



European Conference on Interventional Oncology

ECIO 2022

APRIL 24-27
VIENNA, AUSTRIA

ABSTRACTS
AND AUTHOR INDEX



Cardiovascular and Interventional Radiological Society of Europe

Content

3 Scientific Papers

Scientific Paper Session 1

Scientific Paper Session 2

10 Posters

Kidney

Liver

Lung

Musculoskeletal

Novel therapies

Other organs

Pre-clinical and experimental

Technical developments

62 Author Index

P-numbers stand for poster presentations

ECIO 2022 Abstracts and Author Index

In case of any enquiries or comments, please contact us at info@cirse.org.

© Cardiovascular and Interventional Radiological Society of Europe / 2022

CIRSE does not accept responsibility for errors or misprints.

The European Conference on Interventional Oncology is organised by CIRSE (Cardiovascular and Interventional Radiological Society of Europe).

The official congress website is: www.ecio.org

GraphX by LOOP. ENTERPRISES media
www.loop-enterprises.com

Scientific Paper Session 1

902.1

Radioembolization with Yttrium-90 glass microspheres as first-line treatment for unresectable intrahepatic cholangiocarcinoma – a prospective phase 2 clinical trial

Kis B¹, Shridhar R¹, Mhaskar R², Frakes J¹, El-Haddad G¹, Choi J¹, HOFFE S¹

¹Moffitt Cancer Center, Tampa, United States of America,

²University of South Florida Morsani College of Medicine, Tampa, United States of America

Purpose: The purpose of our trial was to evaluate the safety and efficacy of yttrium-90 (Y90) glass microsphere radioembolization as first-line treatment without chemotherapy for unresectable IHC.

Materials and methods: This phase II study (NCT01253148) included 23 patients (median age 76 years) with intrahepatic cholangiocarcinoma (IHC) if they had no evidence of extrahepatic metastasis, Childs-Pugh A, without main portal vein thrombus, bilirubin <2 mg/dL, ECOG performance status of 0-2, and no prior chemotherapy, liver embolization, or radiation therapy for IHC. The primary endpoint was progression-free survival (PFS). Secondary endpoints were OS and toxicity.

Results: Median delivered dose was 136 Gy. 12 patients didn't receive chemotherapy post-Y90. Median PFS was 5.5 months (95% CI: 3.9-7.1 months). Imaging response at 3 months follow-up were 13 SD and 10 PD, the best radiographic response was 1 CR, 4 PR, 11 SD and 7PD and 70% disease control rate. Median OS was 27.2 months (95% CI: 8.5-45.9 months) from diagnosis and 19.4 months (95% CI: 4.6-34.1 months) from Y90 treatment. Univariate and multivariate analysis failed to identify any prognostic factor associated with PFS or OS. Treatment was well tolerated with 2 grade 3 adverse events.

Conclusion: First-line treatment of IHC with radioembolization showed promising OS and minimal toxicity. Comparing to published data on IHC, radioembolization appears to be at least as effective as systemic chemotherapy but has a much favorable toxicity profile. This prospective trial suggests that radioembolization can be considered as first line treatment of unresectable IHC.

902.2

Evaluation of voxel-based dosimetry for predicting outcome in HCC patients treated with resin-based Y90 radioembolization

Kokabi N, Arndt-Webster L, Chen B, Brandon D, Sethi I, Galt J, Elsayed M, Bercu Z, Cristescu M, Kappadath SC, Schuster D
¹Emory University School of Medicine, Atlanta, United States of America

Purpose: To evaluate the efficacy of voxel-based dosimetry for predicting treatment response in patients with hepatocellular carcinoma (HCC) undergoing resin-based Y90 radioembolization

Materials and methods: This is a correlative study based on a prospective single-arm clinical trial (NCT04172714) evaluating the efficacy of low/scout activity of resin-based Y90 for treatment planning. Each patient underwent mapping with 15 mCi of Y90 and Y90-PET/CT. Partition model was used with the goal of tumor dose (TD) >200 Gy and non-tumoral liver dose <70 Gy for non-segmental therapies. Single compartment dose of 200 Gy was used for segmentectomies. Prescribed Y90 activity minus scout activity was administered for therapeutic Y90 followed by Y90-PET/CT. Sureplan® (MIM Software, Cleveland, OH) was used for dosimetry analysis. Treatment response was evaluated by modified response evaluation criteria for solid tumors at 3-month post Y90. Receiver operating characteristic curve was used to determine cumulative (scout & therapeutic) TD response threshold for objective (OR) and complete response (CR).

