). Optison (0.5 to 1 ml) was injected as ultrasound contrast agent. Ultrasound evaluation of perfusion was made by power mode, contrast harmonic imaging (CHI) and coded harmonic angio (CHA).
Results: Only 22/36 lesions showed an increased intra-tumoral perfusion using the conventional B-mode together with power mode. The best way to detect an increasingly reduced perfusion of the tumor was the CHI-mode with power mode. Thus, the evaluation of perfusion was considerably facilitated. In 29/36 tumor perfusion could not be detected by ultrasound after an energy supply of maximal 100,000 Ws.
Conclusion: With the help of contrast-enhanced sonography it seems to be possible to prove defects which finally lead to necrosis in real-time.

P55.

Radiofrequency thermal ablation combined with transcatheter chemoembolization for hepatocellular carcinoma

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Purpose: To assess the therapeutic effect of the combination of percutaneous radiofrequency thermal ablation (RFTA) with transcatheter arterial chemoembolization (TACE) for hepatocellular carcinoma (HCC).
Materials/Methods: Thirty-eight HCC nodules ranging from 1.8 to 8 cm (mean 3.6 cm) in diameter in 38 patients were treated with TACE followed by a single session of RFTA within seven days. Superselective TACE with gelatin sponge after injection of a EpiADM/Lipiodol mixture was performed. RFTA was performed with an expandable needle electrode under ultrasonography- and/or computed tomography-guidance. The patients were regularly followed every two months by imaging studies for the detection of recurrence.
Results: A local residual recurrence was observed in five nodules (5/38; 13.2%) larger than 6.5 cm during a mean follow-up of 19.3 months. Survival reached 90.9% at one year, 73.8% at two years; the mean survival period was 484.9 days. There were ten cases of new nodular recurrences during the follow-up period. There were no major complications, but minor complications such as abdominal pain, fever, and a transient elevation of liver enzymes were recorded.
Conclusion: RFTA combined with TACE might contribute to improve local control and survival in patients with non-resectable HCC less than 6.5 cm in diameter.

P56.

Hepatocellular carcinoma recurrence after successful percutaneous ablation therapy: imaging-based management

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Purpose: To describe our experience in the management of hepatocellular carcinoma (HCC) recurrences after successful percutaneous ablation therapy (PAT) based on previously categorized imaging patterns.
Materials/Methods: Seventy-two patients with HCC recurrences after successful PATs were retreated according to helical-CT and contrast-specific sonographic patterns. Pattern A: enhancing tissue within the edge of the ablated nodule ("in-growth") = new PAT session/s. Pattern B: enhancing tissue around the treated nodule, continuous to its border ("out-growth) = chemoembolization (TACE). Pattern C: enhancing tissue within the same segment of the treated nodule ("spread") = PAT or TACE. Pattern D: enhancing tissue within different segments from the treated nodule ("disease progression") = PAT or TACE.
Results: In six pattern-A patients treated with PAT, necrosis was achieved in five. In 20 pattern-B subjects treated with TACE, necrosis was obtained in 13. Of 29 pattern-C patients treated with PAT (18) or TACE (11), necrosis was achieved in 20. In 14 pattern-D patients treated with PAT (8) or TACE (6), necrosis was achieved in ten. Three Child's C-patients were not treated.
Conclusion: Four imaging patterns of HCC recurrences after successful PAT were categorized. Our treatment choice in further management of these patients is now based on these imaging patterns.

P57.

Preoperative percutaneous transhepatic embolization of the portal vein in preparation of liver resection

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Purpose: To evaluate the effect of preoperative percutaneous transhepatic portal vein embolization (PVE) in preparation of major liver resection for hepatobiliary malignancy.
Materials/Methods: PVE was performed in 16 patients with malignancy: 11 with cholangiocarcinoma, two with hepatocellular carcinoma, one with metastasis, one with intrahepatic cholangiocellular carcinoma, one with gallbladder carcinoma. PVE was performed using a balloon-catheter (5-5.5 F). The embolic materials used were absolute ethanol in seven, monoethanolamin oledate in six, and fibrin glue in three. Angiographic findings, serial changes of hepatic lobe volume, and complications were observed.
Results: A technical success was achieved in all the patients without serious complications. Fifteen patients had normal portal anatomy, one had a portal vein variant. Portal vein in the resected lobe was embolized completely (n=10) or incompletely (n=6). The mean future liver remnant (FLR) increased from 366.2 to 473.6 cm^3. Increase in mean FLR to total hepatic volume (TLV) ratio was 8.8%. Fifteen patients underwent hepatic resection. A significant difference was seen in the FLR/TLV ratio increase in the patients with or without complete portal embolization. Embolization in a single session from the proximal portion led to incomplete embolization.
Conclusion: Complete portal vein embolization brings about a favorable compensatory hepatic hypertrophy.

P58.

Feasibility of saline infusion on the liver surface to minimize the thermal injury of the adjacent structure during radiofrequency ablation of subcapsular hepatic tumor: an experimental study

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Purpose: To evaluate feasibility of saline infusions on liver surfaces to minimize thermal injury to the peritoneum during hepatic radiofrequency ablation (RFA).
Materials/Methods: A 17-G electrode embedded in a 6-F introducer sheath was inserted through porcine dissected bowels over the liver, 1.5 cm in depth, and connected to a saline infusion pump. Ten ablations (five with infusion and five controls) were done. Ablation lasted three minutes with an infusion rate of 2 ml/min. Ablated lesion sizes on bowel and liver surfaces and hepatic lesion depths were measured.
Results: Ablated areas of the bowel in the two groups (control and infusion) were 210.7 ± 89.1 mm^2 and 35.8 ± 43.4 mm^2, respectively. Ablated areas of liver surfaces were 312.6 ± 73.6 mm^2 in the control and 80.9 ± 55.1 mm^2 in the infusion group. All the lesions in the infusion group were smaller than those of the control group. The mean hepatic lesion depth was 22.2 ± 1.3 mm in the control and 24.2 ± 2.9 mm in the infusion group. The mean of maximum temperatures was 70.6°C in the control and 47.8°C in the infusion group.
Conclusion: Continuous infusion of normal saline on the liver surface during RFA of subcapsular hepatic tumors is feasible and minimizes thermal injury of adjacent peritoneum.

P59.

Intraarterial regional chemotherapy using implantation of a catheter-port system via femoral approach

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Purpose: To evaluate technical success and complications of intraarterial chemotherapy using implantation of a catheter-port system via femoral approach for hepatic and extrahepatic tumors.
Materials/Methods: Two-hundred and forty-three patients with hepatic, biliary, pancreatic, or uterine cancer were treated by intraarterial regional chemotherapy. A 4-F angiographic catheter was inserted into a purposive artery through a 4-F angiographic sheath introduced via the femoral artery with Seldinger technique. By means of a guidewire, both were then replaced by a 5-F indwelling catheter with antithrombotic properties. The proximal end of the catheter was connected with a port and both were embedded subcutaneously. Position of the catheter and patency of the artery were evaluated with DSA every three months post-procedure.
Results: The technical success rate was 99% with three failed cases. During the follow-up, 47 patients had 49 complications (20%): 26 catheter dislodgments, 14 arterial thromboses, three catheter kinkings, seven abscesses or pseudoaneurysms, and one hemorrhage from the femoral artery. Fifteen of the 49 complications were treated percutaneously without interruption of chemotherapy, whereas in other 15 the whole system required interventional replacement.
Conclusion: Percutaneous implantation of catheter-port system via femoral approach is simple, easy, and useful for intraarterial regional chemotherapy.

P60.

Therapeutic chemoembolization of primary and metastatic liver tumors

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Purpose: To report our experience with hepatic chemoembolization using fibroembolic calibrated microspheres (Embospheres).
Materials/Methods: From February 2000 until December 2003, 46 patients (43 hepatocellular carcinomas, three liver metastases; 34 men, 12 women) underwent selective segmentary chemoembolization, with the use of microcatheters, if necessary; Embospheres of 100-300 micron were emulsioned with oil and doxorubicin and those of 300-500 micron were added at the end of the procedure.
Results: Twenty patients had one only lesion, 13 had two or three lesions, 13 had multifocal lesions. Follow-up CTs did not show contrast enhancement in the place of treated lesions in most of the cases. Survival rate was 93.5% at six months and 91.3% at 12 months, while mortality rate in the first 30 days was 4.4%.
Conclusion: Embospheres are a good material because of their high emulsifying properties; furthermore, they make possible to get a distal embolization excluding the vascularization.

P61.

Illustrated history of angiography: part IV

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Purpose: After description of the historical development of angiography in Sweden (CIRSE 2003), this exibition demonstrates the further development of angiography in other European countries.
Materials/Methods: The following historical landmarks of the last decades of the 20th century are described: 1. development of selective and superselective angiography; 2. use of more sophisticated catheters; 3. developement of new contrast agents for angiography; 4. improvement of film changer and programmable injectors; 5. the final part of the exhibition summarizes curriculum vitae and achievements of prominent European angiographers.
Results: The exhibition consists of 24 posters.

P62.

A paper cap with radiation-sensitive indicators using functional dyestuff attached for skin dose monitoring during neuro-interventional procedures

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Purpose: To introduce a new device to evaluate skin doses of radiation during neurointervention.
Materials/Methods: The device was made from radiation-sensitive indicators using functional dyestuff, and a paper cap tightly covering the entire head except for the face. The indicator resembled a square label with side-length of 13 mm. Its color changes from pellucid to red when X-ray exposure is over 0.5 Gy. The red color changes from faint to vivid as dose increases from 0.5 to 5 Gy, allowing for instant dose monitoring by noting the color. The dose can be estimated accurately using a color measuring instrument. We marked 28 points for dose monitoring on the outside surface of the cap, and attached the indicator to each. A patient with carotid-cavernous fistula received transvenous embolotherapy, which took 12 hours, with the device on her head.
Results: The indicator became red at 11 of the 28 points. The skin dose was estimated to be more than 3 Gy by visual observation at 4 of the 11.
Conclusion: Our device seems useful for instant skin dose monitoring at various sites during interventional procedures.

P63.

Nasolacrimal "modified" stents in the resolution of epiphora: preliminary results

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Purpose: To prospectively evaluate the effectiveness of "modified" polyurethane stents in the management of epiphora.
Materials/Methods: One-hundred and eight patients (32 men, 76 women) with severe epiphora underwent "modified"stent (106 eyes/119 stents) insertion to treat obstruction of the nasolacrimal system. A Song stent was used in all patients, but with an open proximal end configuration.
Results: Resolution of epiphora was complete in 104 eyes. At follow-up (mean = 11 months; range, 2 days -14 months), 100 of 119 stents were patent (84%). All 19 obstructed stents were easily withdrawn and 12 patients remained asymptomatic for a mean of seven months (secondary patency: 66.7%). Following stent removal, retrieved stents were cleaned and re-positioned in the same session in seven cases. In the remaining five cases, lacrimal system patency was re-established by washing with saline only.
Conclusion: The procedure is simple and safe in both stent insertion and mechanical disobstruction and withdrawal, when occluded. Stenting failure does not preclude treatment success, since the stent modification allows mechanical disobstruction, easy retrieval, and replacement. Although preliminary results are encouraging, further studies and longer follow-ups are needed.

P64.

Interventional radiological treatment of the complications of surgical procedures

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Purpose: To discuss the effectiveness of interventional radiological methods in the therapy of vascular and non-vascular complications developing after various surgical procedures.
Materials/Methods: Over a five-year period a total of 75 patients with various surgical complications (34 vascular, 20 biliary, 15 extra/intraperitoneal fluid collections, 5 tracheal stenosis, 1 ureteral stenosis) were included in this study.
Results: All vascular complications were treated with angioplasty and embolization procedures. External and internal biliary drainage, balloon dilatations, and fistula tract embolization were utilized for biliary complications. Tracheal stenoses were treated with self-expandable metallic stents. Intraabdominal fluid collections were drained with percutaneous catheter placement. Ureteral stenosis was treated with percutaneous double J stent placement. All patients included in this study were treated with interventional radiological methods without repeat surgery.
Conclusion: Interventional radiological approaches are quite safe and effective in elimination of vascular and non-vascular complications that occur during or after various surgical procedures.

P65.

Percutaneous cryoablation of pulmonary malignancies under CT-fluoroscopy guidance

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Purpose: To assess whether percutaneous cryoablation of pulmonary malignancies under CT-fluoroscopy guidance is safe and technically feasible.
Materials/Methods: Thirty-one patients with 51 primary or secondary pulmonary malignancies underwent percutaneous cryoablation under CT-fluoroscopy guidance. Usually, several masses can be treated during the same session, but in five patients cryoablation was performed twice--with an interval of more than one month--not only because of multifocality but for tumor distribution also. All the procedures were done percutaneously under local anesthesia with a multi-detector row-CT scanner by using intermittent multi-slice CT-fluoroscopy. A coaxial technique with a 21-G fine needle and an 8- to 11-G coaxial needle was employed to penetrate lesions. Tumors were frozen into iceballs using high-pressure argon and Joule-Thomson effect.
Results: Percutaneous cryoablation was well tolerated by all patients. Intraprocedural complications included 17 pneumothoraces (all asymptomatic, but three patients required a chest tube placement), 14 cases of bloody phlegm, seven cases of a low-grade fever, and six cases with mild chest pain. One hemothorax was also recorded, but this was not related to cryoablation but to needle insertion.
Conclusion: Percutaneous cryoablation of pulmonary malignancies under CT-fluoroscopy guidance is safe and technically feasible.

P66.

Computed tomographic-assisted lumbar sympathicolysis in patients with hyperhidrosis plantaris

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Purpose: In a retrospective study, the technical feasibility and the clinical outcome of sympathicolysis were investigated.
Materials/Methods: In 32 patients, computed tomographic (CT)-assisted lumbar sympathicolysis was performed after conservative therapy. Via a dorsolateral incision, intercavovertebral or interaortovertebral instillation of a medication mixture consisting of 96% alcohol, 0.5% Carbostesin and contrast medium was performed using a 22-G biopsy cannula at the level of the arch pedicle of the third lumbar vertebral body. Using a standardized questionnaire (dermatology quality of life index scale), the patients were asked to rate their subjective symptoms before the intervention and one, six, and 12 months thereafter.
Results: The intervention was successful and without complications in all the patients. A temporary erectile dysfunction occurred in one man. A temporary discomfort in the area supplying the plexus lumbosacralis was reported by five patients. Symptoms improved in all patients in both the short-term (index: 9.5; range: 7.6-10) and the medium-term interval (index: 6.9; range: 3.2-10), although all the patients described a slight return of hidrosis after 12 months.
Conclusion: Lumbar CT-assisted sympathicolysis in the treatment of hyperhidrosis plantaris has low complication rates, is effective and easy to perform, and should be considered when conservative measures have failed.

P67.

Complications associated with intraarterial Cisplatin chemotherapy in 99 patients with supratentorial malignant glioma

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Purpose: To describe the complications associated with the treatment of supratentorial high-grade gliomas. The procedure used was selective low-dose intraarterial Cisplatin using pulsatile hand administration. Complications were retrospectively analyzed.
Materials/Methods: Two-hundred seventy-nine procedures were performed in 99 patients (October 1996-May 2003). Different protocols were used, intraarterial administration of Cisplatin was included in all of them (60mg/m2 monthly). Selective carotid catheterization and pulsatile hand administration were used to reduce neurotoxicity.
Results: Percentages of complications were analyzed in relation to the number of procedures. Neurologic complications were observed in 17 cases (6.12%); seizures in two (0.72%); tumoral hematomas in two (0.72%), one was asymptomatic and required no treatment, the other patient died (0.36%); one patient had a hemorrhagic infarct involving the arterial perfused territory (0.36%); visual symptoms occurred in two patients: one had mild visual loss after five sessions (1.8%), the other had transitory blurred vision (0.36%); one patient had auditory loss after six procedures (2.6%). Local complications secondary to catheterization were observed in one procedure (0.36%). No systemic complications were observed.
Conclusion: Intraarterial chemotherapy of cerebral gliomas can be performed with a relatively low complication rate using low doses of Cisplatin administered by selective carotid catheterization and pulsatile hand technique.

P68.

Three-dimensional computed tomographic-angiography in the diagnosis of splenic artery aneurysms in liver transplantation candidates

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Purpose: To investigate incidence, number and morphology of aneurysms of the splenic artery (SAA) in 359 patients who underwent 3D CT-angiography (CTA) before liver transplantation. Rupture of SAA carries a high mortality rate; the pre-transplantation evaluation of recipients regarding the possible presence and morphology of SAAs is therefore mandatory.
Materials/Methods: 3D CTA was performed in 359 liver transplantation candidates ranging in age from 7 to 62 years. Two helical scan sets were obtained and transferred to a workstation; 3D CT angiograms were obtained by MIP and SDD techniques. All 3D CTA were studied for the presence, number, size, morphology, and location of SAA.
Results: In 20 (5%) of the 359 candidates, SAAs were found during 3D CTA. The gender ratio female:male was 3:1. All SAAs were saccular, ranging in size between 8 and 20 mm. In three women (10.5%), multiple aneurysms were identified.
Conclusion: Our study indicates that 3D CTA is a reliable method to identify the presence and morphology of SAA; in addition, it assesses the hepatic arterial anatomy, size and patency of the portal vein, exact liver morphology, portal hypertension, ascites and splenomegaly. On the basis of all these information, the surgeons can safely plan orthotopic liver transplantations.

P69.

A new interventional procedure: magnetic compression cutting

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Purpose: Successful bilio-enteric magnetic compression anastomosis (MCA) was first reported in 1998. This new method has shown satisfactory progress, and a total of 93 patients have undergone MCA in Japan. MCA has been tried in various fields, and magnetic compression cutting (MCC) is a new variation. This study demonstrates the use of our new cutting method, and suggests possibilities for the future.
Materials/Methods: In a 64-year-old man, an abdominal wall flap was raised to treat severe burns on his left hand. Cutting the flap between the fingers and applying skin grafts was thought likely to be very difficult because flap blood flow was extremely poor. Accordingly, MCC was employed to cut between the fingers without skin grafting by applying pressure to elongate the skin. A pair of magnetic blades (neodium-iron-boron rare earth magnets: 10 cm long, 1 cm wide, and 0.5 cm thick) were used.
Results: After two weeks, the flap was successfully cut by MCC without skin grafting, and no complications occurred.
Conclusion: MCC is still a very new interventional method. However, it is safe and quite simple, and may not only be useful for plastic surgery, but also for other fields.

P70.

Core-needle biopsy versus fine-needle aspiration in the diagnosis of lymphadenopathy as a sole manifestation

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Purpose: To retrospectively evaluate the effectiveness of percutaneous CT-guided biopsy in 124 patients with abdominal lymphadenopathy as a sole manifestation.
Materials/Methods: In a three-year period, 124 patients (74 men, 50 women) with lymphadenopathy--89 abdominal and 35 mediastinal (21 at the anterior, eight at the middle, and six at the posterior mediastinum)--and no other findings in their dual-phase spiral-CT, underwent percutaneous CT-guided biopsies. Core-needle biopsy (CNB) (18G/9-15 cm) and fine-needle aspiration (FNA) (20G/9-15 cm) were performed simultaneously in all of them without complications.
Results: A diagnosis was achieved in 111 patients with CNB (89.5%) and in 89 with FNA (71.7%). Our results were lymphoma in 44, TBC in nine, metastasis in 49, sarcoidosis in three, and reactive lymphadenopathy in six. In six the specimen was inadequate and in seven with lymphoma we had false negative results. False positive results were not recorded.
Conclusion: CT-guided biopsy is an effective and safe method in the diagnosis of abdominal lymphadenopathy. CNB is of higher diagnostic accuracy than FNA.

P71.

Radiofrequency ablation of neoplastic endothoracic lesions: some "extreme" cases

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Purpose: Radiofrequency ablation (RFA) of endothoracic tumors is a treatment under clinical testing. It is however already applied in selected patients; we present our experience in some particular cases.
Materials/Methods: Since February 2002, five patients with six lesions and absolute contraindications to other treatments underwent RFA: a 78-year-old woman with two bilateral subpleural metastases from colon carcinoma; a 75-year-old man with a small pulmonary NSCC and severe cardiovascular disease; one patient with posterior mediastinal metastases from adrenal angiosarcoma previously treated by several surgeries; one young man with pleuro-parenchymal recurrence of metastases from osteosarcoma; one case with a slow-growing apical lung metastasis from laryngeal carcinoma. Lesion diameters ranged between 16 and 80 mm. Four patients were treated under US-guidance, one under CT-guidance.
Results: Nine RFA sessions were performed without any major complications (one small pneumothorax, two minimal pleural effusions). At follow-up, four lesions were necrotic, two (45 and 80 mm) showed viable residues. One patient died from a systemic disease progression, the others are alive with an acceptable life quality.
Conclusion: RFA was feasible, safe, and useful as a palliative treatment for endothoracic tumors without any other therapeutic options. The local outcome is influenced by the lesion volume.

P72.

Portosystemic shunt on three-dimensional and thin-section CT during arterial portography

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Purpose: To evaluate detectability of subtle portosystemic shunt (PS) by CT during arterial portography (CTAP) using a multidetector-row scanner.
Materials/Methods: Fifty-five patients with liver cirrhosis underwent angiography and CTAP. CTAP was performed with the catheter placed in the superior mesenteric artery using a 16-detector-row CT. Axial CT-images of 0.625 mm- and 3.75 mm-thickness were obtained. Axial CT-images were transferred to a workstation and multiplanar volume reconstruction images were obtained.
Results: A part of the veins of the ascending colon drained into the right renal vein, the right gonadal vein, or directly into the inferior vena cava (IVC) in 44 patients. Pancreaticoduodenal veins drained into IVC in 14 patients. The preaortic esophageal vein was opacified in five patients; the left inferior phrenic vein was opacified in ten. Paraumbilical veins were opacified in 21 patients. PSs via other intrahepatic portal veins were seen in seven patients.
Conclusion: PSs, such as the veins of Retzius, were frequently depicted on three-dimensional and thin-section CTAP in patients with liver cirrhosis.

P73.

Percutaneous removal of intravascular foreign bodies

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Purpose: The frequent use of central venous catheters has led to a relative increase in the occurrence of intravascular foreign bodies (FB). Their removal is indicated for the associated high risk of possible complications. We present our experience with the percutanous removal of intravascular FB.
Materials/Methods: From 1996 to 2003, percutaneous extraction of intravascular FB was performed in 61 patients (31 women; average age: 54 years, ranging from 10 to 88). Indications included broken catheters (n=48), intravascular loss of guidewire fragments (n=4), coil dislocations (n=4), stent dislocations (n=2), pacemaker-wires (n=2), and dislocated vena cava filter (n=1). For the retrieval we used a Goose-neck snare systems with a loop diameter ranging from 4 to 25 mm.
Results: The interventional procedure was successful in 58/61 patients. One dislocated cerebral coil could not be removed and one broken catheter and one pacemaker-wire were adhering to the vessel wall. No procedure-related complications occurred.
Conclusion: Percutaneous techniques for the extraction of intravascular FB are highly effective and safe and should therefore be considered the primary choice.

P74.