Results: N=30 patients with 33 tumors were treated (mean tumor volume:44.9 cc; 19 segmental and 14 non-segmental). One patient died before follow-up imaging and was excluded from this analysis. Overall, 26(81%) of tumors had OR and 23(72%) had CR. Mean TD of 243 Gy predicted OR with 96% sensitivity and 85% specificity (area under the curve (AUC):0.987). Mean TD of 262 Gy predicted CR with 96% sensitivity and 89% specificity (AUC:0.845).

Conclusion: In patients with HCC undergoing resin-based Y90, mean TD of 262 Gy predicts complete imaging response with high degree of sensitivity and specificity.

902.3

Technical considerations, tolerability and safety and of Irinotecan-eluting transarterial chemoembolization in 152 CRLM patients

Lucatelli P¹, **Helmlinger T²**, Iezzi R³, Zeka B⁴, Kaufmann N⁴, Taieb J⁵, Pereira P⁶

¹Vascular and Interventional Radiology Unit, Department of Diagnostic Service, Sapienza University of Rome, Rome, Italy,

²Institut für Radiologie, Neuroradiologie und minimal-invasive Therapie, München Klinik Bogenhausen, Munich, Germany,

³Dipartimento di Diagnostica per Immagini, Radioterapia Oncologica ed Ematologia, UOC di Radiologia Diagnostica ed Interventistica Generale, Fondazione Policlinico Universitario „A. Gemelli“ IRCCS, Rome, Italy, ⁴Clinical Research Department, Cardiovascular and Interventional Radiological Society of Europe, Vienna, Austria, ⁵Assistance Publique Hôpitaux de Paris, Service d'hépatogastroentérologie et d'oncologie digestive, Hôpital Européen Georges Pompidou, Université Paris Descartes, Sorbonne Paris-Cité, Paris, France, ⁶Zentrum für Radiologie, Minimal-Invasive Therapien und Nuklearmedizin, SLK-Kliniken Heilbronn GmbH, Heilbronn, Germany

Purpose: Using data from the Clrse REgistry for LifePearl microspheres (CIREL), a prospective, Europe-wide, observational study on irinotecan-eluting transarterial chemoembolization (TACE) for unresectable colorectal cancer liver metastases, the completeness of dose-delivery and completion of the treatment cycles were assessed in terms of technical considerations, feasibility and tolerability of treatments.

Material and methods: 152 eligible patients (≥18 years) with liver- only or -dominant disease treated with irinotecan-eluting TACE following an MDT board decision were enrolled. Data was prospectively collected for baseline characteristics, planned and performed number of sessions, technical details of each session and safety according to CTCAE 4.03.

Results: The number of planned sessions was 1 or 2 (uni-lobar treatment) or 4 (bi-lobar treatment) and 121 patients (79%) completed all planned sessions. 41 and 19 patients, respectively, had received systemic therapy or ablation within 30 days after TACE. 99% of sessions were considered technically successful due to complete delivery of the dose (60%), complete stasis (17%) or both (21%). 60% of sessions were performed using opioids, 4% using intra-arterial anaesthetics and 25% both. 60% of patients experienced at least 1 peri-interventional adverse event (AE); 8% of grade 3-4. More peri-interventional AEs were seen for larger liver-involvement (p=0.001), bi-lobar disease (p=0.01) and larger beads (p<0.001). Using corticosteroids together with antiemetics showed reduced and lower grade vomiting (p=0.01).

Conclusion: Irinotecan-TACE treatment within the CIREL registry is a well-tolerated treatment with a high proportion of completed treatment cycles and successfully performed sessions that can be used together with concomitant systemic therapy or ablation.