Percutaneous treatment of pulmonary arterio-venous malformations

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Purpose: To report our experience in treating pulmonary arterio-venous malformations (PAVM) in Rendu-Osler-Weber disease.
Materials/Methods: Thirteen patients (six men and seven women, 18 to 74 years old) with Rendu-Osler-Weber disease were treated by 20 embolization procedures using metal devices and detachable balloons after pulmonary angiography.
Results: Clinical and radiographic involution of PAVM was immediately complete in all patients, with a significant increase in arterial pO2. No early or late migration of the devices occurred, and the only significant complication was one case of transitory ischaemic attack which resolved in 72 hours.
Conclusion: Pulmonary angiography allows confirmation of the diagnosis of PAVM, and successive catheter embolization is a safe treatment in Rendu-Osler-Weber disease. The procedure is very selective, preserving lung, and guarantees an immediately successful result, without early or late device migration and with a low risk of complication.

P75.

Complications of thoracic interventions

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Purpose: To assess factors contributing to complications of thoracic interventions.
Materials/Methods: Chart review of 416 thoracenteses, tube thoracostomies, and lung biopsies performed by six different interventional radiologists.
Results: A total of 61 (14.7%) complications occurred including 43 (10.3%) pneumothoraces; seven (1.7%) hydropneumothoraces; eight (1.9%) localized hematomas; two (0.5%) fatal thoracenteses; and one (0.2%) hemopericardium. Other incidents included one episode each of vasovagal syncope, hemoptysis, and systemic air embolism. One fatality occurred, secondary to diagnostic thoracentesis performed portably in the ICU with ultrasound using an 18-G DSA needle. The other occurred upon chest-tube removal (8-F locking pigtail catheter) in a patient with critical aortic stenosis who was anticoagulated. Of the pneumothoraces, 41 occurred in lung biopsies while two occurred with thoracenteses. Of the hydropneumothoraces, six occurred with thoracentesis while one occurred on removal of a thoracostomy tube.
Conclusion: Chest interventions are associated with infrequent complications such as pneumothorax followed by hydropneumothorax. Bleeding complications while rare can be fatal. Unlike other areas of the body, the pleural space is subjected to vacuum and can accumulate significant amounts of blood. Portable intervention is associated with technical compromises and these may influence complications.

P76.

CT-guided radiofrequency thermal ablation in organs other than the liver

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Purpose: To evaluate radiofrequency thermal ablation (RFA) results of metastatic tumors in organs other than the liver.
Materials/Methods: During a nine-month period, RFA was carried out under CT-guidance in 15 patients (four with hypernephroma, seven with solitary metastatic bone disease, two with recurrence of a rectal adenocarcinoma, one retrosternal, one supradiaphragmatic lymph node and one painful perineal metastasis). The ablation lasted 15 minutes and the target tissue temperature was 95ºC. The procedure was done after local anesthesia of the puncture site. Follow-up after IV administration with dual-phase spiral-CT was carried out immediately after the ablation and at one, three, and six months.
Results: After the surgical resection of the ablated hypernephromas, we had a total necrosis in three and a partial necrosis in one. Four out of seven metastatic bone tumors showed a total necrosis, 2/7 a partial necrosis, and 1/7 a sclerosis. The two rectal recurrences were totally necrosed, as the perineal metastasis too, and the patients had a remission of their symptoms. Finally, the two lymph nodes showed a total necrosis. We had no complications.
Conclusion: RFA is an alternative safe and effective therapeutic tool for the treatment of both primary and metastatic tumors.

P77.

Treatment of large neck femoral pseudoaneurysms: balloon-occluded percutaneus injection of D-stat

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Purpose: Thrombin injection is an effective therapy for pseudoaneurysms, although it cannot be used in case of larger aneurysmal necks. Our aim was to evaluate effectiveness and safety of percutaneous injection of a mixture of D-stat (bovine thrombin and collagen) and contrast after blood flow occlusion in voluminous pseudoaneurysms with a large neck.
Materials/Methods: In four patients with large femoral pseudoaneurysms (three iatrogenic, one mycotic) a balloon-catheter was placed to reduce the flow in the aneurysmatic sac and a percutaneus injection of a mixture D-stat and contrast was done. After complete thrombosis of the aneurysmatic sac, the balloon was deflated.
Results: A technical success was achieved in all patients. In one patient, a small passage of the contrast+thrombin mixture in the femoral artery, observed after deflation of the balloon, was treated with rTPA. The patient with a mycotic aneurysm developed a late arterial breach and was treated with covered stent deployment
Conclusion: Percutaneus thrombin injection is a quick, effective, and safe method for the treatment of iatrogenic femoral pseudoaneurysms, although it cannot be used in larger aneurysmal necks. Balloon-occlusion of the blood flow is an easy and safe way to extend such a treatment to large-neck pseudoaneurysms.

P78.

Influence of a titanium surgical staple on radiofrequency ablation with LeVeen needle

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Purpose: To evaluate whether a titanium surgical staple has an influence on radiofrequency ablation (RFA) of egg white with LeVeen needle.
Materials/Methods: The retractable prongs of LeVeen needles (expansion diameter: 3.0cm) were spread and the following conditions were prepared; 1) no surgical staple; 2) a surgical staple touching one of the prongs; and 3) a surgical staple joining two of the prongs. Each needle tip was placed in egg white, and ablation was performed. After ablation, the diameters of the coagulated areas and the needed time for roll-off were measured.
Results: Ablation was performed until roll-off was obtained under all conditions. The time needed for roll-off tended to shorten and the diameter of the coagulated area tended to slightly reduce when a surgical stapler joined two of the prongs as compared with other conditions. However, the diameter of the coagulated area was more than 3 cm under all conditions.
Conclusion: Estimated coagulation is obtained in RFA with LeVeen needle even under the condition that a titanium surgical staple touches the prong(s).

P79.

Magnetic Resonance-guided percutaneous cryoablation of uterine fibroids: short-term results

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Purpose: To evaluate the feasibility and effectiveness of magnetic resonance (MR)-guided percutaneous cryoablation for uterine fibroids as a minimally invasive treatment alternative.
Materials/Methods: From August 2001 to June 2002, we performed MR-guided percutaneous cryoablation in 7 uterine fibroids of 6 patients, who had clinical symptoms related to the fibroids. With the aid of a horizontal-type open MR system, cryoablation probes were placed in fibroids percutaneously. The fibroids were ablated, and the site and size of the ice balls were monitored on MR imaging.
Results: All of the treated patients showed reduction in tumor size. The average volume reduction rate was 40.3% at 6 weeks and 79.4% at 9 to 12 months after the operation, and symptoms improved in all but one of the patients.
Conclusion: MR-guided percutaneous cryoablation is a feasible and effective treatment for uterine fibroids.

P80.

Digital subtraction and magnetic resonance dacryocystography in patients with epiphora

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Purpose: The goal of this study was to compare the results of tear-drop (td) and canalicular (cn) 3D magnetic resonance dacryocystography (MRD) with the results of digital substraction macrodacryocystography (DSMD) in patients with epiphora.
Materials/Methods: We performed bilateral DSMD, MRD-td and MRD-cn in 37 patients with epiphora using Gd-DTPA-containing solutions and water soluble contrast medium. Blunt galactography cannula was used for cannulation. The passage of the contrast material was compared in these three procedures.
Results: In 30 of 74 nasolacrimal systems, nasolacrimal duct obstruction at varying levels was demonstrated by DSMD. The level of obstruction was diagnosed in all 30 cases by MRD-cn and in 29 of 30 cases by MRD-td. False-positive results were determined in 3 of 74 cases by MRD-cn and in 7 of 74 cases by MRD-td. Additional information was also provided by the MR images. The stenosis or obstructions demonstrated by DSMD were all confirmed surgically.
Conclusion: We think that in patients with epiphora MRD can be used first, because it is radiation-free, does not need viscose contrast media, and is an effective diagnostic method. If MRD dose not provide enough information, "gold standard" DSMD should be carried out.

P81.

Three-dimensional digital subtraction dacryocystography

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Purpose: Digital subtraction dacryocystography (DS-DCG) is considered the gold standard in the assessment of the nasolacrimal duct system. The aim of this study was to determine the diagnostic accuracy of three-dimensional digital subtraction dacryocystography (3D DS-DCG) in patients with epiphora.
Materials/Methods: We performed 32 DS-DCG and 3D DS-DCG in 17 patients (aged 13 to 64 years) with primary epiphora or recurrent post-surgical epiphora using water-soluble iodinated contrast medium. A blunt galactography cannula was used for cannulation. DS-DCG and 3D DS-DCG findings were separated and reviewed by two radiologists. The results were compared.
Results: In 16 of 32 nasolacrimal systems, duct obstruction at varying levels were demonstrated by DS-DCG and 3D DS-DCG. Contrast medium drainage was normal in 12 nasolacrimal ducts. Four stenoses were also demonstrated by these two methods. In seven of 12 cases narrowed portions of normal nasolacrimal ducts and stenotic segments in four cases were demonstrated more clearly by 3D DS-DCG when 3D DS-DCG images were compared with DS-DCG images. In cases with obstruction, additional information about the nasolacrimal duct was supplied by 3D DS-DCG.
Conclusion: Our data suggest that 3D DS-DCG is superior to DS-DCG in planning effective surgical or radiological intervention.

P82.

Inhibiting post-stenting neointimal hyperplasia by using an inhibitor of transcriptional regulator, the nuclear factor[kappa]B

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Purpose: To develop a new treatment for inhibiting neointimal hyperplasia by using an inhibitor of transcriptional regulator, the nuclear factor[kappa]B (NF-[kappa]B).
Materials/Methods: A wound-healing model in human aortic endothelial cells (EC) was used *in vitro* to evaluate cell migration. NF-[kappa]B in EC was activated by high glucose concentrations (30 mM) of culture medium and inhibited by N-tosyl-Lys-chloromethyl ketone (TLCK) (50 microM). *In vivo*, rabbit ear arteries were used. Seven days after denudation of the endothelium, the neointimal thickness was histologically evaluated. In the NF-[kappa]B activity-inhibited group, TLCK (3 mM, 1 ml) was injected into the artery just before denudation.
Results: *In vitro*, the activated group showed a significantly lower number of migrating EC than the control groups ($p < 0.05$) and TLCK restored the EC migration inhibited by NF-[kappa]B activation. *In vivo*, the mean neointimal thickness was 11.8 +/- 3.8 microM in the control group and 7.6 +/- 4.2 microM in the inhibited group. The inhibited group showed a tendency to decrease neointimal thickness as compared with the control group.
Conclusion: NF-[kappa]B inhibitors may accelerate endothelial coverage over the stenting site and attenuate neointimal hyperplasia. As a next step, we are developing stent-based drug delivery systems for NF-[kappa]B inhibitors.

P83.

Percutaneous treatment of arterial-ureteral fistulae with covered stents and ureteral occlusion

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Purpose: Arterial-ureteral fistula is a rare entity, and a high degree of suspicion is needed to establish a rapid and correct diagnosis. Most frequently patients present with massive hematuria. The purpose of this work is to present and discuss the percutaneous treatment of this life-threatening condition.
Materials/Methods: Four cases of secondary arterial-ureteral fistulae, three women and one man, were treated by covered stent placement, with ureteral occlusion in three. All patients had a history of pelvic cancer (cervix 3, bladder 1) treated with radiotherapy five to 20 years previously and were bearers of ureteral stents. Three patients had had previous episodes of intermittent hematuria, whilst one had a single episode at the time of ureteral stent replacement. The fistula was not immediately apparent in any of them and only indirect signs were present.
Results: The follow-up period ranges from eight to 14 months and all patients remain asymptomatic and well. There were no complications.
Conclusion: Treatment of arterial-ureteral fistulae with covered stents and ureteral occlusion is effective. The fistula is not always apparent, and manoeuvres to demonstrate the communication may be needed. These should not be performed unless there is availability to perform immediate treatment, as haemorrhage can be life-threatening.

P84.

Comparison of mechanical properties of peripheral self-expanding nitinol and balloon-expandable stainless steel stents

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Purpose: Balloon-expandable (BE) and self-expanding (SE) peripheral stents were investigated mechanically to compare their suitability in specific vascular regions.
Materials/Methods: *In vitro* tests included: Guidant Acculink, Cordis Precise, and Bard Luminexx for self-expanding nitinol stents and Boston Scientific Express Vascular, Medtronic Bridge, and Biotronik Peiron as balloon-expandable stainless steel stents. All stents were 8 mm in diameter and 36-40 mm long. Their flexural stiffness, length change due to expansion, and radial strength were measured.
Results: In SE stents the stent stiffness ranged from 11.7 to 88.1 Nmm^2 as compared with 109.9 to 522.0 Nmm^2 of BE stents. Length changes were: -7.25% to +11.75% (SE) and -4.78% to -0.50% (BE). Radial strengths expressed as the collapse pressure were 0.18-0.25 bar (SE) and 0.85-1.40 (BE).
Conclusion: The bending stiffness of SE stents was lower than BE stents. This is in accordance with the low collapse pressure of SE stents as compared with the BE group. Differences in length change depend on stent design rather than on the principle of stent expansion. The differences noted by our study support the clinician in the selection of the appropriate stent for a particular vascular lesion.

P85.

Percutaneous treatment of iatrogenic arterial lesions with e-PTFE covered stents

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Purpose: To present our experience in the endoluminal treatment of iatrogenic arterial lesions by using vascular stents covered with extended-polytetrafluoroethylene (e-PTFE) (Hemobahn/Viabahn).
Materials/Methods: In a five-year period, 13 patients (eight men and five women) aged from 18 to 78 years (mean: 53.8) with ten arteriovenous fistulas (AVF) and three pseudoaneurysms were treated. Five fistulas were located in the superficial femoral artery, four in the common femoral artery and one in the deep femoral artery. Two pseudoaneuryms were in the superficial femoral artery and one in the subclavian artery. Follow-ups with Doppler-ultrasounds were performed in seven patients.
Results: In all the cases, the vessel orifice was sealed. In one case, a second endoprosthesis was needed. In two cases, a large perilesion hematoma was drained with urokinase. In all the seven patients who had undergone color-Doppler scans between six and 27 months (mean: 13) the arterial injury was closed and the involved vessels were patent.
Conclusion: The endoluminal treatment of iatrogenic AVFs and pseudoaneurysms with covered stents is a safe and effective alternative to conventional management.

P86.

Fibromuscular dysplasia of the external iliac artery: response to endovascular treatment in two patients

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Purpose: To demonstrate three different angiographic features and different responses to the endovascular treatment of fibromuscular dysplasia of external iliac arteries.
Materials/Methods: Two patients (one man aged 64 years, and one woman aged 60 years) with bilateral fibromuscular dysplasia of the external iliac arteries were treated for claudication.
Results: In the first patient, the angiographic appearances of the lesions were those of a typical bilateral "string-of-beads" stenosis. Response to PTA was good. The lesions were atypical in the second patient, who also had aneurysms of the abdominal aorta and the right renal artery. The lesions were a tight stenosis on the right side and completely elastic on the left. PTA caused severe dissection on the right side and caused no change on the left side with the same balloon size and at the same pressure. Both lesions had significant pressure gradients after PTA and required deployment of stents with good results.
Conclusion: Fibromuscular dysplasia of the external iliac arteries is a rare disease and can be seen with or without involvement of the renal arteries. It may display quite different angiographic features. Response to PTA is variable and is not as good as it is in the renal arteries.

P87.

The PASCAL (performance and safety of the self-expanding stent system in carotid artery lesions) study

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Purpose: To demonstrate the safety and performance of the Medtronic self-expanding carotid artery stent system (Exponent™) in patients with symptomatic and asymptomatic carotid artery stenosis.
Materials/Methods: One-hundred thirteen patients (53 symptomatic [stenosis >/= 80% diameter] and 60 symptomatic [stenosis >/= 60% diameter]) were entered into a multicentre, non-randomised study. Stents (length: 20-40 mm; diameter: 6.0-10.0 mm) were implanted in conjunction with an embolic protection device. Patients were followed-up at 30 days and six months to evaluate vessel patency and the incidence of complications. All patients were evaluated by an independent neurologist for neurological events (National Institutes of Health stroke scale) at 24 hours post-procedure, and at the 30-day and six-month follow-ups.
Results: Delivery success rate was 99.1%. The mean diameter stenosis of the internal carotid artery lesion was reduced from 64.5±14.7% to 17.3±10.9%. Incidence of major adverse events was 9.7% (11/113) at six months post-procedure (stroke 5.3% [6/113], myocardial infarct 1.8% [2/113], death 5.3% [6/113]), most (8%; 9/113) occurring within the first 30 days.
Conclusion: This system performs effectively and is safe. Major adverse event rates with the Medtronic Exponent™ system at 30 days post-procedure are comparable with those from other published studies with carotid stents.
*for the PASCAL investigators

P88.

Endovascular stent-grafting for infected iliac artery pseudoaneurysms

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Purpose: To report two cases of acutely infected pseudoaneurysms of the iliac arteries, successfully treated with endovascular stent-grafting.
Materials/Methods: Two patients underwent stent-grafting for erosive rupture of the iliac artery caused by an infectious surrounding. The first case was a 61-year-old man who had undergone Miles' operation for an advanced rectal cancer. Postoperatively, he developed an intrapelvic abscess formation from which methicillin-resistant *Staphylococcus aureus* was cultured, followed by rupture of the right external iliac artery. The second case was a 60-year-old man who had a pseudoaneurysm of the left common iliac artery contiguous to a left psoas muscle abscess, from which *Streptococcus agalactiae* was cultured.
Results: Both patients were successfully treated with only one stent-graft and antibiotic therapy.
Conclusion: Although endovascular stent-grafting should not be considered the standard therapy for infected aneurysms, our cases suggest that it can repair infected aneurysms even in the uncontrolled active stage.

P89.

Pitfalls in renal stenting

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Purpose: To report renal stenting complications.
Materials/Methods: Between 1997 and 2003, 325 renal procedures have been performed in our Institution.
Results: In our experience, we recorded 4.3% severe complications: three acute or subacute renal artery thromboses, two renal iatrogenic perforations (guidewire), one renal rupture, eight cholesterol embolizations (four severe, four mild renal failures). Mild complications were recorded in 13% of procedures: three stent embolizations, 15 aortic protrusions (3 or 4 mm), six femoral pseudoaneurysms, eight femoral hematomas, 11 transient renal failures. Many cases were resolved by an interventional radiology treatment (coils embolization, covered stent insertion, or thrombolysis); two patients only underwent a surgical procedure; eight patients needed a medical therapy.
Conclusion: The rate of severe complications in renal stenting is low, although cholesterol embolization remains a great concern. The learning curve is determinant for technical problems and the new generation of balloons and stents could reduce their rate and that of complications.

P90.

Transcatheter-thrombolysis of massive pulmonary embolisms in the first week after major surgery

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Purpose: Pulmonary thrombectomy is the treatment of choice in patients with massive pulmonary embolism (MPE) and contraindications for transcatheter-thrombolytic therapy (TT). The aim of this study was to compare the effects of the TT with heparin in patients with MPE during the first week after major surgery (MS).
Materials/Methods: A total of 27 patients was divided into two groups: Group T (16 patients treated with TT) and Group C (21 patients treated with heparin or TT. In this non-randomized study, a physician decided whether to give TT or not.
Results: Mortality rates did not significantly differ between the two groups: 10/16 (75.0%) patients died in Group T and 18/21 (85.7%) patients died in Group C. The cause of death was cardiogenic shock in all (100%) 18 patients in Group C and in 7/10 (70.0%) patients in Group T ($p<0.05$). A massive hemorrhage was the cause of death in the remaining three (30.0%) patients in Group T. Blood transfusions where needed in 4/6 patients (66.7%) who survived in Group T.
Conclusion: Although TT is a risky treatment for MPE after MS, survival is slightly (but not significantly) better when compared with the "nothing-to-do" treatment.

P91.

Balloon-occluded retrograde transvenous obliteration for gastric varices with gastrorenal shunt: long-term clinical results

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Purpose: To evaluate long-term results after balloon-occluded retrograde transvenous obliteration (B-RTO) of gastric varices (GV) with gastrorenal shunt.
Materials/Methods: Seventy-eight patients with GV successfully treated by B-RTO were evaluated for GV recurrence and bleeding, worsening of esophageal varices (EV), and survival. Univariate and multivariate analyses were used to assess the prognostic factors for worsening of EV and survival.
Results: Five-year GV recurrence and bleeding rates were 2.7% and 1.5%, respectively. EV worsening rates at one, two, and three years were 27, 41, and 58%, respectively. The prognostic factor for EV worsening was the presence or absence of EV before B-RTO (relative risk, 4.956). Survival rates at one, three, and five years were 93, 76, and 54%, respectively. Prognostic factors for survival were the presence or absence of hepatocellular carcinoma (relative risk, 24.342) and the Child-Pugh's classification (relative risk, 5.780).
Conclusion: B-RTO is an effective method for GV with gastrorenal shunt and provides lower GV recurrence and bleeding rates. We believe that B-RTO can become a standard treatment for GV with gastrorenal shunt, although treatment for EV worsening may be necessary after B-RTO.

P92.

TIPS with PTFE-covered stent-grafts: a clinical experience

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Purpose: To evaluate our clinical experience with the Viatorr stent-graft in transjugular intrahepatic portosystemic shunt (TIPS).
Materials/Methods: Thirty-six consecutive patients underwent TIPS using Viatorr stents. Indications for TIPS were variceal bleeding (n= 29), refractory ascites (n= 5), and hydrothorax (n=2). Six patients were in Child's A, 20 in Child's B, and ten in Child's C class. Follow-up was performed by clinical exam, US and venography with portosystemic pressure gradient (PSG) measurement.
Results: TIPS placement was successful in all patients. Mean PSG decreased from 20.4 ± 4 to 7.3 ± 3 mm Hg. Two emergency patients developed an early rebleeding requiring shunt revision. The 30-day mortality rate was 11%. During follow-up (mean: 223 days) two patients developed an asymptomatic shunt dysfunction. Primary and secondary patency rates were 74% and 100% at 12 months. The cumulative rate of encephalopathy was 34% at 12 months. Two patients with severe encephalopathy required shunt reduction. The cumulative survival rate was 73% at 12 months.
Conclusion: Our results suggest an improved patency for TIPS using PTFE-covered stent-grafts.

P93.

TIPS-induced refractory hepatic encephalopathy: treatment with reducing stents

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Purpose: To evaluate our experience in the treatment of shunt-induced encephalopathy with reducing stents.
Materials/Methods: During the last 12 years, 271 patients underwent transjugular intrahepatic portosystemic shunt (TIPS) at our institution. Six of them developed a refractory hepatic encephalopathy and were treated by shunt reduction. Indications for TIPS were variceal bleeding in four patients and refractory ascites in two. Shunt reduction was performed by transjugular implantation of a hand-made constraining stent (a Wallstent in four patients, a Wallgraft in two).
Results: In all six cases the reducing stent was successfully placed. No procedural complications were observed. Shunt reduction was followed by a mean increase in the portosystemic pressure gradient of 2.33 ± 1.50 mm Hg. Encephalopathy improved substantially in all. During follow-up (mean: 13.6 ± 5.8 months) the reducing stent remained patent in five patients. One patient developed a shunt occlusion six months after implantation of a constraining Wallgraft and was successfully treated by angioplasty.
Conclusion: In our experience, TIPS-induced encephalopathy can be effectively treated with implantation of reducing stents.

P94.

Change of hepatic function and liver volume after balloon occluded retrograde obliteration of gastric varices

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Purpose: To evaluate the change of hepatic function reserve and liver volume after balloon occluded retrograde obliteration (B-RTO) of gastric varices.
Materials/Methods: B-RTO, which is a procedure to obliterate gastric varices (GV) by a sclerosing agent (Ethanolamine oleate) during temporary occlusion of gastrorenal shunt by a balloon catheter wedged retrograde, was performed in 164 patients with marked gastric varices or portsystemic encephalopathy since 1992. Change of hepatic function reserve after B-RTO, rate of disappearance of GV, improvement of encephalopathy, aggravation of esophageal varices (EV) and change of liver volume (n=5) were evaluated.
Results: 1) Hepatic function reserve was improved in 45 % of patients. 2) Success rate of disappearance of GV was 93%, encephalopathy improved in 90% of patients. EV aggravated in 21%. 3) Increase of hepatic volume was shown in 20 % of patients three months after B-RTO
Conclusion: B-RTO is a promising procedure, showing a high success rate of obliteration of gastric varices in 164 patients. Hepatic function reserve improved in 45 % of patients, suggesting that B-RTO increased hepatopetal portal blood flow with resultant increase of liver volume after B-RTO.

P95.

A new idea to reduce intra-TIPS flow in patients with severe encephalopaty

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Purpose: To describe a possible solution for clinically important portosystemic encephalopathy in patients with percutaneous portocaval shunt, reducing the TIPS blood flow.
Materials/Methods: The right internal jugular vein and the right femoral vein were accessed. Two 5x50-mm intravascular metallic stents Viabahn (W.L.Gore & Associates) were simultaneously deployed inside the primary stent (10x70-mm Viatorr, Gore). The one deployed via the jugular vein was dilated using a 5-mm angioplasty balloon catheter (Pheron 5x40 mm, Biotronik), while the one deployed via the right femoral vein was partially compressed by the first one, with a secondary thrombosis inside it.
Results: Angiographic controls after stent deployement showed an hepatopetous portal flow which did not exist before the treatment. Encephalopathy improved after the reduction of the shunt flow. A clinical follow-up performed 30 days later showed the resolution of encephalopathy.
Conclusion: A simultaneous intra-TIPS double stent implantation can resolve encephalopathy secondary to percutaneous porto-systemic shunt.

P96.

Influence of a paclitaxel-releasing nitinol stent on pseudointimal hyperplasia in a transjugular intrahepatic portosystemic shunt: experimental study in a swine model

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Purpose: To evaluate the influences of the paclitaxel-releasing nitinol stent to inhibit pseudointimal hyperplasia in a transjugular intrahepatic portosystemic shunt (TIPS).
Materials/Methods: Metallic stents for TIPS were made of a nitinol wire 60 mm in length and 10 mm in diameter, coated with a polyurethane solution containing paclitaxel (concentration: 12%). TIPS with paclitaxel-releasing stents were successfully performed in 7 swine with portal hypertension by injection of n-butyl-2-cyanoacrylate into the portal vein. TIPS with bare stents for control study were performed in 5 swine. Excepting 3 animals that expired within 3 days after TIPS in the paclitaxel group, all animals were followed for 14 days. Portograms were obtained before animals were sacrificed. In histologic analyses, maximum pseudointimal hyperplasia as a percentage of stent radius was calculated.
Results: On follow-up portograms, all TIPS using paclitaxel-releasing stents were partially occluded and all control TIPS were completely occluded. As a result of histopathologic analysis, the maximum pseudointimal hyperplasia as a percentage of stent diameter was 25% in paclitaxel-releasing stents and 76% in control stents.
Conclusion: Although luminal patency of TIPS was not improved, TIPS with the paclitaxel-releasing nitinol stent seems to strongly reduce pseudointimal hyperplasia in swine with portal hypertension.

P97.

Virtual stenting: a new modality for choosing a stent or a stent-graft by three-dimensional rotational angiography. Preliminary data

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Purpose: Virtual stenting (VS) is a new dedicated technique, recently implemented in the 3D rotational angio-workstation and intended for virtual placement of stents in pathological vessel portions. The technique enables 3D assessment of stents and stent graft geometry on stenotic, obstructive, or aneurysmatic vessel lesions to be treated.
Materials/Methods: Twenty patients, in whom 3D vessel elaborations and virtual stenting was performed, underwent rotatioal angiography (RA): 15 cases showed iliac stenoses or obstructions, four were abdominal aortic aneurysms (AAA) and one was a case of descending thoracic aneurysm.
Results: The geometrical properties of virtual stents (lengths/diameters) were compared with the geometry of the stents implanted in the patients and with computed tomography scanner measurements (in case of not yet treated AAA). In all cases a corresponding correlation in the measurements was observed. The system was unable to provide the required measurements in one case only with elongated and tortuous aneurysmatic iliac artery.
Conclusion: VS technique appeared effective, fast and objective in almost all cases and provided the required geometrical information on the minimum stent diameter and length. In case of extreme vessel tortuousity associated with aneurysmatic disease a manual intervention is required to optimize the lumen path.

P98.

Angiographic and ultrasonographic assessment of arterial and venous growth after metallic clip placement or conventional suturing with polypropylene anastomosis

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Purpose: Alternatives are still being sought in vascular surgery to address the lack of growth following anastomosis in growing vessels. The aim of this study is to assess, using both angiography and ultrasonography, whether the new VCS titanium clip systems allow longitudinal and transverse growth of anastomosed vessels.
Materials/Methods: Thirty 55-day-old lambs underwent end-to-end anastomosis of the left carotid artery and jugular vein. VCS clips were used in 15 lambs, and polypropylene in the other 15. Serial ultrasonography and angiography were carried out over the ensuing 6-month growth period, after which lambs were euthanized.
Results: Both imaging techniques showed vascular growth during follow-up. No significant differences were seen between suturing techniques with either imaging modality ($p< 0.001$). Arterial diameter after 6 months' postoperative growth was 5.31 ± 0.49mm in the clip group, 5.18 ± 0.52mm in the polypropylene group, and 5.27 ± 0.15mm in contralateral, non-operated arteries. Venous diameters were, respectively, 12.8 ± 1.9mm, 14.01 ± 2.22mm and 12.02 ± 2.2mm.
Conclusion: The satisfactory imaging results obtained in this and previous studies of vascular growth appear to confirm VCS clips as the technique of choice in paediatric vascular surgery, including transplant and cardiovascular reconstructive surgery, in rapidly growing children.

P99.

Suspected entrapment syndrome of the popliteal vein: how to diagnose it? Is it rare in Japan?

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Purpose: To evaluate frequency of the entrapment syndrome of the popliteal vein.
Materials/Methods: Between October 2003 and February 2004, 25 patients (50 limbs) with chronic leg symptoms (calf numbness and swelling without redness) or with a history of pulmonary embolism were studied. The popliteal veins from the viewpoints of venous diameters, compression signs, and flow rate in three positions (neutral, dorsal flexion, and plantar flexion) with venous duplex ultrasound and/or venography were evaluated.
Results: Ten patients (40%) and 12 limbs (24%) were diagnosed as entrapment syndrome of the popliteal vein. Seven limbs showed entrapment syndrome of the popliteal vein in the dorsal flexion, five in plantar flexion and two in neutral position. Two had anomaly of the gastrocnemius muscle, one had elongation of the popliteal artery and one was a venous anomaly (duplicated femoral vein).
Conclusion: Entrapment of the popliteal vein is not common, but it may cause calf deep vein thrombosis and/or pulmonary embolism. It is therefore important not to overlook this syndrome.

P100.

Aorto-iliac imaging with contrast-specific, real-time sonography: a pictorial review

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Purpose: Contrast-specific ultrasonography (CS-US) selectively detects harmonic signals produced by microbubble contrast agents within large and small vessels, while tissue signal is minimized. When CS-US techniques are employed with a low-beam power (low Mechanical Index or non-destructive mode) and second-generation agents, images can then be dynamically displayed in real-time. This exhibit is aimed at providing a comprehensive illustrated guide to those aspects of aortic and iliac disorders during contrast-specific sonographic imaging.
Material/Methods: Case descriptions include endoleaks after percutaneous placement of aortic prostheses, periaortic leaks after surgical placement of aortic prostheses, aorto-iliac dissections, aorto-iliac anastomotic pseudoaneurysms, aortic graft infections, rupture of abdominal aortic aneurysms.
Results: Real-time assessment during contrast medium circulation and recirculation allows optimal detection of subtle changes--there including contrast leakages inside or outside aortic aneurysms--without the artefacts or other limitations typical of color-Doppler techniques. In most cases, a color-power-Doppler and a double-phase helical-CT correlation is required.
Conclusion: CS-US is an accurate, time-effective, and poorly invasive technique in the evaluation of aorto-iliac disorders. Radiologists should be aware of its related diagnostic possibilities and limitations, imaging findings, and potential pitfalls.

P101.

Peripheral vascular disease of aortoiliac system and lower extremities: evaluation with multidetector computed tomography angiography and digital substraction angiography

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Purpose: To compare the accuracy of multidedector-CT angiography (MCTA) with digital subtraction angiography (DSA) for the assessment of peripheral atheroocclusive disease.
Materials/Methods: Twenty-four symptomatic patients were evaluated with MCTA (four detectors) and DSA of the aortoiliac system. The images were read by two independent radiologists. Arterial supply of the leg was divided in anatomic segments calculating for each segment sensitivity, specificity, prevalence of pathology, positive and negative predictive value. Agreement was quantified using the kappa statistic. Distal segments were evaluated using the ROC curve.
Results: Sensitivity of MCTA for occlusion and stenosis was lowest in common and internal iliac arteries (0.65 and 0.71 respectively), with high specificity (0.94 and 1). In the rest of the vascular segments we obtained values near 1. The kappa values for intertechnique agreement were between 0.62 and 1 in all segments. MCTA was superior at showing calcium and mural thrombus. In the distal runoff, the ROC curve determined the best cut-offs for pathological interpretation.
Conclusion: MCTA was accurate in showing atheroocclusive disease of the aortoiliac system and lower extremities as compared to DSA and was more sensitive than DSA in identify patent vessels distal to severe occlusion. However MCTA was worse at identifying looping vessels.

P102.

Sonographic diagnosis of abdominal aortic aneurysm rupture: categorization of findings and illustration of three new signs

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Purpose: Ultrasonography (US) has been widely used in the emergency detection of aneurysms in patients with suspected abdominal aortic aneurysm (AAA) rupture. Nevertheless, no series has categorized specific imaging patterns. Moreover, we have observed three previously undescribed US findings.
Materials/Methods: From January 1997 to December 2002, 388 consecutive patients with AAA (largest transverse diameter >30 mm) were evaluated. Among these subjects, 29 underwent emergency surgery for AAA rupture. The remaining 359 were asymptomatic and had no evidence of AAA rupture at follow-up.
Results: Findings recognised among 29 positive cases included: AAA deformation (n=12), thrombus dyshomogeneity (n=20), clear interruption of a luminal thrombus (n=5), retroperitoneal hematoma (n=22), hemoperitoneum (n=11). Moreover, three novel findings were noted: intraluminal floating thrombus layer (n=8); parietal hypoechoic focus due to aneurysm wall interruption (n=3); paraortic hypoechoic area adjacent to the bleeding side (n=4). None of these new signs was recognised among control subjects.
Conclusion: US was mainly employed in the past to rapidly confirm the presence of an aneurysm with a suspected rupture. But this imaging technique can also frequently identify several direct and indirect signs of aneurysm rupture. Three new findings of ruptured AAA should become familiar to the radiologist.

P103.

Inferior vena cava congenital abnormalities: a variety of multislice CT (MSCT) findings

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Purpose: To show axial, reformatted, and 3D phlebographic images of inferior vena cava abnormalities at multislice-CT (MSCT).
Materials/Methods: The embryological development of the inferior vena cava system is complex and several congenital malformations may develop. This paper provides a clear anatomical depiction of these variations in tables. An embryological correlation is also offered.
Results: Transaxial, oblique and coronal reformatted, maximum intensity projection, and volume rendering images of the chest and the abdomen are offered, dealing with: inferior vena cava interruption with azygos/hemiazygos continuation, double left renal vein/retroaortic left renal vein, inferior vena cava transposition, double inferior vena cava, circumcaval ureter. Cases of vena cava abnormalities combined with situs inversus/ambiguous are included. Special reference is given to each variation prevalence and significance. Thoracic and abdominal differential diagnoses and pitfalls are finally discussed.
Conclusion: By reading our paper the reader will be able to dynamically categorize the wide spectrum of congenital abnormalities of the inferior vena cava district and become confident with MSCT axial, reformatted, and angiography-like findings.

P104.

Role of dual arterial phase scans on 16-detector row CT in the depiction of the visceral artery

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Purpose: Advantages of 16-multidetector CT (MDCT) include multiphase examinations (dual arterial, portal and delayed phases) which have a high diagnostic value, but radiation exposure is also increased. Our purpose was to evaluate the efficacy of dual arterial phases by assessing the detectability of visceral arteries on each arterial phase.
Materials/Methods: Dual arterial phases were obtained in 30 patients on 16-MDCT (0.75-mm collimation, 1.0-mm reconstruction) with 100 ml of contrast material (5 ml/sec). We evaluated the detectability of the arteries on each phase with a 4-point scale (0; nondiagnostic, 1; poor, 2; good, 3; excellent) by using maximum intensity projection.
Results: Major arteries (celiac, superior mesenteric and left gastric arteries, etc.) were well demonstrated on early arterial phase, and these arteries were also identified on late arterial phase because of high-resolution on 16-MDCT. The detectability of intra-hepatic and pancreatic branches on early arterial phase was higher than that on late arterial phase (the average point 2.8 versus 1.2).
Conclusion: Both early and late arterial phases on 16-MDCT are available for the evaluation of visceral major arteries. Early arterial phase should be used for the evaluation of smaller branches especially in solid organs and of vascular anatomy before surgery and IVR.

P105.

Evaluation of the ophtalmic artery flow pattern with color-Doppler ultrasonography in carotid artery stenoses

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Purpose: To assess whether ophtalmic artery flow patterns reflect the status of cerebral circulation in patients with carotid artery stenosis.
Materials/Methods: Twenty-four patients, 14 men and ten women, with varying degrees of monolateral or bilateral carotid artery stenoses or occlusions, with or without ischemic sypmtoms, were included in the study. Patients' ages ranged between 32 and 79 years (mean 60), and they were compared with a 12-subject control group without carotid artery stenosis. Digital subtraction angiography and color-Doppler ultrasonography were performed in all the patients and the subjects of the control group. Degrees of carotid artery stenoses and flow patterns and velocities, pulsatility and resistance indices of carotid and ophtalmic arteries were calculated.
Results: Significant differences in ophtalmic artery flow patterns and velocities, pulsatility and resistance indices between those patients with carotid artery stenosis of more than 70% and the control group ($p<0.05$) were recorded.
Conclusion: Imaging of the ophtalmic artery with color-Doppler ultrasonography is a useful and cost effective method that reflects the status of cerebral circulation in patients with carotid artery stenosis.

P106.

Use of cutting balloons in the treatment of vascular stenosis

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Purpose: To demonstrate the efficacy of cutting balloon angioplasty in various venous and arterial stenoses.
Materials/Methods: We have treated 22 stenoses in 17 patients with 4-8 mm cutting balloons. Ten patients were men, and age ranged from 25 to 60 years (mean, 50). Twenty of the stenoses were in the veins of hemodialysis patients: eight in the efferent vein, five in the arch of the cephalic vein, two in the fistula anastomosis, two in a venous graft anastomosis, one in a venous in-stent stenosis and two in subclavian vein stenoses. All the efferent veins and anastomotic stenoses were failures after high pressure balloons (>15 atm). Two arterial lesions were renal artery stent stenoses unresponsive to conventional balloon angioplasty.
Results: Technical success for tight venous stenoses including fistula anastomosis, four of the cephalic arch stenosis, and two renal artery stent stenoses were excellent. Other lesions did not get a better response with a cutting balloon than with conventional balloon PTA. There were only two minor complications.
Conclusion: Cutting balloon angioplasty has an excellent success in the treatment of tight venous stenoses and is very useful for cephalic arch stenoses. Larger sizes are needed for the treatment of subclavian vein stenoses.

P107.

Usefulness of Günther tulip inferior vena cava filter placement during treatment for deep venous thrombosis of the lower extremity with interventional radiological procedures

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Purpose: To evaluate the efficacy and safety of Günther tulip retrievable vena cava filter (GTF) implantation to prevent pulmonary embolism during treatment of deep venous thrombosis (DVT) of the lower extremity using interventional radiological procedures.
Material/Methods: We evaluated placement of 21 GTFs in 12 patients with DVT who had undergone various treatments utilizing interventional radiological techniques.
Results: Worsening of or new formation of pulmonary embolism was avoided in all patients. All attempts at implantation of the GTF were safely accomplished. Perforation and migration experienced by one patient was the only complication. The mean period of treatment for DVT under protection from pulmonary embolism by the GTF was 18.8±9.2 days. GTFs were successfully retrieved in six of the seven patients in whom the venous thrombus had disappeared after the therapy and were left in the vena cava in five patients for permanent use when DVT was refractory to treatment.
Conclusion: Ability of the GTF to protect against pulmonary embolism during interventional radiological treatment of DVT was demonstrated. Safety in both placement and retrieval was clarified. Because replacement with a permanent filter was not required, use of the GTF was convenient when further protection from complicated pulmonary embolism was necessary.

P108.

Endovenous laser ablation for symptomatic greater saphenous vein incompetence: early outcomes

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Purpose: To evaluate early outcomes after treatment of symptomatic primary incompetence of the greater saphenous vein (GSV) by endovenous laser ablation (EVLA).
Materials/Methods: Retrospective study of all consecutive patients with symptomatic varicose veins who underwent EVLA for incompetence of the GSV (n=6), its tributaries (n=1), or a neo-GSV post-stripping (n=1). All patients had significant reflux by pre-procedure duplex ultrasonography (US). Immediate technical success consisted of occlusion of the treated vein and absence of deep vein thrombosis by US. At end of follow-up, clinical success was assessed by similar criteria and symptomatic improvement.
Results: Of 22 patients referred to Interventional Radiology over ten months, eight (mean age+/-SD = 50+/-13; 50% women) were eligible for EVLA and treated as outpatients with tumescent anesthesia. Procedure was unilateral in seven patients. Three patients required intravenous conscious sedation. Technical success was achieved in all but one patient (12.5%) in whom venous spasm at puncture site required postponement of the procedure. Mean follow-up length was 99 days (range 17-311), with no patient lost to follow-up. Clinical success was achieved in all but one patient (87.5%) who developed GSV recanalization at one month.
Conclusion: EVLA is a safe and effective treatment for symptomatic GSV incompetence.

P109.

Central venous access: our experience with 10,000 implantations under ultrasonographic guidance

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Purpose: To report our experience in central venous access device implantation in the angiographic suite using ultrasonographic guidance for the vein puncture.
Materials/Methods: From 1994 (46 central venous, non-tunneled, hemodialysis catheters only) until December 2003 (1588 central venous catheters), 10,000 central venous access devices were placed in our departement under ultrasonographic guidance for the vein puncture in all cases, and under fluoroscopy only in selected procedures: implantation of hemodialysis catheters, Groshong's catheters and catheters with port.
Results: Technical success with ultrasonographic guidance was obtained in all cases, with a rate of periprocedural complications below 1%: one pneumothorax in the last year (four in the last three years), and no inadvertent arterial punctures, hematomas, heart or vessel perforations, venous air embolisms.
Conclusion: A great variety of central venous catheters are implanted by interventional radiologists at an increasing rate. With the combined use of ultrasonography (for the vein puncture) and fluoroscopy the incidence of complications can be dramatically reduced.

P110.

Post-radiofrequency ablation syndrome: a prospective survey

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Introduction: Post-radiofrequency ablation (RFA), some patients develop flu-like symptoms: low-grade fever, malaise, myalgia and nausea. This study aims to evaluate the incidence of these symptoms in order to guide management options.
Materials/Methods: Thirty-five patients (age 40-88 years) underwent RFA for 18 liver lesions (five hepatocellular carcinomas, 13 metastases) and 17 renal neoplasms (16 primary, one recurrent renal cell carcinoma). Fifteen control patients (age 54-76 years) underwent biopsy of focal liver or renal lesions. A telephone survey was conducted on days one, three, five, and ten post-RFA using a standardized questionnaire.
Results: Post-RFA, 13 patients (37%) developed low-grade fever (range 99-102°F) and 28 (80%) had flu-like symptoms. Only nine patients (26%) had fever and flu-like symptoms. Symptoms peaked on day three and resolved by day ten. Three patients had persisting fever due to pneumonia (n=2) and liver abscess (n=1). No control patients developed post-RFA syndrome.
Conclusion: Patients should be informed that low-grade fever and flu-like symptoms are self-limiting after RFA. Persistent or late onset fever should be regarded as a result of a concurrent infection elsewhere or possible abscess formation.

P111.

Biological monitoring in EVAR: can D-dimer have a predictive value of endoleak?

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Purpose: The complete endovascular exclusion of an aneurysm results in the organization and remodelling of the wall thrombus; if an endoleak occurs, we can instead observe a change in the thrombus turn-over, characterized by a D-dimer and fibrinogen alteration, secondary to the blood flow and the clot rearrangement products inside the sac.
Materials/Methods: All the patients underwent biological monitoring by periodical blood sampling of fibrinogen and D-dimer: preoperatively, every six hours after the procedure for the first 24 hours, and at day seven and 30 postoperatively, according to the conventional EUROSTAR register.
Results: The mean follow-up period was 13 months (range: 2-24). Primary tecnhnical success rate was 100%. A mean D-dimer value of 1045 μg/L was observed in those patients with a documented endoleak, a significantly higher value than that recorded in the patients with complete sac exclusion (82 μg/L). The D-dimer rate of the endoleak group had increased of 200%, as compared with the mean rate of those patients with a successful exclusion.
Conclusion: Our experience suggests that the D-dimer is a clinical predictive marker of endoleak.

P112.

AneuRx endografts: the use of aortic cuff flares for preservation of internal iliac arteries

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Purpose: To review cases in which aortic extenders were used in common iliac arteries larger than 14 mm during aortic stentgraft procedures using AneuRx device for preservation of the internal iliac artery. To identify complications and patency rates with the use of aortic cuffs in a four-year follow-up.
Materials/Methods: The authors reviewed cases of AneuRx aortic stentgrafts at the Massachusetts General Hospital in a four-year period, identifying those in which aortic cuffs were used in common iliac arteries larger than 14 mm for preservation of the internal iliac artery. Follow-up CTs and angiographies were reviewed.
Results: One-hundred and sixty-five patients were treated during this period with this device; 61 had an aortic extender flare used to preserve the internal iliac artery. Preservation of the internal iliac artery is a desirable outcome in order to prevent buttock claudication. Aortic extenders ranging from 20 to 28 mm x 3.75 cm alone or in combination were used.
Conclusion: AneuRx aortic extenders in common iliac arteries larger than 14 mm during aortic stentgraft procedures for preservation on the internal iliac artery is safe and effective. The incidence of complications is low. There were no significant aneurysmal growth, endoleaks or rupture in the studied population.

P113.

EVAR deployment: a 1 in 4 chance of error without 3D computed tomographic imaging

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Purpose: The screening programme for abdominal aortic aneurysm (AAA) based at Chichester (Scott et al.) has provided a consecutive series of 72 patients with AAA >5.9 cm, symptomatic or rapidly expanding (>1 cm per year). The question of suitability for endovascular repair arises and the precise position of the lowermost renal artery can be determined by modern three-dimensional reconstruction of computed tomographic (CT) data.
Materials/Methods: Assessment of renal artery origins with high-resolution axial CT, then repeat evaluation after multiplanar reconstruction on a modern radiology workstation.
Results: Assessment of sequential axial slices revealed that the right renal artery appeared to have a lower origin than the left in 46% (equal in 11%). Assessment by multiplanar reconstruction changed the decision in 25%.
Conclusion: This study emphasises the need for three-dimensional imaging before deployment of endovascular devices, if errors and surprises are to be avoided.