902.4

CPAP versus shamCPAP for radiofrequency ablation of primary and metastatic lung cancer under procedural sedation and analgesia: a prospective, randomized, controlled trial

Páez-Carpio A¹, Vollmer I¹, Torres M², Gomez Muñoz F¹, Casanovas G³, Tercero J⁴, Valero R⁴, Sánchez M¹, Carrero E⁴

¹Department of Radiology, CDI. Hospital Clínic Barcelona, Barcelona, Spain, ²Sleep Unit, Pneumology Service, Hospital Clínic Barcelona, Barcelona, Spain, ³Medical Statistics Core Facility, IDIBAPS, Hospital Clínic Barcelona, Barcelona, Spain, ⁴Department of Anesthesiology, Hospital Clínic Barcelona, Barcelona, Spain

Purpose: To evaluate the safety and efficacy of positive airway pressure (CPAP) for radiofrequency ablation (RFA) of malignant lung tumors under procedural analgesia (PSA).

Materials and methods: This is a prospective, randomized, controlled trial developed at a single tertiary center. Patients were randomly assigned to receive either CPAP-4cmH₂O (CPAP+4) or ShamCPAP as part of the PSA during RFA of lung malignancies. Primary endpoints were the number of subjects reporting at least one adverse event (AE) or severe AE (SAE), hospital stay, and the number of readmissions. Secondary endpoints were the effects of the intervention on respiratory parameters and post-RFA imaging findings.

Results: Of 46 patients randomized (intention-to-treat population, [ITT]) between November 2014 and February 2018, 22 received CPAP+4 during PSA, and 24 received ShamCPAP. Thirty-seven (CPAP+4=17; ShamCPAP=20) adhered to the protocol (per-protocol population, [PP]). All patients presented at least one AE. The risk of AE on the ward post-RFA was 4-fold in the CPAP+4 group (ITT: 4.250 [CI95%:1.234-14.637], p=0.021; PP: 4.457 [CI95%:1.110-17.899], p=0.035), with a higher incidence of pneumothorax (ITT 22.7%vs0%, p=0.019; PP 29.4%vs0%, p=0.014). Patients in the CPAP+4 group had also more SAE (ITT: 22.7%vs4.2%, p=0.093; PP: 23.5%vs0%, p=0.036). Additional therapy after procedure or prolonged hospital stay was also higher in the CPAP+4 group (ITT: 18.2%vs4.2%, p=0.152; PP: 23.5%vs0%, p=0.036). No patients were readmitted. No differences were found in respiratory parameters or post-RFA imaging findings.

Conclusion: CPAP is not safe for RFA of lung cancer under PSA and does not influence patient oxygenation or post-RFA imaging findings.

902.5

Interim results of the COLLISION trial

Puijk R¹, Dijkstra M¹, Nieuwenhuizen S¹, Lissenberg-Witte B², Ruars A¹, Vroomen L¹, Schouten E¹, Versteeg K³, Swijnenburg RJ⁴, de Vries J¹, Zonderhuis B⁴, Kazemier G⁴, Coupe V², Scheffer H¹, van den Tol P⁵, **Meijerink M¹**, COLLISION Trial Group

¹Amsterdam UMC (location VUmc), Department of Radiology, Amsterdam, Netherlands, ²Amsterdam UMC (location VUmc), Department of Epidemiology, Amsterdam, Netherlands,

³Amsterdam UMC (location VUmc), Department of Medical Oncology, Amsterdam, Netherlands, ⁴Amsterdam UMC (location VUmc), Department of Surgery, Amsterdam, Netherlands,

⁵Leeuwarden Medisch Centrum, Department of Surgery, Leeuwarden, Netherlands

Introduction: The current standard to treat resectable colorectal liver metastases (CRLM) is surgical resection. Guidelines reserve thermal ablation for anatomically unresectable metastases and for patients whose comorbidities disqualify them as surgical candidates. Given a presumed superior safety profile, comparable local control and competitive survival outcome, thermal ablation and surgical resection have reached equipoise for small-size resectable CRLM. Here, we report the preplanned interim analysis (n = 200 randomized patients) of a study that aims to demonstrate non-inferiority of thermal ablation compared to surgical resection in patients with small-size resectable CRLM (≤3 cm).