P114.

Endoluminal treatment of type B aortic dissections

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Purpose: To report our experience and initial results with the endovascular management of aortic type B dissections.
Materials/Methods: Nine patients, seven with aortic type B dissection and two with thoracic aorta penetrating ulcer, aged 37-80, all men, underwent endovascular treatment in a fully-equipped angiographic suite. Seven patients were treated with a stent-graft implantation (Endofit®-Endomed) and two with balloon-fenestration of the intimal flap to equalize pressures in the two lumens. A patient was concomitantly treated for abdominal aneurysm with another stent-graft. Diagnostic evaluation and follow up included CT-angiography (CTA) in all patients and 3D contrast-enhanced MR-angiography (MRA) in six of them. Follow up was in ten months.
Results: Stent-graft deployment and closure of the entry site was successful in six patients. A stent was implanted in the false lumen in one patient who died from aortic rupture 20 days later. Follow-up MRA and CTA revealed an endoleak in one patient and thrombosis of the thoracic false lumen in four. The two cases treated with balloon-fenestration had a sufficient flow in both lumens.
Conclusion: Endoluminal management of type B aortic dissections is a safe and feasible method with hopeful initial results.

P115.

Endovascular treatment of endoleaks in patients after stent-graft placement for abdominal aortic aneurysm

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Purpose: To evaluate secondary radiological interventions to treat endoleaks after stent-graft placement for abdominal aortic aneurysm (AAA).
Materials/Methods: As of December 2003, 200 patients with AAA had undergone stent-graft placement at our institution. At follow-up, endoleaks were found in 16 cases. Interventional procedures were performed in 12 cases to eliminate the leakage into the aneurysm sac. In 4 cases of type I endoleaks, the proximal end of stent-graft was dilated with a high-pressure balloon. In another 6 cases, an additional stent-graft was implanted, in 2 at the proximal end of the stent-graft body and in 4 at the distal end of the stent-graft limb. In 2 cases of type II endoleaks, selective embolization of feeding anstomosis was performed to eliminate retrograde filling of the sac with sponge-gel (n=1) or coils (n=1).
Results: At follow-up, sealing of the endoleak was achieved in 10 cases. We had no procedural complications. In 2 cases residual endoleak was observed on CT.
Conclusion: Secondary radiological interventions are feasible in endoleak treatment in patients after stent-graft placement for AAA.

P116.

Multidisciplinary agreement for carotid stenting? A retrospective study of 272 cases without cerebral protection

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Purpose: Interventional radiologists, neuroradiologists, and vascular surgeons have witnessed the technical evolution of percutaneous treatment of carotid stenoses. Presently, the role of protection devices is not clearly assessed yet. The aim of this study was to evaluate the results of a multidisciplinary group of 272 cases treated without protection devices.
Materials/Methods: During the period March 1995-December 2003, 272 patients underwent carotid revascularization by angioplasty and stenting. All procedures were monitored by analyzing indications, patients' selection, duration of the procedure, complications, morbidity, and mortality. In all cases, treatment was accomplished without cerebral protection device.
Results: Two procedures were unsuccessful (0.73%, one extreme tortuosity of the left carotid artery and one severe and calcified stenosis). Five major complications occurred: two major and three minor strokes. Minor complications included four TIAs. Three patients with restenoses after the endovascular therapy were retreated by angioplasty alone. Follow-ups showed the complete patency of all but one stent without signs of cerebral ischemia.
Conclusion: Our series shows that carotid angioplasty and stenting without cerebral protection is a reasonable procedure, since we think that the safety and efficacy of such devices is still unproven.

P117.

Simultaneous bilateral carotid stenting: experience in 24 patients

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Purpose: Simultaneous bilateral carotid stenting is considered unsafe because of the potential risks of cerebral bi-hemispheric thromboembolic complications. The literature, however, includes some reports of simultaneous bilateral treatments. Treatments were reserved to selected cases when severe co-morbidities made the single-setting bilateral procedures more advisable than staged bilateral ones. We report our experience.
Materials/Methods: Out of 269 protected carotid stenting procedures, 48 in 24 patients (18 males, 6 females, mean age 76 yrs) were simultaneously performed. Each patient was neurologically asymptomatic, with bilateral stenoses (>70%), scheduled for surgical by-pass because of severe coronary artery disease. Different cerebral protection devices were used according to the characteristics of the stenosis, vessel anatomy and cerebral flow patterns. Neurological evaluations were obtained before, immediately after, and 24 hours after the procedures. Follow-up was performed with Duplex-Scan at 1, 6, 12 months, and every year thereafter.
Results: Technical success (residual stenosis <30%) was achieved in all cases without any immediate or 24-hour complications. Primary patency rate was 100%. 5/24 patients died during follow-up of myocardial infarction.
Conclusions: According to our experience, simultaneous bilateral protected carotid stenting proved to be safe and proposable in appropriately selected cases.

P118.

Embolization of experimental wide-necked aneurysms with polyvinyl alcohol polymer (PVAP), a new, nonadhesive, iodine-containing liquid embolic agent

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Purpose: Evaluation of polyvinyl alcohol polymer (PVAP), a new liquid embolic agent synthesized by the authors for embolization of experimental wide-necked aneurysms in swine.
Materials/Methods: Ten broad-based carotid side-wall aneurysms were constructed surgically. PVAP (40%) in dimethyl sulfoxide (DMSO) was injected over a microcatheter into the aneurysm under temporary balloon occlusion. Multi-detector row CT angiography (CTA) and control angiography were performed 4 weeks later. Harvested aneurysms were investigated by high-field MRI (3.0 T).
Results: PVAP can be used without prior preparation. Seven aneurysms were completely occluded (70%), whereas in 2 cases minimal protrusion of PVAP was observed. One aneurysm was embolized almost completely (90%), and another was partially embolized (~80%). During one embolization leakage of PVAP from a DMSO-incompatible microcatheter resulted in carotid artery occlusion without clinical sequelae. Aneuryms embolized with PVAP could be well discriminated on CTA. MRI demonstrated liquid embolic distribution within the aneurysm as well as neointimal formation. Histologic evaluation revealed only mild foreign-body reaction in 2 embolized aneurysms.
Conclusion: Liquid embolization of experimental wide-necked aneuryms with PVAP is technically feasible, while handling is facilitated as compared with Onyx. The liquid embolic agent is well visible under fluoroscopy and enables artifact-free evaluation with CT and MR angiography.

119.

Treatment of lymphangiomas with OK-432 (Picibanil®)

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Purpose: To determine the efficacy of OK-432 sclerotherapy (Picibanil®) in the treatment of lymphangiomas.
Materials/Methods: Twenty-five patients with lymphangioma or venolymphatic malformation were included in the study. Their mean age at the time of the first sclerotherapy was 11 years and six months (range ten months to 42 years). Twenty lesions involved the head and the neck region, four were localized in the axilla, one in the abdomen. Sclerotherapies were performed by direct puncture of the lymphangioma, under ultrasound and fluoroscopic guidance. Seventeen patients received OK-432 as first line treatment, while eight were treated after a previous unsuccessful surgery. All the lesions were macrocystic. The mean follow-up was one year and seven months (range three months to four years and eight months).
Results: Two thirds of the patients showed a response to the OK-432 sclerotherapy. Those patients who had not previously received surgical treatment showed significantly better results. One patient developed an intense cervical swelling after the first injection. Other adverse effects of the treatment were limited to a mild post-injection pyrexia. No other complications were encountered.
Conclusion: Sclerotherapy with OK-432 for lymphangiomas was safe and effective, especially for those patients whose lymphangiomas had not been previously operated.

P120.

Three-year results and experience with transcatheter uterine artery embolization for uterine myomas

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Purpose: To evaluate medium-term effectiveness and safety of transcatheter uterine artery embolization (TUAE) for uterine fibroids.
Materials/Methods: One-hundred and ninety-eight consecutive women with uterine fibroids were treated by TUAE; 138 of them were followed up for one to three years to evaluate medium-term results. In these 138 cases, fibroid volumes, measured by ultrasound, ranged from 19 to 504 cm^3 (mean, 121 cm^3). Bilateral TUAEs were performed using a lipiodolpingyingmycine emulsion (LPE) and gelatin sponge particles in 115 women and with LPE alone in the remaining 83 women.
Results: Menorrhagia reduced to normal bleeding or markedly improved in 96.6% of cases. Lumbago and lower abdominal pain disappeared or markedly improved in 94.2%. Bulk-related symptoms disappeared or markedly improved in 96.7%. After embolization, ultrasound revealed that mean tumor volume reduction rates were 60.7% at one year, 63.3% at two years, and 67.4% at three years, and that mean uterine volume reduction rates were 49.6% at one year, 54.3% at two years, and 57.14% at three years. New fibroids did not grow and regrowth of pre-existing fibroids did not occur. No serious complications occurred.
Conclusion: TUAE with LPE is an effective and safe treatment for uterine fibroids.

P121.

Angiographic diagnosis and endovascular treatment of recurrent intractable epistaxis: ten-year experience

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Purpose: To present our methods and results of angiography and endovascular treatment in patients with recurrent intractable epistaxis.
Materials/Methods: Thirty-two patients (four children, 20 male, 12 female) with recurrent intractable epistaxis (>2 episodes, including 11 spontaneous, five traumatic, five from hemangiomas, one neoplastic and ten iatrogenic) underwent multiplane bilateral angiography of internal (ICA) and external (ECA) carotid arteries and vertebral arteries. In 31 patients, hemorrhage involved several arteries, contralateral ECA (29) and ICA branches (4); in three cases, the bleeding originated from a false aneurysm of the ICA cavernous sinus. Bilateral ECA were previously ligated in three patients. Thirty patients underwent bilateral ECA branches embolization with PVA (30) and detachable balloon (3).
Results: In 31 patients, hemorrhage stopped immediately post-embolization. In one patient with bilateral ECA ligation, embolization failed; three patients needed repeated embolization, one procedure was complicated by stroke, one patient died four days after embolization for acute renal failure.
Conclusion: Bilateral superselective embolization of ECA branches for epistaxis is an effective way of hemorrhage coping. All patients with intractable epistaxis need multiplane angiography of ECA branches, ICA and vertebral arteries. ECA ligation is ineffective and prevents further endovascular interventions; it should not be used, therefore, for epistaxis treatment.

P122.

Definitive hypogastric artery occlusion with coils and cyanoacrylate

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Purpose: We present our experience with proximal embolization of the hypogastric artery with coils and cyanoacrylate.
Materials/Methods: From March 2002 to January 2004, eight hypogastric arteries in seven men were occluded. Mean age was 76 years (range: 70-83). Two isolated hypogastric aneurysms larger than 3.5 cm were embolized as a definitive treatment. Six proximal hypogastric arteries were intentionally occluded before endovascular repair of aorto-iliac aneurysms (EVAR). In all cases, embolization was done at least one week before EVAR. Both internal iliac arteries were embolized in one patient with a two-week interval between the left and the right one. Either an ipsilateral or a crossover 4-F cobra catheter was advanced into the hypogastric artery. First we deployed Gianturco coils at the origin of the main hypogastric branches to prevent distal migration of the glue. The proximal segment of the artery was then filled with cyanoacrylate mixed with lipiodol (ratio 1:1)
Results: No major complications occurred. Transitory (1 week-3 months) gluteal claudication was recorded in six patients and permanent in one. At follow-up, both isolated hypogastric aneurysms had shrunk. There were no hypogastric leaks in EVAR patients.
Conclusion: Proximal definitive hypogastric occlusion with cyanoacrilate embolization is feasible and safe.

P123.

Magnetic navigation in an *in vitro* model of uterine fibroid embolization

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Purpose: To compare the steering of a novel, magnetic guidewire with a standard 0.014-inch guidewire (Taper®, Instinct™) within a vascular phantom.
Materials/Methods: The magnetic guiding system (MGS) was composed of two permanent magnets on each long side of the fluoroscopy-table generating a 0.1-Tesla magnetic field and a C-arm angiography system. The magnetic field was built up according to vectors drawn onto two x-ray projections. The ferromagnetic tip of the intravascular guidewire was deflected in parallel to the magnetic field. Ninety-six catheterizations were performed in water-filled PVC tubes imitating the arterial tree of a female pelvis. This vascular phantom resembled a total of 12 uterine arteries with different calibers: 1.1, 1.7, and 4.2 mm. Fluoroscopy times were measured to compare magnetic and conventional catheterizations.
Results: Catheterization to every predefined target was successful for all attempts. Fluoroscopy time during magnetic navigation was significantly lower in vessels of all three sizes as compared with conventional navigation (19.6, 5.9, 4.8 sec versus 48.8, 49.8, 32.7 sec; averages for small, medium, large vessels; $p<0.05$).
Conclusion: MGS enables exact endovascular navigation with less fluoroscopy time in an *in-vitro* model. This may offer opportunities to reduce x-ray exposure to the patients and the operators.

P124.

Radiofrequency ablation using a new cooled-perfusion electrode: experimental study in *ex-vivo* bovine liver

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Purpose: We developed a new monopolar cooled-perfusion radiofrequency (RF) electrode that allows simultaneous internal cooling ("cooled") and interstitial hypertonic saline infusion ("perfusion"). We compared the *in-vitro* efficiency of RF ablation using a new cooled-perfusion electrode with RF ablation using a cooled electrode by assessing dimension of ablation zone in bovine liver.
Materials/Methods: A total of 20 RF ablation zones (cooled electrode, $n = 10$; cooled-perfusion electrode, $n = 10$) were created in explanted bovine livers (12 minute ablation; pulsed technique; 2,000 mA, maximum). Following RF ablation, axial MR images were obtained and volumes were calculated. Maximum and minimum diameters and calculated volumes of ablation zones were compared between the two groups.
Results: Ablation zones created with the cooled-perfusion electrode were significantly larger than those created with the cooled electrode for minimum diameters (5.4 ± 0.65 cm versus 3.6 ± 0.38 cm; $P<.05$), maximum diameters (6.0 ± 0.56 cm versus 4.4 ± 0.20 cm; $P<.05$) and volumes (80.0 ± 34 cm^3 versus 23.1 ± 8.7 cm^3; $P<.05$).
Conclusion: The new cooled-perfusion electrode, thanks to simultaneous internal cooling and interstitial hypertonic saline infusion, could efficiently increase the dimension of the liver ablation zone than the cooled electrode.

P125.

Histopathologic comparison of the infrarenal aorta after implantation of control-, Rhenium 186- and Rhenium 188 stents in hypercholesteremic rabbits

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Purpose: To compare two different isotopes (Re-186 and Re-188) for stent-coating with different half-lifes and beta-energies according to morphometric and histologic differences in atherosclerosis models.
Materials/Methods: Forty-seven hypercholesteremic rabbits underwent balloon-angioplasty before insertion of Palmaz stents in the infrarenal aorta. The animals were sacrificed after seven weeks. Control stents (n=8) were compared with Re-186 and Re-188 labeled stents at low- (n=6/6), intermediate-(n=6/8) and high-activity (n=6/7) levels.
Results: Neointimal formation was 2.11 mm^2 in the control group. A dose-dependent neointimal reduction was detectable in the Re-186 and the Re-188 groups. No induction of neointima formation was observed at the edges of radioactive stents. Significant differences were observed between the Re-186 and Re-188 stents regarding the intimal cell density and the monocyte count within the vessel wall. Significant differences were seen between the radioactive stents and the control group: granulocyte count, alpha-actin staining, fibrinoid necrosis and fibrotic tissue reactions. Radiation resulted in a delayed reendothelialization, which was more pronounced in Re-186 than in Re-188. A dose-dependent increase of thrombotic material was observed in all radioactive groups.
Conclusion: Different physical properties of various radioisotopes may influence the histopathologic response of the arterial wall. Further studies could determine the most valuable radioisotope for stent labeling.

P126.

Experimental animal study with Paclitaxel-coated retrievable inferior vena cava filters

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Purpose: To assess the physiological and technical viability of the Günther-Tulip temporary inferior vena cava filter when coated with Paclitaxel.
Materials/Methods: Günther-Tulip retrievable filters (n=15) were inserted in experimental pigs. Devices were left *in situ* for 14, 19, 22, 26, or 30 days. Animals were sub-grouped (n=5 each) to contain non-coated filters (A), and taxane-coated filters (B, C). In Groups A and B the filters were scheduled for percutaneous withdrawal via the jugular vein and surgically removed in Group C. Retrieval difficulty degree was rated as None, Slight, Average, High or Un-retrievable.
Results: Of the 15 filters, ten were scheduled to be removed percutaneously but only seven (two in Group A, five in Group B) were successful. All taxane-coated filters (Group B) were retrieved relatively easily, except in the 30-day filter where the difficulty was moderate. Anatomic-pathologic examination indicated a significant delay in the appearance of signs of intimal hypertrophy of the vena cava in those animals fitted with taxane-coated filters.
Conclusions: Günther-Tulip Paclitaxel-coated filters allow the device to remain *in situ* for prolonged periods of up to 30 days without major disruption of the venous endothelium.

P127.

Virtual planning of interventional procedures: a new approach

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Purpose: To assess the feasibility of virtual manipulation of fused computed tomography CT), magnetic resonance (MR), and magnetic resonance angiography (MRA) for planning both interventional radiology and neuroradiology.
Materials/Methods: A workstation called Dextroscope (Volume Interactions, Singapore), which allows direct manipulations of 3D reconstructions of fused multimodal images (CT, MR and MRA) was employed. The operator interacts using both hands to hold tracked 3D instruments and visualizes the data on a stereoscopic display. During the period August-December 2003, 50 consecutive patients were evaluated.
Results: Virtual interventional planning focused on vascular, neuro, and ENT surgery, including 37 cases. This approach allowed us to avoid diagnostic angiography, with a remarkable reduction of the preoperative invasiveness in 32/37 cases for the superior information offered by 3D manipulation of multimodality images. Based on these encouraging results, we have extended this technique to neurosurgical planning in 13 cases.
Conclusion: By avoiding the angiography step, we have obtained time- and cost-savings; moreover, we have achieved a better spatial understanding of the pathology. The loss of image resolution in CT and MR with respect to angiography was compensated by the ability to manipulate and visualize the images from all the angles.

P128.

Flow velocities after carotid angioplasty: impact of stent design. A fluid dynamics study in a carotid artery model with laser-Doppler-anemometry

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Purpose: To study the influence of different stent designs on flow patterns in carotid artery models.
Materials/Methods: Four different stents (steel, nitinol, two inside-covered nitinol stents) were positioned in carotid artery models. All stents were deployed across the bifurcation. Measurements were performed with laser-Doppler-anemometry, using pulsatile flow conditions (Re=220). Hemodynamic changes were analyzed with 3D flow profiles.
Results: The flow rate ratio: internal carotid artery/external carotid artery (ICA/ECA) shifted significantly in the covered stents and remained nearly unchanged in the SelfX and Wallstent. Inside the SelfX no relevant changes occurred. In the Wallstent the separation zone shifted from the ICA entrance to the distal end of the stent. Distal to the SelfX and the Wallstent the flow profile turned to normal. In the covered stent the central slipstreams were accelerated with creation of flow separation distal to the stent. With modification of the covering this flow separation vanished. In the ECA flow disturbances occurred in the SelfX and Wallstent. With the covering a calming of flow was found.
Conclusion: Depending on stent design, flow changes are located in different regions. All stents were suitable for the carotid bifurcation. Stent selection must be adapted to the individual anatomical and pathological situation.

P129.

Stent placement in an elongated carotid artery: correlation of experimental flow alterations and clinical outcome

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Purpose: Correlation of hemodynamic changes after carotid artery stenting (CAS) in elongated carotid arteries with localization of restenosis.
Materials/Methods: CAS performed in elongated carotid arteries results in a straightening of the ICA. Distal to the stent, the elongation turns into a kinking. Angiographic findings were simulated with silicon rubber models of a carotid artery and a u-bend model. Stents were positioned in the models according to anatomic findings. Flow visualization was performed with laser-Doppler-anemometry using pulsatile flow conditions (Re=220). Hemodynamic alterations were analyzed with 3D flow profiles.
Results: At follow-up, restenosis occurred distal to the stent at the apex of the kinking. Depending on the degree of the vessel bending, a separation of the flow from the inner wall could be observed in experimental models, with flow disturbances distal to the stent. In the u-bend-model, the maximum flow separation was found at the apex. The localization of restenosis correlates with the measured maximal separation zone.
Conclusion: Changes in the vessel geometry due to stent placement lead to significant flow disturbances, especially in elongated arteries. Experimental flow visualization enables detection of predilection sites of restenosis. The influence of stent architecture on flow alterations can be analyzed with this method.

P130.

Aortic aneurysm creation with pressure augmented elastase infusion in swine: a new experimental model

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Purpose: To establish an aneurysm model that possesses characteristics such as elastin breakdown, aortic-wall degradation, and patent lumbar arteries.
Materials/Methods: Four-cm/14-mm and 4-cm/16-mm balloons with one or two holes were used in pigs' abdominal aortas; 100 mg protein elastase were infused under 2-4-atm pressure continuously (n=5, Group 1) and with fractionation (n=7, Group 2). Four aortas (16 mm, n=1; 14 mm, n=3) were treated with saline with fractionation (Group 3).
Results: The mean infusion time was 24.2 minutes (Group 1). Fusiform aneurysms developed in three aortas (230%, 160%, 170%) at three weeks. The total "working time" of elastase was almost tripled (mean 60 minutes) (Group 2). Three aneurysms (200-210%) were observed at three weeks. Three aneurysms with a 160-220% post-procedure dilatation perforated within 24 hours (n=2, 16 mm). One aneurysm (165% at one week) almost completely disappeared by three weeks. The saline infusion (Group 3) resulted in acute perforation (n=1; 16 mm) and moderate diffuse narrowing (n=3; 14 mm). All lumbar arteries remained patent. Histology revealed extensive elastin degradation up to complete breakdown.
Conclusion: As for aneurysm creation, the fractionated infusion was more efficacious. However, the injection created a jet-phenomenon resulting in vessel perforation with both elastase and saline infusion.

P131.

The active connection matrix system: a new paradigm for intelligent image processing. Preliminary experience in digital subtraction angiography

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Purpose: In the last years, a number of clinical studies have shown the potential role of different kinds of artificial adaptive systems in automated image-processing, both for detection or diagnostic purposes. The goal of this preliminary experience is to assess the usefulness of active connection matrix (ACM), a new system in interventional radiology.
Materials/Methods: ACM, developed by the Semeion Research Center in Rome, is able to automatically extract features of interest (e.g. edges, tissue differentiation, etc.) from digital images to a special kind of artificial adaptive system. From September to December 2003, ten patients with peripheral (7) or carotid (3) diseases were investigated by digital subtraction angiography (DSA). The need of further information from diagnostic and post-procedure images suggested the use of ACM.
Results: Every image was processed according to different protocols relying on original recursive non-linear equations and the results were assessed by independent comparative analyses. ACM allowed the expression of hidden morphological features and, on this basis, an improvement of diagnostic images was achieved in all cases.
Conclusion: ACM is a new paradigm for intelligent image-processing able to substantially improve DSA information by overcoming the problem of invariant feature extraction from digital images.

P132.

Comparison between Texan™, a new foreign body retrieval device, and Amplatz snare in a swine model

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Purpose: To compare efficacy of the Texan™ [TX] foreign body retrieval device (IDev Technologies, Inc.) with the Amplatz snare (ev3) [AS] in a swine model.
Materials/Methods: Three sizes of AS were compared with TX, with an adjustable loop ≤30-mm. Foreign bodies (FB) were placed in the iliac vein, infrarenal aorta, inferior vena cava, and stomach. Times needed to capture the foreign body and to complete the retrieval were recorded.
Results: All attempts (n=15) were successful with TX while 16 of 18 attempts were successful with the AS. Two attempts with the suboptimally sized 5-mm AS were abandoned after 14:42 minutes and 6:22 minutes. These FBs were retrieved successfully with a 15-mm AS and TX, respectively. Based on the capture-times and the total procedure times, there was no significant difference in efficacy of the devices in any anatomical region. The 0.018-inch guidewire compatibility and contrast injection capability of TX were favorable features.
Conclusion: TX was equivalent to appropriately sized AS in all anatomical locations regarding its foreign body retrieval capability. The adjustability ('one size fits all') and preserved perpendicular orientation of the TX loop, the guidewire compatibility, and the ability to inject contrast were all favorable features of the new device.

P133.

A new approach for abdominal aortic aneurysm endovascular repair: virtual planning

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Purpose: To assess the feasibility of virtual manipulation of computed tomography angiography (CTA) and magnetic resonance angiography (MRA) for planning interventional radiology repair of aortic aneurysms.
Materials/Methods: A stereoscopic surgical planning workstation called Dextroscope (Volume Interactions, Singapore) was employed. The operator interacts using both hands and visualizes volume-rendered reconstructions using a stereoscopic display. During the period August-December 2003, ten consecutive patients were evaluated.
Results: Virtual interventional planning allowed us to avoid a diagnostic angiography in eight cases and to perform a correct endovascular therapy. This was due to the superior stereoscopic visualization of the aorta, an easy 3D manipulation, and the availability of accurate and flexible measurement tools. Two patients were not eligible for the endovascular repair. The next step will be to incorporate the virtual model of the stent into the planning stage.
Conclusion: The interactivity of single imaging modalities and the accuracy of measurement tools allowed a reliable method of decision-making about the endovascular therapy to be performed and the type of endoprosthesis to be inserted. By avoiding the angiography step, we have reduced the invasiveness and obtained time- and cost-savings. The study is now running for a definitive assessment of the protocol in 100 consecutive cases.

P134.

Experimental radial strength analysis of self-expanding stents using modified *ex-vivo* models of balloon-expandable stents

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Purpose: To evaluate radial strengths of self-expanding stents under modification of an *ex-vivo* test procedure for balloon-expandable stents.
Materials/Methods: Ten stents of seven different models were implanted in the common iliac arteries taken from cadavers (n=35). The vessels were maintained at 37°C for 24h in an autolysis inhibiting solution, thus permitting stents' expansion and then filled with silicon caoutchouc. After another 24h, the vessel walls and stents were removed from the hardened casts. By means of fine analytic measurements, we demonstrated that the volume of a hardened cast formed in the stent cylinder is an indirect but precise measure of the radial force of a stent.
Results: The differences between the actually measured volumes, i.e radial strength, (1-cm stent length) of the various stent models, were not statistically significant ($p>0.05$), but the differences between the theoretically possible volumes that we had previously calculated were highly significant ($p<0.05$).
Conclusion: The modification of our *ex-vivo* models of balloon-expandable stents makes it possible to obtain comparable, realistic values for both radial force and expansion of self-expanding stents. Our model could be an additional procedure to optimize the preclinical evaluation of a new self-expanding stent during certification.

P135.

Thromboelastographic changes following non-ionic contrast medium injection during angiography in patients with peripheral arterial occlusive disease

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Purpose: Peripheral arterial occlusive disease (PAOD) patients undergoing angiography or angioplasty may be at risk of thrombosis or embolism from the procedure itself. There have been conflicting data from in vitro and in vivo studies regarding the effect of non-ionic contrast media (NICM), including systemic changes in haemostatic parameters far from the site of high contrast concentration. We aimed to examine changes in coagulation adjacent to the site of contrast injection/potential angioplasty to determine the magnitude of local change.
Materials/Methods: We measured changes in coagulability of aortic blood samples taken before and within five minutes after injection of Iohexol (a NICM), prior to any intervention procedure, in 30 patients undergoing thromboelastograpy (TEG). TEG parameters of aortic samples taken before and 5 minutes after injection of Iohexol were compared.
Results: Injection of Iohexol led to a significant increase in R time (time to fibrin formation) ($p<0.05$), and a reduction in angle (decreased acceleration of fibrin build up) ($p<0.05$), maximal amplitude (MA; reduced ultimate clot strength) ($p<0.005$) and coagulation index (overall coagulation status) ($p<0.001$).
Conclusion: The changes in TEG parameters suggest that the local effect of NICM results in reduction of coagulation activity rather than the activation suggested by some previous studies.

P136.

Modified diamond-like carbon (fluorine-doped DLC; F-DLC) as a novel biocompatible coating material for use in cardiovascular and interventional devices

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Purpose: 1. To synthesize a new type of fluorine-doped DLC (F-DLC), an inert and amorphous hydrocarbon with a more antithromobogenic surface. 2. To evaluate the efficacy of F-DLC coating in preventing thrombogenesis *in vitro*. 3. To evaluate safety and biocompatibility of this material in *in-vivo* rat models.
Materials/Methods: F-DLC was deposited onto stainless steel wires/disks (SUS316L: SUS) using a plasma-assisted technique from CH_4/C_2F_6 gas. 1: either F-DLC-coated or non-coated (SUS) wires were immersed in the conical tubing with blood for three hours (n=4/group). Cell counting of platelets was performed. Markers of mechanically induced platelet activation (beta-TG), activated coagulation (TAT), and acute inflammatory reaction (complement C3a) were assayed. 2: either F-DLC-coated or non-coated disks were implanted subcutaneously (n=6/group) for one and 12 weeks, then excised for hematological (IL1-beta, TNF-alpha and C3a) and histopathological analyses.
Results: 1. Thrombogenicity was remarkably reduced in the F-DLC-coated group, with a statistical significance. 2. No acute inflammatory reaction was observed in all groups. 3. The thickness of the fibrous tissue capsule surrounding F-DLC was nearly equivalent to that of SUS.
Conclusion: F-DLC appears to be a promising candidate to be used as a coating material in blood-contacting devices, such as interventional devices, artificial organs, pacemakers, etc.

P137.

Radiological treatment of varicocele in 223 men: technical, clinical and seminal aspects

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Purpose: To present our experience with the percutaneous treatment of varicocele in men considering technical, clinical, and seminal aspects.
Materials/Methods: In the past ten years, 230 patients with left (212) or bilateral (18) varicoceles, aged between 18 and 37 years (average 27.3), were treated at our center. Sixty-seven patients with untreated varicocele were taken as a control group. All our patients were evaluated from a clinical, Doppler, and seminal point of view at baseline and after six months of follow-up. Varicocele sclerosis was performed with selective injection of Atossisclerol 3% into the internal spermatic vein.
Results: A technical success was achieved in 223/230 cases (97%). The complete resolution of varicocele was obtained in 172/223 patients (77.1%), while 34 patients had only a partial detension of the pampiniform plexus. In these 206 patients, a spermogram showed a significant increase in spermatozoal concentration (52.1 ± 4.1 versus 44.2 ± 3.6 millions/ml, $p=0.002$) and motility (40.5 ± 2.2 versus 33.3 ± 2.0%, $p=0.0001$), without any detectable morphological changes. In the control group, significant changes in seminal parameters were not observed.
Conclusion: Mini-invasive percutaneous radiological treatment of varicoceles significantly improves seminal parameters in men with infertility.

P138.

Peripheral cutting balloon experience in hemodialysis access management

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Purpose: To evaluate percutaneous transluminal angioplasty (PTA) with a cutting balloon in stenosed hemodialysis fistulas.
Materials/Methods: Twenty-nine stenoses in 15 patients were treated using a cutting balloon with an inflated diameter of 3-6 mm. The grade of stenoses ranged from 60 to 90% (mean, 64.4%), and lesion length ranged from 0.2 to 4.0 cm (mean, 1.8). Cutting PTA was performed after insufficient conventional PTA in two patients; in 13 patients the cutting balloon device was used primarily.
Results: Cutting balloon PTA was successful in 26 cases (89.7%). In three cases (10.3%) there was a residual stenosis of more than 20%. In one case there was restenosis with shunt occlusion after 92 days, and in another thrombotic shunt occlusion occurred within 24 hours. Device-related technical problems occurred in two cases (incomplete balloon deflation), and in two cases there was a minor bleeding at the dilatation site.
Conclusion: Cutting balloon angioplasty proved useful in the short term for treatment of stenosed hemodialysis fistulas.

P139.

Salvaging non-maturing Brescia-Cimino fistulas by percutaneous transluminal angioplasty

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Purpose: To report our experience in salvaging non-maturing Brescia-Cimino fistulas by percutaneous transluminal angioplasty (PTA).
Materials/Methods: We retrospectively analyzed fistulographies, technique and success rates of PTAs, and patency rates in 22 hemodialysis patients who underwent PTA because of non-maturing Brescia-Cimino fistulas.
Results: Seventeen segmental stenoses and five segmental occlusions of cephalic veins were the culprits of non-maturing Brescia-Cimino fistulas. Sixteen stenoses and two occlusions were located at the cephalic vein adjacent to the anastomosis site, and three occlusions and one stenosis were seen at the proximal vein near the elbow joint. In addition to the venous stenosis, a focal arterial stenosis at the anastomosis site and two accompanying accessory veins that might have hampered maturation of the main cephalic vein were seen in each one of the two patients; a simultaneous occlusion of the left innominate vein as well as occlusion of the cephalic vein were noted in one patient. Initial success rate of PTA was 95.5% (21/22). Overall success rate including 11 additional PTAs performed during follow-up was 96.9% (32/33). No major complications occurred. The patency rate at six months was 80%.
Conclusion: PTA is an effective and safe method in salvaging non-maturing Brescia-Cimino fistulas.

P140.

Outcomes of stent placement in hemodialysis patients

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Purpose: To analyze patency of stents placed in patients with hemodialysis grafts or fistulas.
Materials/Methods: After Institutional Review Board approval, a retrospective study of all hemodialysis patients who had stents placed from June 1998 to January 2004 was performed. In 18 patients, 12 women and six men, stents were placed because of inadequate angioplasty results. Nine polytetrafluoroethylene (PTFE) grafts and nine fistulas were treated. There were 12 patent accesses and six occluded accesses. The Kaplan-Meier method was used for survival analysis. Primary patency rates were determined at three, six, and 12 months.
Results: Twenty-seven stents were placed in 18 patients as follows: cephalic vein (11), innominate vein (8), superior vena cava (6), and basilic vein (2). Primary patency at three, six, and 12 months from intervention was 80% (60%, 100%), 70% (47.4%, 100%), and 70% (44.2%, 100%), respectively. There was no difference in primary patency between grafts and fistulas (p=. 4879). The median follow up time was 122.5 days.
Conclusion: Patency of stented lesions in hemodialysis patients is favorable with a primary patency of 70% (44.2%, 100%) at one year.

P141.

Percutaneous declotting of femoral hemodialysis grafts

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Purpose: The intent of this study is to evaluate outcomes of percutaneous declotting procedures on femoral dialysis grafts.
Materials/Methods: Femoral dialysis grafts placed from 2/14/1992 through 4/30/2003 were followed through radiological and surgical retrospective chart reviews. Twenty-four patients (nine men, 15 women) were included, with a mean age at graft placement of 46.5 years. A total of 108 declotting procedures were reviewed on 29 femoral grafts using a pharmacomechanical technique with either urokinase or tissue plasminogen activator (tPA).
Results: Technical success in this study was 98.1%. An average of 1.98 declots was performed per year of dialysis. Using life-table analysis, 30-day post-interventional primary patency was 71%, 90-day primary patency was 46%, 180-day primary patency was 25%, and 360-day primary patency was 4%. The 30-day secondary post-interventional patency was 93%, 90-day secondary patency was 85%, 180-day secondary patency was 76%, and the 360-day secondary patency was 52%.
Conclusion: Percutaneous declotting of femoral hemodialysis grafts has similar technical success and patency rates as percutaneous declotting in upper extremities.

P142.

Stenting of hemodialysis-related central venous stenoses or occlusions: primary and long-term results

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Purpose: To report our experience and results with endovascular stent placement for central vein stenoses and occlusions in hemodialysis patients.
Materials/Methods: Nineteen hemodialysis patients (14 men, five women) with symptomatic shunt dysfunction and arm swelling due to central venous stenoses or occlusions (12 subclavian, five brachiocephalic vein stenoses, and two subclavian occlusions) were treated endovascularly. Three patients were managed with percutaneous transluminal angioplasty (PTA) only and 16 with PTA and stent placement. Follow-up included clinical assessment and digital subtractive phlebography. The mean follow-up was 30 months (range 4-78). Technical success, complications, and patency rates were estimated.
Results: Stent deployment was successful in all cases with following resolution of symptoms. No complications occurred during the procedures. During follow-up, four patients died from unrelated causes with the stent patent. Six cases of restenoses were treated with a new PTA and/or stent placement. In a case of re-occlusion, the percutaneous treatment failed and ligation of the patient's fistula was required. Primary patency rate at 30 months was 60%, with a secondary patency of 93%.
Conclusion: Stenting of hemodialysis-related central venous obstructions shows an excellent technical success resulting in symptomatic relief and preservation of vascular access. Multiple reinterventions are frequently required to maintain patency.

P143.

Properties of the introducing systems of various metallic biliary stents: experimental comparisons

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Purpose: For a less invasive and more precise biliary metallic stent (MS) placement, the properties of the various introducing systems were experimentally compared.
Materials/Methods: The introducing system of seven different kinds of MS (Wallstent, 7-F Luminexx, ZA stent, SMART, Selfx, 6-F Luminexx, and covered Wallstent) were evaluated for flexibility, trackability, radiopacity of the non-marker portion, and resistance of stent release.
Results: The 7-F Luminexx, the ZA, and the Selfx were more flexible than the others. Trackability, assessed by measuring the pushing force through the curved plastic tube, was smallest in the Selfx and in the 6-F Luminexx, whereas that of the others was twice or more bigger. Radiopacity, assessed by densitometry, was best in covered Wallstent followed by Luminexx; visual recognition of MS was however best in Selfx. Resistance of stent release was highest at the beginning of the release in all stents, which suggested the tendency of pushing the stent forward in this phase. The maximum release resistance was smallest in the Selfx, that of Luminexx was 1.5 times, and that of the others was twice or more bigger.
Conclusion: These results may contribute to the selection of the appropriate MS, concerning its less invasivity and more precise placement.

P144.

Interventional management of biliary complications in pediatric liver transplants

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Purpose: We report our experience in the treatment of biliary complications following orthotopic liver transplantation in children. Biliary complications, with an incidence of 13-25%, are a major problem in liver transplantation.
Materials/Methods: From 1999 to 2003, 127 liver transplants in children (32 whole, 82 split livers) were performed at the Liver Transplant Center of our hospital. The age of the patients ranged between two months and 19 years. The incidence of biliary complications was 23%.
Results: Strictures at biliary-enteric anastomoses were resolved after 1-3 bilioplasty sessions (87%). Metallic stents were used in two patients. Some late recurrences occurred in successfully treated patients during follow-up and required a new bilioplasty treatment. Cut-edge leak bilomas were drained under ultrasonographic guidance. Bilomas were successfully treated in 82% of cases. Anastomotic leaks were treated by surgery.
Conclusion: Interventional radiology plays a major role in the correct treatment of biliary complications following orthotopic liver transplantation in children, even in split or reduced livers. Surgery may be proposed only in few unsolved cases and in anastomotic leaks.

P145.

Endoluminal treatment of liver transplantation complications. Sixteen-year experience in 570 patients

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Purpose: To retrospectively evaluate most frequent complications related to liver transplantation and how interventional radiology has contributed to improve survivals and outcomes in these patients.
Materials/Methods: From a total of 570 patients who had undergone partial or total liver transplantation in a 16-year period (1987-2003) those in whom one or several minimally invasive procedures were performed in our institution where included.
Results: Several variables were evaluated, including number of interventions, type of complication (vascular, portal, biliary or miscellaneous), morbidity and mortality, improvement of survival in every specific complication and outcomes. Seven percent of all transplanted patients underwent interventional procedures. Biliary and arterial interventions were most frequent and included stent insertions and biliary drainages.
Conclusion: There was an increase in the number of interventional procedures in the last years due to the improvement of materials and new devices. The survival of the transplanted patient has significantly improved.

P146.

Long-term result of transcatheter arterial chemoembolization plus percutaneous ethanol injection in the treatment of hepatocellular carcinoma

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Purpose: To evaluate long-term efficacy of transcatheter arterial chemoembolization (TACE) combined with percutaneous ethanol injection (PEI) in the treatment of hepatocellular carcinoma (HCC).
Materials/Methods: Six-hundred seventy-five patients with HCC with a diameter ranging from 2 to 15 cm (average: 9.6) were enrolled. One-hundred and seventy-nine of them underwent a combined treatment TACE + PEI (group A) and 496 cases were treated by TACE alone (group B). After the treatment, ten patients in each group underwent resection and the resected specimens were studied by the pathologist. Unresected patients were followed up for five to seven years.
Results: Pathological reports showed remarkable differences in mean necrosis rates (100.0±0.0% vs. 91.5±7.1%, p<0.05) and in complete necrosis rates of tumors (100% versus 20%, p=0.0007), although there were no statistical significant results in the extent of tumors shrinkage after the treatment between the two groups. Follow-up showed that one-, three-, five-, and seven-year survival rates were 80.5, 58.6, 29.6, and 16.5% in the TACE+PEI group, and 68.5, 27.8, 7.2, and 5.2% in the TACE alone group, respectively. Significant differences were found between the two groups (p<0.01).
Conclusion: The combination of TACE+PEI is a valuable remedy in the treatment of HCC to prolong long-term survival rates.

P147.

Treatment of inoperable primary and secondary malignant liver tumours with SIR-Spheres®

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Purpose: To describe the initial local experience with SIR-Spheres (20-40 μm biocompatible microspheres containing yttrium-90) in the treatment of inoperable malignant liver tumours.
Materials/Methods: This prospective ongoing study started in September 2003. At present (February 2004), five patients have completed the treatment and a further three have been included in the programme. SIR-Spheres act as a pure beta-emitter and are implanted via a catheter placed into the hepatic artery. Prior to treatment, any variations in the arterial blood supply to the liver is assessed and the degree of arteriovenous shunting is calculated. Total radiation doses depend on tumour extent. Radiological follow-up includes magnetic resonance and/or computed tomography.
Results: The initial results are promising with a radiological and/or a clinical response achieved in all cases, although follow-up is still short. Complications did not occur.
Conclusion: Our initial local experience with SIR-Spheres is favourable. Training and cooperation among all the specialties involved (oncology, hepatology, nuclear medicine, radiology) is required.

P148.

Arterial embolisation of neuroendocrine tumor liver metastases with tris-acryl gelatin microspheres

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Purpose: To assess the effectiveness and safety of hepatic artery embolisation with tris-acryl gelatin microspheres (Embospheres®) as palliative treatment for neuroendocrine tumor (NET) liver metastases.
Materials/Methods: Data were recollected prospectively (January 2001- September 2003) in 12 patients with histologically proven NET liver metastases subjected to 31 hepatic artery embolisation procedures (mean: 2.6; range: 1-7) with Embospheres (100-300 μm and 300-500 μm). The median follow-up period was 10.3 months. All patients had received chemotherapy and had experienced treatment failure.
Results: There was complete radiological response in two patients, partial response in six, tumor stabilisation in two, and progression in two. Of five patients with previous endocrine symptoms, complete symptomatic response was achieved in two and partial response in three. The commonest complications were mild to moderate pain (35.8% of procedures), fever (19%), and nausea. The volume of Embospheres used per procedure averaged 3 ml (range: 1-10). Eleven patients were still alive after a mean follow-up of 361 days.
Conclusion: Tris-acryl gelatin microspheres are an effective and safe embolic agent, but not exempt of complications, for the palliative and sometimes curative treatment of NET liver metastases.

P149.

Open prospective phase-II trial of MR-guided interstitial laser ablation of liver malignancies

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Purpose: To assess safety and efficacy of MR-guided laser ablation of liver malignancies.
Materials/Methods: Between January 2001 and December 2003, 108 patients with 191 liver malignancies were treated with MR-guided laser ablation. We performed 156 treatment sessions (496 applicators). In 64.7% of cases, the primary tumour was a colorectal carcinoma, in 9% a breast cancer, in 6.4 % an hepatocellular carcinoma and others in 19.9 %. Tumours were divided into subgroups of >5 and <5 cm (76 and 24%, respectively). Follow-up MR was performed two days and every three months after treatment.
Results: Clinically relevant complications were 2.6%. Thirty-day-mortality rate was 1.9%. Median follow up was eight months (0.3-33.8). Local tumour control was 93.2% after six months and 84.8% after nine months. Local tumour control was significantly higher in <5-cm malignancies. The median progression-free survival was 5.35 months (min.= 0.3; max.= 27).
Overall median survival was 61.7 months (95% CI: 44.8-78.5) after the initial diagnosis and 25.1 months (95% CI: 19.8-30.4) after the first treatment.
Conclusion: In patients with liver metastases, local tumour MR-guided laser ablation is effective with minimal procedure-related morbidities or mortalities.

P150.

Selective intraarterial injection of ^{111}In-pentetreotide in the treatment of somatostatin positive (receptors II, $SSTR_2$) neuroendocrine metastatic disease in the liver

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Purpose: Neuroendocrine tumors of the gastrointestinal tract commonly present with symptomatic liver metastases. Most of them are positive for type-II somatostatin receptors ($SSTR_2$). We present our experience in the treatment and follow-up with selective intraarterial infusion of ^{111}In-pentetreotide.
Materials/Methods: Thirteen patients with histologically proven liver metastases from carcinoid tumors underwent 55 therapies in total. All treated metastases were positive for $SSTR_2$, as documented in a pretreatment diagnostic octreotide scan.The average dose administered was 4.07 GBq. No simultaneous embolization was performed. Each patient's response was evaluated with imaging (ultrasound, computed tomography, magnetic resonance).
Results: Infusion was successfully performed in all the patients and no periprocedural mortality was recorded. A transient decrease of platelets count was noticed in three patients with no sequelae. A plain nuclear scan performed the next day confirmed a good liver uptake in all. Mean follow-up is 18 months. From a radiological point of view, six patients demonstrated stability of the disease, four a partial response and three a disease progression (all died).
Conclusion: Intraarterial infusion of ^{111}In-pentetreotide produced disease stability or partial response in 75% of patients and a significant symptomatic palliation in the majority of them. Our results compare favorably with other embolization or chemoembolization therapies.

P151.