Methods: In the phase 3, randomized, controlled COLLISION trial (ClinicalTrials.gov, NCT03088150), patients aged 18 years and older with previously untreated CRLM were recruited from 11 hospitals in 2 countries. Patients with 1-10 CRLM (≤3 cm), no extrahepatic metastases and an ECOG status 0-2 were stratified into low-, intermediate-, and high-disease burden subgroups and randomly assigned (1:1) to undergo surgical resection (control arm) or thermal ablation. The primary endpoint of this interim analysis was overall survival (OS) according to an intention-to-treat analysis; secondary endpoints were adverse events, local tumor progression-free survival (LTPFS), local control (LC) allowing repeat treatments, distant progression-free survival (DPFS), complications and length of hospital stay. Study continuation was considered futile if the conditional probability was <20%.

Results: Surgical resection was associated with a higher in-hospital mortality and a higher number of low- and high-grade adverse events (p = 0.010). Length of hospital stay was shorter for thermal ablation (median stay 5 days for resection and 2 days for ablation; p = < 0.001). No differences were found with regard to LTPFS (HR 1.470; 95% CI, 0.629-3.435; p = 0.374), DPFS (HR 1.261; 95% CI, 0.880-1.809; p = 0.207) and OS (HR 0.925; 95% CI, 0.462-1.853; p = 0.827). Local control was superior following thermal ablation (HR 0.105; 95% CI, 0.013-0.857; p = 0.010). With a conditional probability of 88.3% to prove non-inferiority, the futility threshold was amply exceeded.

Conclusion: Compared to partial hepatectomy, thermal ablation was associated with a superior safety profile, shorter length of hospital stay and higher local control rate. Futility to eventually prove non-inferiority was rejected, the trial will continue accrual. A new interim analysis with efficacy boundaries is planned one year after having randomized half of the initial sample-size (n = 309).

Scientific Paper Session 2

1801.1

A preclinical endogenous rat HCC model system for the prospective evaluation of imaging-derived biomarkers in interventional tumor therapy

Bohrer P¹, Werner J¹, Harder F¹, **Lohöfer F¹**, Steiger K¹, Paprottka P¹, Braren R¹, Kronenberg K², Karst U²

¹Klinikum Rechts Der Isar, TU München Institut für diagnostische und interventionelle Radiologie, München, Deutschland,

²WWU Münster, Institut für Anorganische und Analytische Chemie, Münster, Deutschland

Purpose: To establish a preclinical animal model system for catheter-based interventions in hepatocellular carcinoma (HCC).

Material and methods: HCC was induced in rats by oral administration of diethylnitrosamine (DEN) over 10 weeks. Tumor growth was monitored by weekly T2-weighted MRI. When tumors reached a size over 10mm, MRI with DCE-imaging and T1-mapping were performed using a liver-specific contrast agent (Primovist). Digital subtraction angiography (DSA) was then performed through a left common carotid artery approach. A 1.2 French catheter was navigated to the common hepatic artery. DSA was performed with a standardized flow rate. After DSA-imaging, Cis-Platin was injected selectively over the angiographic microcatheter. At the same time Primovist was injected via a tail vein catheter. After 10 minutes, the animals were euthanized and tumors were excised. Tumors were histologically graded and deposition of Platinum and Gadolinium was assessed by Laser Ablation Inductively Coupled Plasma Mass Spectrometry (LA-ICP MS) on tissue slices. Tissue heterogeneity was assessed by histogram analysis.

Results: Contrast dynamic parameters (time to peak, influx/efflux slopes) correlated well between DSA and DCE imaging in HCCs. T1-mapping showed no significant uptake of liver-specific contrast agent in HCC. LA-ICP MS allowed for spatially resolved ex vivo quantification of Gadolinium and Platinum in the hepatic and the tumor tissues. Tumors with lower perfusion showed less uptake of Gadolinium and Platin.