Initial clinical experience with a new multipolar system for radiofrequency ablation of liver tumours

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Purpose: Initial clinical evaluation of a new radiofrequency (RF) system developed to increase and optimise energy deposition.
Materials/Methods: The RF system is based on bipolar probes and enables multipolar RF application with 1-4 probes. Total energy deposition (kJ) is used as the endpoint of RF ablation, according to tumour size and probe geometry. Fourteen primary or secondary hepatic tumour nodules ranging from 2.3 to 5.9 cm in size were treated in nine patients under US- or CT-guidance. All nodules were considered "difficult" lesions due to their size or position, adjacent to major vessels, colon or gallbladder. Follow up was done by CT, MRI, and tumour markers.
Results: Six tumour nodules were treated with a single probe, five nodules with two probes, and three nodules with three probes. Energy deposition varied from 20 to 120 kJ. Postprocedural imaging and tumor markers showed a successful ablation in all instances. The size of RF lesions, as observed on postprocedural CT, ranged from 3.7 to 8.5 cm. No complications were observed.
Conclusion: Our initial experience suggests that RF ablation with this new bipolar/multipolar RF system is safe and effective and holds promise for the treatment of "difficult" lesions.

P152.

Combined portal and hepatic arterial embolization in liver tumors before liver transplantation

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Purpose: Extensive metastasic or primary liver tumors reduce the possibility of resection or liver transplantation. The purpose of this study is the evaluation of preoperative combined portal and arterial embolization before liver resection and transplantation.
Materials/Methods: In five patients, we performed a sandwich technique for arterial chemoembolization (lipiodol, embospheres, carboplatin) and a percutaneous approach with the use of Lipiodol/Histoacryl for selective portal vein embolization to treat primary and secondary liver tumors.
Results: All procedures were performed without major complications.
In three patients an extended resection could be performed after combined embolization with increased lobe size. In the other two, successful transplantation could be performed.
Conclusion: Despite extensive disease load, with combined use of arterial and portal embolization, resection may become possible due to increased lobe size, and transplantation become feasible even for patients who initially are inelegible for these surgical procedures by usual criteria.

P153.

Correlation of MR- and CT-arterioportography in the detection of primary and secondary liver lesions

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Purpose: To compare MR-arterioportography (MRAP) with CT-arterioportography (CTAP) in the detection and differentiation of liver lesions before surgery.
Materials/Methods: Following the ethical principles of the Institutional Review Board and the Good Clinical Practices, 15 patients with primary and secondary malignant liver lesions were enrolled in this study prior to surgery. In all cases, a celiaco-/mesentericography was performed by angiography. The catheter was placed into the mesenteric artery in case of extrahepatic primary tumors or into the hepatic artery in case of primary liver tumors. Scan delay for contrast medium enhancement was angiographically optimized. CTAP (Volume Zoom) was performed before and after early and late enhancement. MRI (Symphony) followed immediately with T1w-TSE, T2w-turboFlash, Gd-enhanced multi-phase T1w Flash 3D and Flash 2D. A qualitative and quantitative evaluation of CTAP and MRAP was performed by three blinded radiologists.
Results: Overall sensitivities and specificities in detecting primary and secondary liver lesions were significantly higher with MRAP than with CTAP ($p<0.01$). The diagnostic confidence with regard to the differential diagnosis of hepatic lesion was also higher with MRAP ($p<0.01$).
Conclusion: MRAP proved to be a reliable radiological method in the preoperative detection of focal liver lesions, with a higher sensitivity and specificity than CTAP.

P154.

Bipolar radiofrequency tissue ablation controlled by MR-thermometry

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Purpose: MR-thermometry is of great interest for monitoring energy deposition in a lesion during radiofrequency (RF) ablation. The aim of this study was to evaluate the feasibility of MR temperature control of RF lesion in a porcine liver model, using a mono-electrode bipolar ablation system.
Materials/Methods: MR imaging was performed on a 1.5-T MR system. RF ablation was carried out with a RF generator outside the MR room and a bipolar electrode inserted into *ex vivo* and *in vivo* porcine liver samples. A RF filter designed to remove RF interferences was serially connected between the RF generator and the electrode. A bipolar RF protocol was applied (20W, 7 minutes) with internal cooling electrode. Temperature maps were calculated by proton resonance frequency (PRF) technique from phase images on a separate workstation.
Results: Images with no significant artifacts were obtained, allowing temperature monitoring with a precision error <2°C. Continuous temperature increase was observed during RF deposition and abrupt T° drop was detected, corresponding to rapid tissue impedance increase due to dessiccation. Slow temperature decrease due to heat diffusion was observed after RF application.
Conclusion: RF ablation with simultaneous MR imaging and temperature control is feasible, without any modification of the RF generator.

P155.

Radiofrequency ablation (RFA) of hepatic metastases from colorectal cancer: mid-term results

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Purpose: To present our mid-term results in RFA of colorectal hepatic metastases.
Materials/Methods: Ninety-eight patients with 163 lesions (diameter 5-80 mm; median 27) underwent 182 RFA treatments (161 percutaneous, 21 intraoperative), in 24/182 cases combined with ischemia-inducing manoeuvres. Feasibility, complications, local effectiveness (radiological/clinical outcome), and clinical usefulness (survival) were evaluated.
Results: RFA was always feasible under US-guidance. Major complications occurred in 7/182 cases (3.8%): 3/158 (1.9%) in simple versus 4/24 (16.7%) "combined" technique. Early CTs showed that devascularization was obtained in 130/163 (80%) lesions, while local control at follow-up (1-92 months, median 36) was only 96/163 (59%). The median diameter of those lesions with a complete response was 23 mm; that of lesions with residue/local recurrences 35 mm. Survival rates were 83, 56, 48, 35, and 30% at one, two, three, four, and five years, respectively; 74% of patients underwent other treatments also (chemotherapy, surgery, etc.).
Conclusion: RFA of hepatic metastases is safe when "combined" techniques are avoided. Short-term CT is not accurate to evaluate RFA results, long-term clinical and radiological follow-up is therefore necessary. A complete necrosis can be achieved in lesions of about 2.5 cm. Randomized trials comparing integrated therapies including or excluding RFA should be recommended.

P156.

Compared carboplatin with docetaxel hydrate in a combined therapy of super-selective arterial infusion chemotherapy and irradiation. Evaluation of clinical results and feasibility

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Purpose: To compare the clinical effect of carboplatin (CBDCA) with docetaxel hydrate (TXT) in a combined therapy of super-selective arterial infusion (SAI) chemotherapy + irradiation for head and neck cancer.
Materials/Methods: The CBDCA-infused group (CBDCA-G) included 13 cases (seven tongue cancers, four gingiva cancers, one buccal mucosa cancer, and one cancer of the mandibula). Clinical stages were: T1/T2/T3/T4 in 2/8/1/2 cases. The TXT infused group (TXT-G) included 14 cases (nine tongue cancers, two gingiva cancers, and three buccal mucosa cancers). Clinical stages were: T1/T2/T3/T4 in 5/6/2/1 cases. A coaxial technique was used to place microcatheters in the target arteries. Anticancer drugs (CBDCA=100-500 mg/body or TXT=20-80mg/body) were injected. All cases received irradiation from a linear accelerator (average total dose: 64.7 Gy).
Results: The overall response rate in CBDCA-G and TXT-G were: 92.3% complete response (CR), 23% partial response (PR), 69%) and 92.8% (CR, 50%; PR, 43%). Irradiation in the TXT-G was longer than that of the CBDCA-G, since in this group side-effects such as leukopenia and mucositis in the oral cavity were more severe.
Conclusion: The clinical results achieved by the combined SAI and irradiation method were very successful. Side effects of TXT were more severe than those of CBDCA.

P157.

Efficacy and safety of a retrieval hook for the removal of retrievable expandable stents in the tracheobronchial tree

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Purpose: To evaluate efficacy and safety of a retrievable hook for removing retrievable expandable tracheobronchial stents.
Materials/Methods: Under fluoroscopic guidance, 45 retrievable expandable tracheobronchial stents were removed from 31 patients using a retrieval hook. Indications for stent removal included tissue hyperplasia (n=16), stent migration (n=10), stent misplacement (n=2), tumor overgrowth (n=2), persistent gastrobronchial fistula (n=1), and incompletely expanded stent (n=1). Thirteen stents were electively removed after temporary use. The success rate, causes of failure, and complications related to stent removal using a retrieval hook were analyzed.
Results: Forty-one of 45 stents (91.1%) were successfully removed using a retrieval hook despite the following difficulties: disruption of the polyurethane membrane (n=3) and an untied drawstring (n=1). The removal procedure using a retrieval hook failed in four cases (8.9%) and was caused by excessive tissue hyperplasia (n=4) in the proximal portion of the stent. The hook wire fractured in two of the four failed cases. The overall complication rate was 4.4% [minor bleeding (n=2)].
Conclusion: For complications or temporary use, retrievable expandable tracheobronchial stents and the retrievable hook show promising initial results for tracheobronchial stent removal.

P158.

Ultrasound-guided thrombin injection of double-chamber femoral artery pseudoaneurysms using very low doses of thrombin

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Purpose: The use of large-diameter sheaths and aggressive anticoagulation and antiaggregation treatments in coronary interventions can lead to the formation of complex multi-chamber pseudoaneurysms, a diagnostic and therapeutic challenge. Our aim was to assess ultrasound-guided thrombin injections (USGTI) using very low doses of thrombin.
Materials/Methods: Between 01.01.2002 and 31.12.2003, 17 femoral artery USGTIs were performed: 4/17 large single-chamber, 9/17 double-chamber, and 4/17 triple-chamber pseudoaneurysms. Low doses (very diluted) of 100 IU thrombin/1ml saline were slowly injected via a 21-G spinal needle, inserted by a single puncture under real-time color-Doppler ultrasound-guidance via the shortest path to the most superficial pseudoaneurysm lumen until complete obliteration of all chambers; 50-200 IU (median: 100) of thrombin were required in all cases under full antiaggregant therapy.
Results: All 17 pseudoaneurysms were successfully and completely obliterated using this method. A slow injection of up to 200 IU diluted thrombin was sufficient to obtain the complete thrombosis of single and multi-chamber pseudoaneurysms in all cases. Twenty-four-hour ultrasound follow-ups showed the complete obliteration in all cases.
Conclusion: USGTI of complex multi-chamber pseudoaneurysms using single-path injections of low-dose thrombin is safe. We found that the "low-dose thrombin" method is as effective as the "high-dose method" for a successful USGTI.

P159.

Radiofrequency ablation in the treatment of primary and metastatic lung tumors: preliminary results

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Purpose: To assess feasibility and effectiveness of radiofrequency ablation (RFA) in the treatment of primary and metastatic lung tumors.
Materials/Methods: During the last year, we selected ten patients, (aged 52-78 years), not candidate for surgery, with ten pulmonary lesions (diameter 3-5 cm): five primary tumors and five metastases (three colon, one kidney, one lung). Pre-treatment evaluation was performed with CT and CT-guided needle-biopsy. In CT-guided procedures a coaxial Le Veen needle-electrode (Radiotherapeutics ®) was employed. Follow-up CTs were done after one, three, and six months.
Results: A post-procedure CT showed an immediate technical success in all the patients, with extension of the treated area over the lesion borders. Four pneumothoraces occurred: two resolved spontaneously and two were drained through the coaxial needle used for RFA; three pleural reactions were recorded; in all cases, fever occurred on the second post-procedure day for tumoral necrosis. During follow-up (0-6 months; median, 2) tumor recurrences in the treated area did not occur.
Conclusion: RFA is a safe and effective treatment for primary and metastatic lung tumors. Further clinical studies aimed at establishing long-term effectiveness are essential.

P160.

Factors contributing to pneumothorax in transthoracic CT-guided needle aspiration biopsy

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Purpose: To study pneumothorax as a complication of transthoracic CT-guided needle aspiration biopsy, and its relationship with different variables.
Materials/Methods: This cross-sectional study was performed on 145 consecutive patients, age range 9-87 years (mean 55.3±17.6; M/F=1.6), during a 6-month period. We reviewed the pathology results of 150 biopsy specimens obtained from these cases, and assessed the effect of lesion size, depth, patient age and emphysema on pneumothorax rates.
Results: Lesion size ranged from 1 to18 cm (mean 6.5±3.4 cm), and 95 had zero distance from the chest wall, which were all taken into account in our calculations. Pneumothorax rate was 6 percent. Lesion depth (p<0.05), lesion size (p=0.069), patient age (p=0.058) and presence of emphysema (p<0.001) had a significant effect on increasing pneumothorax rate (CI=90%).
Conclusion: Lesion depth, lesion size, patient age and emphysema significantly increase the rate of pneumothorax during transthoracic CT-guided needle biopsy.

P161.

Optimizing work-flow in material management in interventional radiology departments

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Purpose: Reduction of costs by smart organization of purchasing materials.
Materials/Methods: After compilation of a comprehensive stock list of all disposable materials necessary for our interventional department, an ABC-analysis was performed with focus on high-priced and high-turn over materials. Data were processed by a new stock management and ordering program (Boston Scientific). Based on ordering frequency, all A-articles were subjected to XYZ-analysis, which is based on predicting the probability of requirement. On this basis, capital binding costs were considered with an assumed annual interest rate of 8%.
Results: The reduction in warehouse size saved 2,700 € each year. The smaller amount of capital tied up in inventories brought about another annual saving of 14,500 €. The total reduction in costs was 17,250 € per year. The PC-based program automates ordering, records expiration dates and assigns the consumption to patients allowed so further annual cost cuts of 37,500 €. The maximum total saving was 54,750 €, equivalent to 15.5% of our interventional department expenses.
Conclusion: Flexible just-in-time purchase of medical articles and the application of Boston Scientific's new stock management can help to reduce stock and capital binding especially of cost sensitive A-articles.

P162.

Air ambulance system in the treatment of acute coronary syndrome

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Purpose: The aim of this study was to clarify whether air ambulance system using a helicopter with a medical doctor and a nurse (doctor helicopter system; DHS) could shorten the prehospital delay.
Materials/Methods: The time from the emergency call to the initial treatment (IT time), to the coronary angiography (CAG time), and to the percutaneous coronary intervention (PCI time) were evaluated in 44 patients with acute coronary syndrome (ACS; 67.5+/-10.8 years old; 37 men and seven women). Twenty-two patients were transported by DHS, and the other 22 were by ground ambulance (GA). IT time, CAG time, PCI time, and prognosis were compared between DHS and GA.
Results: IT time, CAG time, and PCI time were significantly shorter in DHS (18+/-8 min, 103+/-38 min, and 174+/-56 min, respectively), than in GA (39+/-13 min, 208+/-165 min, and 257+/-112 min, respectively; $p<0.05$). In-hospital death occurred in two of the 22 DHS (9.1%), and in seven of the 22 GA patients (31.8%).
Conclusion: DHS shortened the prehospital delay, and could improve the prognosis of patients with ACS.

P163.

Interventional radiological simulation modelling using virtual reality: defining the instrument-tissue interaction

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Purpose: To improve understanding of instrument-tissue interactions as a basis of virtual reality (VR) training systems for interventional radiology.
Materials/Methods: Deformation of living tissues is non-linear and difficult to model mathematically. There is, consequently, interest in accurate measurement of forces generated during procedures such as needle puncture, as a basis for accurate force feedback ('feel') in future VR simulator models. No such studies have been performed *in vivo* and we have therefore calibrated a system to allow this. Sensors for *in vivo* force evaluation must be unobtrusive and we have subjected four capacitive pads to a range of force applications in controlled conditions, with a record of output data obtained.
Results: Preliminary calibration of the devices *in vitro* shows a stable signal, typical values obtained (v=volts) at 500 grams=average 3.514v (max 3.88, min 3.28, SD = 0.2v). Further work with a tensile testing device has shown a linear response to applied force using surrogate materials.
Conclusion: The output from these devices is stable and linear. Worn under surgical gloves, and connected to recording apparatus during interventional procedures, capacitive pads will allow collection of essential baseline data on forces generated, enabling verification of underlying mathematical models in VR training simulators.

P164.

FIRE registry of infra-popliteal percutaneous transluminal angioplasty: results in 390 patients

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Purpose: To report interim results after inclusion of 390 patients in the FIRE registry of infra-popliteal percutaneous transluminal angioplasty (PTA).
Materials/Methods: A prospective registry on infra-popliteal PTA for critical limb ischemia (IPCLI) is ongoing under the auspices of FIRE. All centres can enter cases of IPCLI using e-CRF via the Internet (www.cirse-fireregistries.org). Follow-up is also entered in the data base.
Results: As of February 2004, 390 patients (40% women) have been entered (mean age 73.3 years), treated for rest pain (26.5%) or tissue loss (53.4% minor, 20.1% major). An average of 1.6 lesions/patient were treated, chiefly stenosis >75 % or total occlusion. Simple PTA accounted for 83.6% of interventions and stent placement for 12.3%. Mean hospital stay was 14 days and in-hospital mortality was 2.8%. Clinical success was obtained in 83% of patients at discharge. Mean ABI increased from 0.49 +/- 0.36 [0-1.5] to 0.85 +/- 0.33 [0-1.6]. After 6 months, 77 % of patients were free of critical limb ischemia.
Conclusion: The FIRE registry demonstrates that infra-popliteal PTA for critical limb ischemia is a safe and effective procedure, even if cases are recorded in centres with various levels of experience.

P165.

Low-brachial access for the endovascular treatment of extensive bilateral ileo-femoral arterial disease

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Purpose: To evaluate the routine use of low brachial access (LBA) for endovascular recanalization of extensive bilateral ileo-femoral peripheral arterial occlusive disease (PAOD).
Materials/Methods: Between 1998 and 2003, 126 patients with severe PAOD were treated using an LBA. LBA was evaluated by Doppler-ultrasonography and only those patients with an LBA diameter of at least 4 mm were treated. We found 32/126 (25%) complete bilateral occlusions of ileo-femoral segments that were recanalized before stenting. In 18/126 (14%) a transfemoral access was initiated for simultaneous deployment of "kissing" stents in aortic bifurcation. We used 7- (90/126) and 6-F (36/126) self-expandable stents with long delivery systems for all patients. Manual hemostasis control was successfully applied in all patients.
Results: LBA was used effectively for the endovascular treatment of bilateral ileo-femoral PAOD in all 126 patients. All procedures were technically successful. Only six small hematomas at the puncture site that did not require any treatment occurred.
Conclusion: Self-expandable stent insertion via LBA is safe and effective in managing bilateral ileo-femoral PAOD. LBA allows the safe use of relatively large-sized delivery systems for recanalization of both ileo-femoral segments during the same session. LBA preserves patency of femoral arteries, thus allowing patient mobility one hour post-procedure.

P166.

Radiologic management of subclavian arterial injuries with Wallgraft endoprostheses

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Purpose: Pseudoaneurysms and penetrating injuries to the subclavian arteries are uncommon lesions difficult to manage surgically. With the advent of metallic and covered stents, the interventional radiologic management of these arterial injuries is being accepted, thereby avoiding additional trauma and operative risks, and allowing a shortened hospital stay, rehabilitation, and the patient's return to work.
Materials/Methods: We present six patients (16 to 87 years old) with subclavian artery pseudoaneurysms secondary to blunt and penetrating trauma. The patients were poor surgical risks, and the trauma surgeons referred them to us for treatment.
Results: The interventional radiologic treatment was successful in all patients. No major complications were recorded. The procedures were completed in less than 30 minutes. At follow up after several months no adverse sequela was found. Blood pressure was equal in both arms, with no evidence of microemboli. One patient died of unrelated cause four months later. Five patients are doing well two, six and 18 months later.
Conclusion: This novel approach to managing traumatic injuries to the subclavian arteries must be considered the first choice in arterial (or venous) injuries, seen more often in this era of violence and social decay.

P167.

Subintimal stenting: indications and feasibility in heavy calcified, long femoral-popliteal occlusions

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Purpose: The aim of this study was to evaluate indications of stent placement during subintimal recanalization of long, heavily calcified femoral-popliteal occlusion, in patients with Fontaine II-IV ischemia.
Materials/Methods: Ten patients (eight men/two women), out of a group of 68 patients with long, heavily calcified, femoral-popliteal occlusions (>15 cm) in whom SA angioplasty was ineffective were included in our study. Six patients had gangrene, one rest pain, one severe claudication (<100 m). Doppler-US was performed as post-procedure evaluation.
Results: In six cases we deployed three stents, in four cases two stents. We obtained 90% of technical success rate.
Conclusion: Subintimal stent implantation is a safe and effective method in case of calcified obstructions, especially in those patients who are poor candidates to surgical revascularization and in whom subintimal angioplasty is ineffective.

P168.

Leg reconstruction by reversed saphenous flap: role of angiography and interventional procedures

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Purpose: Reconstruction of skin degloving lesions remains a significant challenge for reconstructive surgery. A reliable and vital saphenous reversed flap represents an excellent therapeutic option. This study deals with the angiographic evaluations of microvascular pattern improvement after surgery.
Materials/Methods: From December 2001 to December 2003, 35 patients (19 men, 16 women) were treated by sural or saphenous reversed flap. Surgical indications for lower leg, heel and proximal foot were chronic ulcer (14), open fractures (8), neoplastic ulcer (2), diabetic ulcer (7), and ischemic ulcer (4). According to the patient conditions, a one- or a two-step technique for flap preparation was considered. Fourteen patients underwent peripheral PTA to improve distal circulation.
Results: All the patients were evaluated by DSA preoperatively and three months after surgery. The flap survived completely in 29/35 patients (82.8%), and in all cases a microcirculation improvement was achieved. Eleven patients with severe systemic disease (diabetes in seven, peripheral vasculopathy in four) suffered from delayed healing due to venous congestion. PTA of tibio-peroneal arteries was successful in all cases.
Conclusion: The evaluation of these patients confirmed the role of microvascular pattern improvement after plastic surgery enhanced by the positive results of the endovascular treatment.

P169.

Endovascular treatment for visceral artery aneurysms

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Purpose: Visceral aneurysms may present with rupture, which often results in the patient's death. An aggressive approach to the management of these aneurysms is therefore mandatory.
Materials/Methods: Twenty-four endovascular exclusions of visceral aneurysms were performed over the last six years, with five (21%) emergency procedures: two splenic, one hepatic, one pancreatoduodenal and one hypogastric. Coil embolization and stenting were both performed.
Results: Primary technical success rate was 100%, with no perioperative death despite three hemorrhagic shocks and no conversion to surgery of any procedure. Mean follow-up was 26 months (range 1-72).
Conclusion: In our experience, the endovascular treatment is the primary approach for both elective and emergency treatments of visceral artery aneurysms.

P170.

Tibial angioplasty: is it worth the effort?

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Purpose: To evaluate radiological and clinical outcomes of tibial angioplasty in critical limb ischaemia (CLI) and "at-risk" vein grafts (ARVG).
Materials/Methods: Twenty-five patients with CLI (n=18) or ARVG on duplex surveillance (n=7) had tibial angioplasty over a six-month period. Outcomes were determined with duplex scanning and clinical follow-up.
Results: Thirty limbs were treated by tibial angioplasty (31 procedures), 22 had additional fem-pop angioplasty. Technical success (in-line flow to the ankle) was achieved in 23/31 procedures (74.2%). Complication rate was 25.8% (8/31) - six minor (19.4%), two major (6.5%). Major complications were popliteal thrombosis and compartment syndrome requiring fem-distal bypass and fasciotomies, respectively. Duplex follow-up was available in 25 limbs. Primary patency at five-month median follow-up (range three days-nine months) was 24% (6/25 limbs). Clinical follow-up (30 limbs - median six months, range 1-9 months) demonstrated "clinical success" in 17 (56.7%), no change in seven (23.3%), major amputation in one (3.3%); five patients died (six treated limbs - all intact) during the follow-up period (mortality 20.0%).
Conclusion: Tibial angioplasty has poor primary patency. Despite this, in patients with CLI and limited options for surgical intervention, good "clinical success" and limb salvage rates are achievable, with acceptable risk of major complication.

P171.

Comparative assessment with diagnostic imaging of atherosclerotic ischemic renal disease in a hypertensive and/or uremic elderly population

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Purpose: To evaluate different diagnostic techniques for detection of renal artery disease in a population over 50 with hypertension and/or renal failure, unrelated to other known causes of renal disease.
Materials/Methods: Color duplex sonography (CDS) was used in 170 patients. Thirty-five patients with renal artery stenosis and 38 with high clinical suspicion but with negative findings on CDS underwent 3D-contrast enhancement magnetic resonance angiography (MRA) and/or selective angiography (SA).
Results: CDS showed that 35 (20.6%) had RAS; MRA or SA were performed in all 35. The diagnosis was confirmed in 33 cases, while 2 cases were false positive. Twenty-three of 135 patients with negative results on CDS underwent renal angiography. In 20 cases angiography confirmed normality, while 3 cases were found to be false negative. The positive predictive value of CDS was 94.3%, and the negative predictive value was 87%. RAS was found in 11% aged 50-59, 18% aged 60-69 and 23 % at age 70 and above.
Conclusion: Comparative analysis with the two diagnostic gold-standard techniques, MRA and SA, showed that CDS is a valid method of investigation and screening for RAS, especially in a hypertensive and/or uremic elderly population.

P172.

Image quality and dose of angiography systems: a digital flat panel system compared with conventional image intensifier system

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Purpose: Comparison of image quality (IQ) and radiation dose between digital flat panel detector (FP) based and image intensifier (II) based angiography systems.
Materials/Methods: IQ and dose measurements were made using the SCAI-NEMA phantom comparing the GE Innova 4100™ FP with the Siemens Axiom Artis II system (both max FOVs 40 cm). Iodine visibility and entrance dose were measured for typical patient sizes (20 and 25 cm PMMA). Other IQ measurements were made using standard 20-cm setup. Measurements were obtained using 30-fps fluoro and 3.75-fps DSA images, normal mode, and averaged over all FOVs. The FP system was operated at equal entrance dose in fluoro to that of the II system.
Results: Values shown are percentage differences with positive sign indicating higher value than the FP. Percentage comparison: dose, iodine, resolution, dynamic range, stationary wires, moving wires. Fluoroscopy: -3, 6, -26, -25, -3, -25; DSA: 97, 8, -15, -51, 0, NA.
Conclusion: Fluoroscopy, performed at equal dose levels, demonstrated that the FP system was clearly superior in resolution, dynamic range, and moving guidewire visibility. DSA perfomed at half the dose level of the II system demonstrated superior resolution and dynamic range.
Thanks to Loren Niklason, medical physicist, for his support.

P173.

Gadolinium-enhanced CT-angiography with a 16-detector row scanner

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Purpose: To assess the quality of gadolinium-enhanced CT-angiography with a 16-slice CT-scanner and to compare it with previously obtained similar studies on a 4-slice CT unit.
Materials/Methods: Eleven gadolinium-enhanced CT angiograms were performed in ten patients with contrast contraindication. ROI with Hounsfield unit measurements were obtained from the abdominal aorta to common femoral arteries during non-enhanced, gadolinium-enhanced and delayed acquisitions. Results were compared with the last 15 patients who had similar examinations performed on a 4-slice CT unit.
Results: On the 4-slice CT, throughout the scan length, mean enhancement values were 53.8±5.3 HU and 15.0±2.6 HU for gadolinium-enhanced and delayed series, respectively. For the 16-detector row CT unit, they were 76.1±3.4 HU and 21.3±1.3 HU, respectively. The 16-detector row CT unit provided significantly higher and more consistent enhancement throughout the scan, when compared with the 4-detector row CT (p value: 0.0106). Similar structures had significantly higher HU values when 120 kV was applied instead of 140 kV (p value: 0.0495)
Conclusion: The 16-slice CT scanner improved gadolinium-enhanced CT-angiography results. Gadolinium-enhanced CT examinations may be helpful in patients with a contraindication to iodinated contrast.

P174.

How are patients with severe limb ischaemia managed? A systematic audit of a large specialist vascular unit

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Purpose: To assess the impact of patients presenting with severe limb ischaemia on a specialist vascular radiology service.
Materials/Methods: A single-centre activity audit of a large vascular unit with a catchment population of one million was conducted. All patients presenting with severe limb ischaemia during a six-month period were analysed. Diagnostic imaging, primary and secondary interventions, and patient outcome were recorded.
Results: Two-hundred fifteen patients accounted for 227 presentations. Lower limb arterial status was diagnosed by intra-arterial digital-subtraction angiography in 164 cases (72.2%); duplex ultrasound examination in 14 (6.2%), and magnetic-resonance angiography in one (0.4%). No diagnostic imaging procedures were undertaken in 48 (21.1%) patients. Percutaneous transluminal angioplasty/stent implantation was performed in 66 (29.1%); surgical revascularisation in 49 (21.6%); minor amputation in ten (4.4%) and major amputation in 29 (12.8%). A further 73 (32.2%) cases were managed conservatively.
Conclusion: For a population of one million, an urgent workload of approximately 460 procedures (330 diagnostic and 130 interventional) can be expected per year. The nature and volume of this activity should be taken into account when planning service delivery and training in vascular radiology.

P175.

The influence of axial spatial resolution on diagnostic outcome by 16-channel multi-detector row-CT angiography of peripheral run-off vessels

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Purpose: To assess three different CT-angiography (CTA) reconstruction techniques for lower leg stenoses grading and compare diagnostic outcomes with digital subtraction angiography (DSA).
Materials/Methods: Seventeen patients with symptomatic peripheral arterial occlusive disease of the lower legs were prospectively evaluated with DSA and CTA. CTA data were reconstructed using three-slice widths and reconstruction increments (2.0/1.0 mm; 1.0/0.5 mm; 0.75/0.4 mm). Vessel opacification quality and stenosis grades (0-9%; 10-50%; 51-99%; occlusion) in 163 vascular segments were independently rated by two blinded readers for DSA and the three CTA techniques (axial images with 3D VRT reconstructions). Sensitivity and specificity of >50%-stenoses was determined for the three CT techniques using DSA as the gold standard.
Results: All studies were diagnostically conclusive. Arterial opacification was better with CTA compared with DSA ($p<0.001$). Sensitivities, for the detection of hemodynamically significant stenoses (>50% luminal narrowing) were 95.6%, 95,6%, and 97.5% for CT2/1, CT1/.5, and CT.75/.4, respectively ($p>0.05$). Corresponding specificities were 85.0%, 88.8% and 95.3%.
Conclusion: Sixteen-channel CTA of the lower leg has an excellent diagnostic concordance with DSA for the detection of hemodynamically relevant stenoses. The CTA technique with highest possible axial resolutions performed best in stenosis grading and should therefore be recommended for routine use.

P176.

Occult mediastinal great vessel trauma: the value of aortography performed during angiographic screening for blunt cervical vascular trauma

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Purpose: The goal of this study is to determine the value of aortography in the assessment of occult aortic and great vessel injuries when routinely performed during screening angiography for blunt cerebrovascular injury (BCVI).
Materials/Methods: One-hundred and one consecutive patients who received both aortography and screening four-vessel angiography over four years were identified retrospectively. Forty-five patients also underwent trauma computed tomography (CT)-scan of the chest. Angiograms and CT-scans were separately evaluated for mediastinal arterial injury.
Results: Of the 101 patients, six (6%) had angiographically documented traumatic aortic injuries and one (1%) had a traumatic subclavian artery injury. Of these seven patients, two injuries (28%) were unsuspected prior to angiography. Five of the seven (71%) also had BCVI. Forty-five patients underwent CT scanning. CT had a sensitivity of 75% (3/4), specificity of 80% (33/41), positive predictive value of 27% (3/11), and negative predictive value of 97% (33/34) for mediastinal arterial injury. There was one false negative CT-scan.
Conclusion: Routine aortography during screening angiography for BCVI is not warranted due to the low incidence (2%) of occult mediastinal arterial injury. In the setting of a positive BCVI screening study and no CT-scan of the chest, aortography may be advantageous.

P177.

Multi-detector CT-angiography with perfusion analysis in the follow-up of renal artery stenting

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Purpose: Renal artery stenosis may cause arterial hypertension and end-stage renal disease. Percutaneous transluminal stent angioplasty (PTRAS) allows effective treatment with high primary technical success rates. This study focuses on the additional value of perfusion analyses as assessed with multi-detector computed tomography angiography (CTA) in the follow-up of renal artery stenting.
Materials/Methods: Thirty-three consecutive patients after primary successful PTRAS of a main renal artery underwent CTA. The initial contrast medium bolus series for bolus tracking was used for perfusion imaging by placing one additional region of interest in the cortex of each kidney; we then calculated four perfusion parameters. The morphological assessment was based on the analysis of source images as well as standard reconstructions (MIP, CPR)
Results: The morphological analysis in 5/33 (15.2%) stented arteries revealed: one (3%) 0-50% stenosis, one (3%) 51-75% stenosis, two (6.1%) 76-99% stenoses, and one (3%) occlusion. Mean relative HU-max was 63.7+/-29.7, the mean HU-ratio 0.37+/-0.12, the mean time-to-peak (TTP) was 32.9s+/-7.4s and the mean TTP-ratio 0.76+/-0.10. None of these parameters was significantly different between patients with and those without hemodynamical significant restenoses.
Conclusion: None of the evaluated perfusion parameters adds any useful information in the follow-up of renal artery stenting

P178.

Virtual 16-slice CT intravascular endoscopy: evaluation after placement of endovascular stents or stent-grafts

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Purpose: To investigate the value of post-processing techniques after 16-slice CT high-resolution acquisition with particular analysis of virtual intravascular endoscopy (VIE).
Materials/Methods: Thirty patients were evaluated within 6 months after implantation of 8 suprarenal stent-grafts, 10 renal stents and 12 carotid stents, using 16-slice helical CT (Philips MX 8000 IDT). A dedicated work-station produced VIE and additional 3D reconstruction images as shaded surface display (SSD) and thick-slab multiplanar reconstruction (MPR). Images were independently analyzed by two vascular radiologists to evaluate patency of renal and suprarenal vessels and ostial crossing wires in suprarenal grafts, and patency, ostial position and degree of strut wall apposition in renal and carotid stents.
Results: VIE was able to demonstrate the relationship between graft-wires and aortic branch ostia and to depict renal stent configuration and expansion at the ostial level. Endoleaks, graft/stent migration, and stent mesh apposition were better studied with MPR.
Conclusion: 16-slice CT angiography provides high quality VIE and MPR images with increased accuracy and therefore could become a gold-standard method of investigation following endovascular procedures.

P179.

Contrast-specific ultrasonography: a new technique in the diagnosis of abdominal aortic aneurysm rupture

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Purpose: Suspected abdominal aortic aneurysm (AAA) ruptures are usually imaged by CT, mainly because of ultrasonography (US) difficulty in demonstrating retroperitoneal hematomas. The effectiveness of contrast-enhanced US is described here.
Materials/Methods: Four men and two women (mean age: 75 years) with AAA rupture were studied by baseline US, followed by a low-mechanical index technology (CnTI, Esaote) with contrast agent injection (SonoVue, Bracco). Imaging lasted 1-2 minutes. A contrast-enhanced CT was performed in five of them.
Results: Baseline US identified one suprarenal and five infrarenal aneurysms with a transverse diameter of 41-108 mm (mean: 65). Non-homogeneous luminal thrombi were present in 6/6 cases, floating luminal thrombus layers in 2/6, irregular aneurysmal shapes in 2/6, abrupt focal interruptions within the lumen thrombus in 4/6, retroperitoneal hematomas in 4/6, hemoperitoneums in 2/6. Contrast-specific US allowed a more clear depiction of retroperitoneal hematomas in 5/6, a delayed aortic lumen opacification in 3/6, a protracted aortic lumen opacification in 4/6, a contrast leakage within the thrombus in 6/6, an extravascular contrast leakage in 5/6. Contrast leaks appear as hyperechoic jets arising from the aneurysm wall and pooling dependently.
Conclusion: CS-US is accurate, time-effective, and poorly invasive in detecting ruptured aneurysms.

P180.

Criteria for localization of parathyroid adenomata using superselective venous sampling – time for revision?

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Purpose: To evaluate the criteria for localizing parathyroid adenomas in the era of superselective catheterization. Micro-catheters allow much more selective catheterization of draining veins from parathyroid adenomas than was possible when criteria for localization were developed over two decades ago. We reviewed the results of superselective parathyroid venous sampling (SPVS) to determine the relevance of traditional criteria.
Materials/Methods: SPVS was performed in 9 patients with primary hyperparathyroidism and one with tertiary hyperparathyroidism. Micro-catheters were used to access draining veins as small as 1 mm diameter. Typically 20-30 areas were sampled.
Results: False positive changes in parathormone (PTH) by conventional criteria (two fold increase in PTH levels) were found in all patients. In seven patients with true positive localization the mean venous PTH was 77 (29-191); mean highest PTH on selective sampling of 1398 (516 - 2635); mean ratio of 11.6:1 (7.2-42.4:1). In the patient with tertiary hyperparathyroidism and very high peripheral PTH levels (1199) the ratio of selective PTH (14276) to peripheral PTH remained high (11.9:1).
Conclusion: The use of micro-catheters allows selective venous sampling much closer to the source parathyroid adenomas. This produces much higher PTH levels. Conventional diagnostic criteria may no longer be appropriate and may need revision.

P181.

Placement of filters in the superior vena cava and azygous system. Preliminary experience

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Purpose: Filter placement in inferior vena cava (IVC) is an established procedure to prevent pulmonary embolism (PE) from deep vein thrombosis (DVT) of lower extremities and pelvis. The incidence of PE from DVT of the upper extremities is increasing in this era of aggressive therapy and widespread use of central catheters. Some patients with IVC occlusion may develop large collaterals draining into the azygous veins. Therefore, in some of them, the placement of a filter in the superior vena cava (SVC) and/or azygos is necessary. Unfortunately, this topic is controversial and has not received adequate attention. We, therefore, present our experience with 20 patients.
Materials/Methods: We have placed filters in these very unusual locations in 20 patients. Filters were placed in the SVC in 17 patients and in the azygos in three. Some of them also required filters in the IVC. Filters were: "old" stainless steel Greenfield, Titanium Greenfield, "new" stainless steel Greenfield, Simon Nitinol, Gunther tulip.
Results: All procedures were successful. No procedure-related complications were recorded. No SVC or azygos occlusions were found.
Conclusion: Placement of filters in SVC and/or azygos system is a safe, easy, effective, albeit controversial, method to prevent PE in certain patients under specific circumstances.

P182.

Chest port placement in pediatric patients

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Purpose: To describe our pediatric experience with chest port placement. **Materials/Methods:** From 1994 we have placed 540 ports and removed 403. Average age: 7 years (two months-18 years), weight: 26.5 kg (2.1-117). All were performed under general anesthesia, ultrasound, fluoroscopy with electrocautery with prophylactic antibiotics. One-hundred four standard, 375 low-profile, 16 mini, and 45 dual-lumen ports were placed. A total of 324 procedures was performed simultaneously, including vascular device removals, biopsies, bone marrow aspirates, LPs and G-tubes. Ports were secured to the fascia with two non-absorbable sutures, and closed with two layers of interrupted sutures and a running subcuticular absorbable suture.
Results: Ports were successfully placed in all patients with a RIJ access in 535 patients, and a LIJ in five. The catheter tips were positioned at the SVC/right atrial junction. There were no major post-procedure complications. Wound dehiscence and local haematoma occurred in three patients and were treated conservatively. Confirmed catheter-related infection rate was approximately 3%, or 0.016 per 100 access/days.
Conclusion: Interventional radiology has become the primary service for port placement. It has the advantage of peri-procedural imaging, and other image-guided procedures can be performed simultaneously. Although the procedure includes some traditional surgical skills, these are easily acquired.

P183.

Pediatric hemodialysis catheter placement in interventional radiology

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Purpose: To describe the technique and evolution of hemodialysis catheter placement technique in children with end-stage renal disease.
Materials/Methods: Retrospective analysis was performed of 203 patients [105 female, 98 male, age 0.3-21 years (mean 10.5), weight 3-108 kg (mean 29)] who underwent image-guided placement of 293 catheters between August 1992 and January 2004. All procedures were performed under general anesthesia with ultrasound guidance. Catheter tips were placed at the superior vena cava/atrial junction.
Results: The right internal jugular vein was used for access in 198 patients; the remaining five were accessed through the left internal jugular. One-hundred eighty-three adult and 100 pediatric Quinton catheters were used; the remainder measured 8 F (Medcomp). No major complications occurred. One patient's catheter initially reached the pleural cavity; it was repositioned intravascularly. Minor bleeding complications occurred at the site in eight patients due to heparinization and underlying coagulation abnormalities.
Conclusion: Hemodialysis catheter placement in interventional radiology is used by our clinicians as the technique of choice. This is largely based on the fact that ultrasound is used for accessing the internal jugular vein, and pre-procedure imaging identifies venous abnormalities. The subclavian vein is not used as this makes later upper limb fistula creation impossible.

P184.

Efficacy and safety of rotating pigtail catheters for lower extremity deep vein thrombosis in May–Thurner syndrome

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Purpose: To evaluate efficacy and safety of mechanical fragmentation of left iliofemoral deep vein thrombi with rotating pigtail catheters.
Materials/Methods: Ten patients (eight women) with iliofemoral deep vein thrombosis (DVT) underwent a combined technique: rotating pigtail catheter plus aspiration thrombectomy. About 5-10 minutes after infusing 400,000-700,000 IU urokinase into the thrombosed veins, thrombuses were fragmented by the mechanical action of a rotating pigtail catheter tip and then aspirated. A stent was inserted if, after completion of the procedure, an iliac vein stenosis was present. Total procedural time, thrombolytic agent volume, valvular injury, symptom-free time interval, and success rate (primary patency rate) were evaluated.
Results: In all the patients, thrombi were successfully fragmented and aspirated using the combined technique: rotating pigtail catheter plus aspiration thrombectomy (clinical and technical success rate, 100%). With an average time of 5.7 minutes, thrombosed veins were declotted by the rotating pigtail catheter. The average duration of the whole intervention was 108 minutes. Mean primary patency was about four months and no recurrences were recorded. Total urokinase average dose was 890,000 IU. There were no major complications.
Conclusion: Rotating pigtail catheters in the treatment of iliofemoral DVT are effective and safe in patients with iliofemoral DVT.

P185.

Central venous access: 15-year experience

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Purpose: To assess the outcome of a series of patients with central venous access (CVA) systems.
Materials/Methods: Four-thousand two-hundred and forty patients, ranging in age from 21 to 87 years, were treated from December 1988 to December 2003. The venous systems were selected according to the therapeutic needs and post-operative management was coordinated by the nurse crew for a detailed information recording. Outcomes included data regarding revisions, malfunctions, and complications.
Results: The use of different entry sites allowed to obtain a success rate of 99.5% (4219/4240). Immediate complications were 11 cases of pneumothorax (0.25%) and three vagal reactions (0.07%). Minor complications were easily managed. Cumulative infections rate was a (+) culture in 327 patients (7.7%) and infectious complications were recorded in 31 patients (0.73%).
Conclusion: Interventional radiology matches the need of a prompt and safe placement of CVC and, with an increasing number of cases performed, infection's rate has dropped. An interdisciplinary coordination of the patients' management plays a significant role in the achievement of such positive results.

P186.

Ultrasonic ablation in chronic deep vein thrombosis of lower extremities

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Purpose: To evaluate the clinical efficacy of ultrasonic ablation in patients with chronic deep vein thrombosis of the lower extremities.
Materials/Methods: Thirty-eight patients with chronic deep vein thrombosis and total occlusion of the left ilio-femoral vein were included. Through a surgical approach, an ultrasonic ablation catheter was inserted into the occluded ilio-femoral vein segment. This device consists in a flexible, 2.2-mm diameter wire attached to a piezoelectric crystal generating ultrasounds at 24kHZ. The time of ultrasonic ablation ranged from12 to 24 minutes.
Results: The ultrasonic ablation easily created a channel within the occluded ilio-femoral vein and achieved successful recanalization in 31/38 patients. Follow-up showed two cases of reocclusion in nine patients with a stent inserted and in ten of the 15 patients without a stent.
Conclusion: These results suggest that intravascular ultrasonic ablation is an effective therapeutic modality for patients with chronic ilio-femoral vein occlusion; additional endovascular treatment modalities are however necessary to obtain good clinical results.

P187.

Endovascular treatment of low-flow vascular malformations: long-term follow-up and life quality after the treatment

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Purpose: To evaluate the results of endovascular therapy in treating venous and venocapillary malformations and to assess the post-treatment life quality.
Materials/Methods: Forty-two patients underwent percutaneous ethanol sclerotherapy and two malformations were embolized with PVA particles. The mean follow-up was two years and ten months. Twenty malformations were located in the head and neck region and 24 in the extremities. To evaluate the quality of life after treatment, 42 patients filled in a questionnaire, which included 20 multiple-choice questions exploring four dimensions: psychological, physical, social functioning, and pain.
Results: Pain was the most important injurious factor for the state of health, especially in malformations involving the extremities. At the beginning of treatment, those patients younger than 16 had a better life quality. In the extremities, the poorest outcome was found in malformations that filled the whole muscle or muscle compartment. The patients whose malformation at the clinical control caused swelling of the extremity affected had poorer quality indices. Patients with venous malformations of the tongue had the worst outcome.
Conclusion: The results concerning the quality of life showed that most of the patients did well after the endovascular treatment. To achieve better results the treatment should be started before puberty.

P188.

Endovascular treatment in the common iliac vein obstruction

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Purpose: To evaluate effectiveness and long-term results of endovascular stent placement for common iliac vein obstruction with deep vein thrombosis.
Materials/Methods: Twenty-two patients (13 women, nine men; age range: 30-91 years, mean 57.6) with common iliac vein obstruction and deep vein thrombosis underwent endovascular treatment. Twenty lesions were in the left and two in right lower extremity. The cause of common iliac obstruction was May-Thurner syndrome in 16, pelvic mass in two, and unknown cause in four. Technical success, resolution of clinical symptoms, complications, and long-term results were evaluated.
Results: Technical success was 100%. Twnety-seven Wallstents were deployed after thrombolysis and aspiration thrombectomy. The aspiration thrombectomy was performed after thrombolysis in 18 patients and in four patients without thrombolysis. Twenty-one patients showed a good stent patency, while one had a partial stent obstruction. Twenty-one patients had no recurrent deep vein obstruction symptoms. Follow-up ranged from one to 41 months (mean: 21.4). Major complications were one case of stent upward migration and one spinal epidural hematoma.
Conclusion: Endovascular stent placement in the treatment of common iliac vein obstruction is very effective and safe in the relief of lower extremity swelling and pain.

P189.

Craniofacial hemangiomas: angiographic study and endovascular embolization

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Purpose: To define the role of angiography and endovascular embolization (EE) for patients with craniofacial hemangiomas (CHA).
Materials/Methods: From 1993 to 2004, 24 patients aged from 4 to 36, including eight children below 14, underwent angiography and EE for CHA in various localizations. EE was executed with PVA or microcoils for the following reasons: to limit CHA growth (n=10), embolization immediately before plastic surgery (n=9), and profuse bleeding (n=5). Surgery is feasible only when patients reach age 18, so embolization in children aimed to confine CHA growth (n=6) or to stop life-threatening bleeding (n=2).
Results: No deaths or complications occurred. All CHA had multiple feeding arteries. In five patients with a previously ligated external carotid artery (ECA), blood supply had been completely restored from the contralateral ECA and other vascular beds. EE was achieved in 21 patients (87.5%) and was unsatisfactory in three patients with ligated ECA. Eight patients underwent repeated interventions, and nine had plastic surgery two days - three months after EE.
Conclusion: EE reduces the risk and broadens the potential of surgical management, decreases risk of hemorrhage, and improves quality of life. Surgical planning must consider angiography data. ECA ligation complicates EE procedure and must be avoided.

P190.

Complications after percutaneous saline-enhanced radiofrequency ablation of liver tumors: a four-year experience of a single center with 358 patients

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Purpose: To describe complications in patients with hepatic tumors treated with US-guided saline-enhanced high-frequency induced thermotherapy (HiTT).
Materials/Methods: Three-hundred fifty-eight patients with 427 malignant hepatic nodules underwent HiTT (Elektrotom 106 HiTT, Berchtold, Germany) with a 15-G electrode needle: 301 cirrhotic patients had hepatocellular carcinoma (HCC), 55 had liver metastases, two had primary cholangiocarcinoma. Child-Pugh's class of cirrhotic patients was A in 220 cases and B in 81. Nodules diameters were 1.5-8.5 cm.
Results: One Child-B cirrhotic patient (0.3%) with a 2-cm single HCC nodule showed an acute liver failure (progressive jaundice worsening, ascites, severe hemocoagulation impairment) within one week and died 38 days after. One patient with a 35-mm HCC nodule had a liver abscess from *E. coli*, treated with percutaneous drainage and antibiotics. A mild peri-hepatic fluid collection or post-treatment ascites occurred in four and 12 patients 24 hours post-procedure. One patient with a self-limiting subcutaneous cellulitis along the electrode needle-path healed in two weeks. Short-term post-treatment fever (162/358, 42%) and pain (185/358, 78%) were recorded. Analgesics were necessary in 39/185 (21%) patients. No seeding was recorded.
Conclusion: HiTT of liver tumors can be considered a safe procedure. Life-threatening acute liver failure should be considered a rare complication.

P191.

Technical success and safety of ultrasound-guided central catheter placement through the internal jugular vein

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Purpose: To show safety and technical success of ultrasound-guided central catheter placement through the internal jugular vein.
Material/Methods: Four-hundred and twenty non-tunneled internal jugular catheters were placed under ultrasound guidance in 382 patients (261 men and 121 women, age range one month to 82 years, mean 43 years). Three-hundred and eleven (74%) hemodialysis catheters measured 12 F, whereas the remaining catheters (4 to 8 F) were for other purposes. Twenty-nine procedures were performed in pediatric patients, 37 in patients who had a bleeding tendency, and 28 were performed at bed-side.
Results: Technical success was 100% for adults and 96% for pediatric patients. Overall success was 99.8%. Average number of punctures was 1.04 for adults and 1.6 for pediatric patients. Seven (1.6%) minor complications were encountered. There were three carotid punctures without sequelae, three oozing around the catheter, and one puncture through the pleura without development of pneumothorax. Complications like hematomas, pneumothoraces, or hemothoraces were not encountered in any patients.
Conclusion: Ultrasound-guided central catheter placement is very safe in the general population, at bed-side, in pediatric patients, and in patients with a bleeding tendency.

P192.

Embolization in severe recurrent hepatic encephalopathy in patients with spontaneous splenorenal/gastrorenal shunt

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Purpose: To evaluate the efficacy of spontaneous splenorenal or gastrorenal shunt embolization in cirrhotic patients with recurrent hepatic encephalopathy.
Materials/Methods: Seven patients with hepatic cirrhosis (four men and three women, aged 29-80 years) were included. Five patients had recurrent hepatic encephalopathy, and two had recurrent variceal bleeding with at least one encephalopathic episode. Before embolization all the patients underwent a fibrogastroscopy to evaluate the presence and type of gastroesophageal varices and an abdominal ultrasound and/or CT to diagnose the shunt. After embolization, all the patients had an abdominal ultrasound within two weeks to control the portal flow. A spontaneous splenorenal shunt was found in five patients and a spontaneous gastrorenal shunt in two.
Results: Two patients died of hepatic failure and one patient died due to the embolization technique. Encephalopathy was not present in the remaining four patients (one of them, after the first year was lost to follow-up; another one underwent liver transplantation four months after embolization).
Conclusion: Embolization of portosystemic collaterals seems to be an effective and safe procedure that ensures hepatopetal portal flow, thus helping to control recurrent encephalopathy and variceal hemorrhage in patients with spontaneous portocaval shunts.

P193.

Endovascular management of deep vein thrombosis and chronic venous insufficiency caused by May-Thurner syndrome

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Purpose: To evaluate the usefulness of endovascular management of deep vein thrombosis and chronic venous insufficiency caused by May-Thurner syndrome.
Materials/Methods: During the last two years, 13 patients (seven men; mean age, 57 years) with iliofemoral deep vein thrombosis and venous insufficiency due to May-Thurner syndrome were treated in our Department. They presented with painful swelling, heaviness, or varicose veins of the left leg. Six patients had acute and four chronic thrombosis; three cases presented with chronic venous insufficiency. The ten thrombosed patients were managed by catheter-directed thrombolysis and angioplasty followed by stent insertion. Two patients were initially treated with mechanical thrombectomy, and one with combined catheter-directed thrombolysis, mechanical thrombectomy, and angioplasty with stent insertion. The three patients with chronic venous insufficiency were managed by angioplasty and stent insertion.
Results: An initial technical success was achieved in all patients. Twelve out of 13 patients showed a complete clinical and symptomatic improvement after the treatment. One patient showed a partial improvement only, but a follow-up sonography performed two weeks after revealed a rethrombosis. No major complications were recorded.
Conclusion: Endovascular management is an effective and safe treatment of acute and chronic venous thrombosis and chronic venous insufficiency due to May-Thurner syndrome.

P194.

Radiation protection to the eye and thyroid during cerebral angiography

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Purpose: We measured doses to the eye and thyroid during cerebral angiography to assess the effectiveness of bismuth and lead shields.
Materials/Methods: Phantom cerebral angiography (standard 4-vessel) was performed with bismuth (study 1) and lead shields (study 2). In study 1 (12 phantoms), thermoluminescent dosimeters were placed over the eyes and thyroid in 3 groups (4 phantoms in each): A) no shields, B) anterior bismuth shields, and C) anterior plus posterior bismuth shields. In study 2 (8 phantoms) lead shields were placed over the thyroid only and thermoluminescent dosimetry doses obtained in 2 groups (4 phantoms in each): A) with and B) without thyroid shielding.
Results: Study 1 (bismuth shields) demonstrated higher doses to the eyes as compared with the thyroid (mean 13 vs. 6 mSv) and a higher dose on the x-ray tube side. Bismuth shielding did not significantly reduce dose to eyes or thyroid. Study 2 (thyroid shields) showed a significant thyroid dose reduction (4.62 vs. 2.46 mSv; 47%) with the use of lead shields (p=0.048).
Conclusion: Eye shielding is impractical, interfering with diagnostic capabilities. Thyroid lead shielding yields significant protection, is not in the field of view and should be used routinely. A patient study is underway.

P195

Radiofrequency ablation: development of a flow model of bovine livers for experimental testing

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Purpose: To evaluate different liquids for tissue modulation during radiofrequency ablation in order to improve necrosis size.
Material and Methods: To avoid animal experiments a formerly developed perfusion model for bovine livers was used for all experiments. Adjustable swivels with the RF probe and a perfusion needle attached were mounted on the liver perfusion tank. For tissue modulation saline 0.9% and 10%, ethanol 98%, acetic acid 50% and Lipiodol were used. The size of the thermolesions was assessed by macroscopic measurements.
Results: 270 thermolesions were generated. For RFA only the mean lesion size was 3.9cm^2. RFA in combination with saline 0.9% showed a mean lesion size of 4.3cm^2 (p=0.36), with Lipiodol 4.2cm^2 (p=0.79). A significant increase in lesion size was documented with RFA combined with saline 10% (4.7cm^2; p=0.04), ethanol 98% (4.7cm^2; p=0.03) and acetic acid 50% (5.4cm^2; p=0.005). Tissue modulation with acetic acid 50% produced thermolesions that were very irregular in shape in contrast to the other liquids which did not.
Conclusion: Significant increase in lesion size was observed with RFA in combination with saline 10%, ethanol 98% and acetic acid 50%. Because of uneven diffusion acetic acid 50% should not be recommended for tissue modulation during RFA.

P196.

Experimental radiofrequency ablation: tissue modulation with different liquids

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Purpose: To evaluate different liquids for tissue modulation during radiofrequency ablation (RFA) to improve necrosis size.
Materials/Methods: The perfusion of fresh bovine livers was simulated in a specially designed flow-model. Swivels mounted on the perfusion tank allowed the reproducible placement of the RF electrode within the liver with standardized depths and angles. A 2-cm LeVeen needle and the RF 3000 generator (Boston Scientific) were used for RFA. For tissue modulation, saline (0.9% and 10%), ethanol (98%), acetic acid (50%) and Lipiodol were injected via additional puncture needles. The size of the thermolesions was assessed.
Results: Two-hundred and seventy thermolesions were generated. Mean sizes were 3.9 cm^2 (RFA only), 4.3 cm^2 (saline 0.9%), 4.7 cm^2 (saline 10%), 4.7 cm^2 (ethanol), 5.4 cm^2 (acetic acid) and 4.2 cm^2 (Lipiodol). There was no statistical significance in the size of the thermolesions between the different liquids (Friedmann test p=0.526).
Conclusion: Although tissue modulation during RFA with acetic acid seemed to create the largest thermolesions, there was no significant difference in lesion size between the evaluated liquids.

P197.

Development of a relational database to facilitate research and management of interventional radiology procedures

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Purpose: To introduce a database that integrates statistics, data, images, as well as inventory and equipment usage.
Materials/Methods: Interventional radiology has established as a minimally invasive field that reduces patients' morbidity and hospital days. However, the cost of equipment, inventory and labour is usually not monitored or trended. For research purposes, it is important to track these patients pre- and post-procedure, as well as store imaging, as well as track QA issues related to materials. The database is built on SQL and integrates data with HIS, RIS and other relational databases.
Results: This database was developed over a ten-year period and has undergone numerous upgrades to meet the increasing needs for clinical research and operational activities.
Conclusion: The database has allowed us to do complete case management, integrate data and images, track utilization and forecast future requirements, thus justifying a four-suite interventional department.

P198.

Advantages and safety of 16-slice computed tomographic fluoroscopy in interventional radiologic procedures

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Purpose: To evaluate the advantages and safety of 16-slice computed tomographic (CT) fluoroscopy when compared with conventional CT as guidance in interventional radiologic procedures.
Materials/Methods: Data on 30 percutaneous intervention procedures performed with use of CT fluoroscopic guidance and 45 with conventional CT guidance were obtained from a questionnaire completed by radiologists and CT technologists regarding radiation dose measurements absorbed by patients and personnel, total procedure time, total CT fluoroscopy time, mode of CT fluoroscopic guidance (continuous versus intermittent), success of the procedure, major complications, and type of procedure (biopsy, aspiration, drainage, vertebroplasty). Evaluation of success rate, complications and operator skill was also accomplished.
Results: The median calculated patient absorbed dose per procedure and the median procedure time with CT fluoroscopy were 86% less and 40% less, respectively, than those obtained with conventional CT. The intermittent mode of image acquisition was used in 95% of the 75 procedures.
Conclusions: Use of 16 slice CT fluoroscopy for the guidance of interventional radiologic procedures markedly decreased patient radiation dose and total procedure time compared with use of conventional CT guidance. CT fluoroscopy makes interventional procedures easy and approachable for less expert operators.

P199.

Ultrasound-guided thyroid fine needle aspiration biopsies: a comparison between 2D, 2D-assisted 4D, and 4D methods

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Purpose: To compare the effectiveness of 2D-assisted 4D and 4D methods with 2D ultrasound in thyroid fine needle aspiration biopsies (FNAB).
Materials/Methods: Sixty-four patients (age range, 22-77; mean, 49) underwent ultrasound-guided FNAB procedures. Biopsies were performed with a 2D method in 24 cases, with a 2D-assisted 4D method in 20 cases, and with a 4D method in 20 cases. In 2D-assisted 4D and in 4D procedures the needle tip was shown in real-time in three orthogonal views and in 3D rendered images. The procedure time was measured in all cases.
Results: In all 2D cases, the needle was seen in the nodule. In 17/20 of 2D-assisted 4D and in 15/20 of 4D cases, the needle was seen in all four views. The mean procedure time was 174s, 285s, and 294s in 2D, 2D-assisted 4D, and 4D biopsies, respectively. In 2D biopsies the time was significantly shorter ($p<0.01$). Biopsy specimens were diagnostic in 16/24(67%), 14/20 (70%), and 13/20 (65%) in 2D, 2D-assisted 4D, and 4D biopsies, without significant differences ($p>0.05$).
Conclusion: 4D-ultrasound provided superior information about the needle position. Its major limitation is the low-frame rate of the system.

P200.

Tunneled peripheral venous port insertion in children: an eight-year experience

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Purpose: To review technique and outcomes related to tunneled peripheral venous ports (PVP) in children.
Materials/Methods: Since 1995, 73 PVP were placed in 65 patients (37F, 28M) aged 6-36 years (mean=15). Indications included malignancy (n=47), hematological disorder (n=16), osteomyelitis (n=2), Gaucher's disease (n=2), fibromatosis (n=2), other (n=4). Most were placed without GA (n=20), under conscious sedation (n=46) or local anesthesia (n=7). The left arm (n=54) and the basilic vein (n=52) were preferred to the right arm (n=19) and brachial vein (n=21).
Results: The catheter tip was usually placed at the SVC/RA junction (n=64), with the remainder in the proximal RA (n=8) or proximal subclavian vein (n=1). Paresthesia of the forearm required port removal in two children. Delayed complications included site infection (n=2), catheter infection (n=3), cellulitis or necrosis (n=2), thrombosis (n=1), and phlebitis (n=1). Thirty ports were removed electively after 60-1620 port-days (mean= 321) and 11 non-electively after 15-150 port-days (mean=60). Thirty-two ports remain functioning after 15-1440 port-days (mean=450).
Conclusion: Peripheral tunneled venous port insertion is safe and effective in children, and is a cost-effective alternative when done with conscious sedation in Interventional Radiology.

P201.

Percutaneous ureteral stent retrieval: technique, results and complications

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Purpose: Occasionally ureteral stents cannot be removed cystoscopically. We reviewed a series of patients in whom antegrade retrieval was attempted.
Materials/Methods: Eighteen patients (M:F; 6:8, age range 31 - 82) were included. Indications for antegrade retrieval included proximal stent migration in 5, and encrustation causing failed retrograde retrieval in the remaining 13. After standard nephrostomy access a 14-16 Fr sheath was inserted into the pelvicalyceal system, after first cutting a 45 degree bevel at the end of the sheath. Alligator forceps were then used to grasp and remove the stent.
Results: Eighteen stents were successfully retrieved from 17 patients (one patient had bilateral stents removed). There was one failure due to marked stent calcification, requiring open retrieval. In 6 patients new stents were then inserted antegradely. The remaining patients did not require further stenting. Complications included nephrostomy site pain in 2 patients, periprocedural sepsis in 1, and a small urinoma in 1. All 4 patients stabilised with conservative therapy. No major complications were encountered.
Conclusion: Percutaneous ureteral stent retrieval is a safe procedure when retrograde retrieval fails or is not possible.

P202.

Experience with the treatment of traumatic peripheral arterial injuries with stent-grafts

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Purpose: To present our experience with the treatment of peripheral arterial injuries or aneurysms, with stent-grafts.
Materials/Methods: Eighteen patients (all men) with traumatic injuries (n=14) and aneurysms (n=4) of the carotid (n=4), iliac (n=5), superficial femoral artery (SFA) (n=4), subclavian (n=2), hepatic (n=1), brachial (n=1), brachiocephalic (n=1) arteries were treated with stent-grafts of different types. Age ranged from 18 to 72 years. Follow-up ranged from one month to seven years.
Results: Treatment was primarily successful in 16 cases, with no significant complications. Two patients required repeated interventions to treat endoleaks. One patient presented with acute occlusion of the SFA, one year after treatment, requiring surgical bypass.
Conclusion: Stent-graft treatment of traumatic arterial injuries and aneurysms of the peripheral circulation is adequate and properly seals off vascular lacerations and aneurysms, with no significant complications.

P203.

Short-term results of a covered stent (passive coating) for intra-stent restenosis in the renal arteries

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Purpose: To evaluate the efficacy of implanting covered stents (PTFE coverage; Jomed) to avoid muscular cells proliferation in intra-stent restenoses of the renal arteries.
Materials/Methods: Sixty-one patients (36 men; mean age 65 years) with intra-stent restenosis were enrolled in this consecutive study (May 1998-February 2003). All the patients were hypertensive, 34% of them were diabetics and 16% had a creatinine of >15mg/l. Indications of covered stent implantation were based on clinical criteria and on >50% proliferation in diameter. Covered stents were implanted in the right (22), the left (36), or both (3) renal arteries. Six-month follow-up was performed by ultrasound.
Results: Technical success was 100%. Immediate complications were one acute thrombosis 12 hours post-stent implantation (successfully treated with fibrinolysis), two hematomas, two false aneurysms at the puncture site (manual compression), one transient increase in the renal function. At six months, one renal thrombosis, one ostial restenosis (not covered by the initial covered stent), and one intra-stent restenosis were reported. No patients were in a terminal dialysis condition.
Conclusion: Implantation of a covered stent seems to be efficient to prevent proliferation when an intra-stent restenosis is present in the renal arteries. A randomized trial needs to confirm these preliminary results.

P204.

Radiofrequency ablation of focal liver lesions: complications and results

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Purpose: To report complication rates of percutaneous liver tumor radiofrequency ablation (RF) performed under ultrasonographic guidance.
Materials/Methods: From May 1998 to January 2004, 110 patients with hepatic lesions (73 with hepatic cell carcinoma and 37 with metastases) were treated with RF, for an overall of 135 lesions. Primary lesions had a diameter ranging from 0.5 to 5.6 cm (mean: 2.7 cm) while metastases had a diameter ranging from 0.9 to 6 cm (mean 2.9 cm). The procedures were performed using either single or cluster needles.
Results: Two (1.8%) major complications occurred: one patient died (0.9%) for peritonitis after right colon perforation eight days after RF. The second patient presented necrosis of the left hepatic lobe with jaundice and ascites after intra-operative portal vein occlusion during a Pringle's maneuver. Thirteen minor complications (8.1%) were reported: liver abscess (n=1), hemoperitoneal effusion (n=1), arteriovenous fistula (n=1), severe abdominal pain (n=10).
Conclusion: RF of hepatic lesions is associated with a low major complications rate (2 /110; 1.81%) and represents a valid alternative to conventional surgical hepatic resection.

P205.

Post-biopsy renal allografts' vascular injuries causing life-threatening haematuria: treatment with percutaneous superselective catheterization and embolization

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Purpose: To evaluate efficacy of transcatheter superselective embolization in the treatment of post-biopsy arteriovenous fistulas (AVFs) and pseudoaneurysms in renal transplants when such iatrogenic injuries lead to life-threatening haematuria.
Materials/Methods: During a four-year period (1999-2003), six renal transplantation patients with post-biopsy persistent haematuria and in danger of hypovolemic shock were referred to our department for examination. Arteriography showed AVFs and/or pseudoaneurysms in five of the six cases and superselective catheterization and embolization were performed. Embolization materials consisted of platinum microcoils (0.018 inches x 3-5 cm) and/or gelfoam particles. Superselective catheterization of the injured artery was performed in all cases using 4-F standard catheters and 0.035-inch hydrophilic guidewires.
Results: A successful embolization could be performed in all five patients and haematuria was effectively controlled in only one session without any procedure-related complications. Serum creatinine levels--determined five to 15 days after embolization--were found in all patients at the same or at a lower level when compared with those before embolization.
Conclusion: In all cases, immediate control of haematuria with no further impairment of serum creatinine levels suggests that transcatheter superselective embolization is a safe and effective technique to treat biopsy-related vascular injuries in renal allografts.

P206.

Preclinical assessment of the new Sorin self-expandable Carbofilm coated nitinol stent (Flype)

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Purpose
To assess the biocompatibility and stenting effectiveness of a Carbofilm coated nitinol peripheral stent in the non-atherosclerotic porcine model.
Materials and methods
Sixteen minipigs received a Carbofilm coated self-expandable nitinol stent in iliac and femoral arteries. Devices were explanted after 7, 30, 90 and 180 days. Histological and histomorphometric analyses were performed to assess thromboresistance, acute and chronic inflammatory response as well as foreign body reaction.
Results
Twenty-four stents were successfully implanted. No mural thrombi were observed at macroscopic or histological examinations. Histologically, no significant inflammatory reaction was detected. The neointima proliferation showed moderate and homogeneous growth respectively after 30, 90 and 180 days (0,06$\pm$0,01 mm; 0,19$\pm$0,08 mm; 0,09$\pm$0,02 mm; p=n.s.).
Conclusions
This study showed good procedural results and a very satisfactory tissue and hemocompatibility with absence of thrombus deposition and negligible inflammatory response.

P207.

PTA of infrapopliteal arteries: One year clinical follow up in groups of patients stratified according to comorbidities.

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Purpose: To evaluate the efficaccy of infrapopliteal PTA in patients with CLI - one year clinical FU in different groups of patients.
Material/Methods: Since 1985 to 2003 infrapopliteal PTA was performed in 782 patients (961 l.limbs, 1982 arteries). 68 % of patients were male, 82 % of patients had DM, average age was 66 years, all of them with symptoms of CLI.
Stratification to groups:.....No limbs..... one year FU
1)Post-transplant patients: ..... 49.....40
2)Dialysed patients:..... 114 68
3)Non-dialysed,non-DM:..... 131..... 102
4)Patients with DM:..... 522..... 361
Results:
Group:..... Technical success %..... Limb salvage rate %
1) .....90..... 80
2)..... 86 55
3)..... 83..... 80
4)..... 90 76
Conclusion: Infrapopliteal PTA is highly efficient method in therapy of CLI we consider it as a method of first choice.
The efficacy of PTA differs in various groups of patients and clinical success depends on comorbidities.

P208.

Combination of femoropopliteal bypass and infrapopliteal PTA in patients with critical lower limb ischemia. A feasibility study

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Purpose: To evaluate technical feasibility and clinical outcome of infrapopliteal PTA performed from surgical cut-down combined with femoropopliteal bypass in patients with critical limb ischemia.
Material and Methods: 22 patients/l. limbs. Male 16 patients, female 6 patients. Average age: 61.2 years (36 - 75 years).
Ischemic ulcer: 10 patients
Toe(s) gangrene: 5 patients
Rest pain: 4 patients
Claudications < 10 m: 3 patients
None of the limbs had at least one crural artery patent, all of them had either total occlusion or multiple severe stenoses of SFA.
Technique: A 5 F sheath was inserted to popliteal artery using surgical cut-down and PTA of all accessible infrapopliteal arteries was performed, being immediately followed by femoropopliteal bypass.
Results: Immediate PTA outcome:
3 crural arteries patent.....3 patients
2 crural arteries patent....10 patients
1 crural artery patent.....9 patients
Six days femoropopliteal bypass patency rate: 100 %

This index lists the names of authors of all submitted abstracts. The presentation number is bolded for presenting authors.
(The letter "P" before the presentation number refers to the Poster Section)