Conclusion: The development of an transarterial chemoembolization model in HCC-bearing DEN rats allows a sensitive quantification of tumor perfusion and chemotherapeutic agent uptake, validated with a spatially resolved, high-accuracy mass spectroscopy method.

1801.2

Predictive value of platelet-to-lymphocyte ratio and systemic immune-inflammation in hepatocellular carcinoma patients receiving transarterial chemoembolization plus PD-1/PD-L1 inhibitors and molecular targeted agents: a study based on multicenter cohort

Chen J¹, Jin Z¹, Zhong B², Zhu H¹, Teng G¹

¹Center of Interventional Radiology and Vascular Surgery, Department of Radiology, Zhongda Hospital, Medical School, Southeast University, Nanjing, China, ²Department of Interventional Radiology, the First Affiliated Hospital of Soochow University, Suzhou, China

Purpose: Inflammation-based scores have good predictive ability in cancer prognosis. Transarterial chemoembolization (TACE) plus programmed death-1 (PD1) or its ligand (PD-L1) inhibitors and molecular targeted therapies has demonstrated promising clinical benefit for hepatocellular carcinoma (HCC). The aim of this retrospective cohort study is to analyze the possible association of neutrophil-to-lymphocyte ratio (NLR), platelet-to-lymphocyte ratio (PLR), prognostic nutritional index (PNI) and systemic immune inflammation index (SII) with clinical outcomes among HCC patients who were treated with TACE plus PD-(L)1 inhibitors and molecular targeted therapies. **Material and methods:** A multicenter retrospective cohort study of 302 patients with intermediate and advanced stage HCC who underwent TACE plus anti-PD-(L)1 and molecular targeted therapies was conducted to explore the prognostic impacts of NLR, PLR, PNI and SII by Kaplan-Meier analysis and the log-rank test. The optimal cutoffs were generated by the X-tile software. Propensity score matching analysis was used to further revalidate the prediction ability for significant inflammatory biomarkers. The common cutoffs were also validated.

Results: PLR and SII showed good prediction ability in progression-free survival (PFS) before and after PSM (all P < 0.05). The PLR was an independent predictor for PFS in multivariable analysis (hazard ratio, 1.46; 95 % confidence interval, 1.06-2.02; P = 0.022). PLR with common cutoff of 150 also showed significant stratification ability for such patients.

Conclusion: PLR and SII are significant prognostic factor for PFS of patients with HCC receiving TACE plus anti-PD-(L)1 and molecular targeted therapies.

1801.3

The changing trends of image guided biopsy of small renal masses before intervention: an analysis of European multinational prospective EuRECA registry

Chan V^{1,2}, Keeley, Jr F³, Lagervald B⁴, King A⁵, Breen D⁵, Nielsen T⁶, van Strijen M⁷, Garnon J⁸, Alcorn D⁹, Graumann O¹⁰, de Kerviler E¹¹, Zondervan P¹², Walkden M¹³, Lughezzani G¹⁴, Wah T¹⁵

¹School of Medicine, Faculty of Medicine and Health, University of Leeds, Leeds, United Kingdom, ²Division of Surgery and Interventional Science, University College London, London, United Kingdom, ³Bristol Urological Institute, North Bristol NHS Trust, Bristol, United Kingdom, ⁴Department of Urology, OLVG, Amsterdam, United Kingdom, ⁵Department of Radiology, Southampton University Hospitals, Southampton, United Kingdom, ⁶Aarhus University Hospital, Department of Urology, Aarhus, Denmark, ⁷Department of Radiology, St Antonius Hospital, Nieuwegein, Netherlands, ⁸Department of Interventional Radiology, Nouvel Hôpital Civil, ¹ place de l'Hôpital 67000 Strasbourg, Strasbourg, France, ⁹Department of Interventional Radiology, Gartnavel General Hospital, Glasgow, United Kingdom, ¹⁰Department of Radiology, Odense University Hospital, Odense, Denmark, ¹¹Radiology Department, Saint-Louis Hospital, AP-HP, ¹, avenue Claude-Vellefaux, 75475 Paris cedex ¹⁰, Paris, France, ¹²Department of Urology, 26066 Amsterdam UMC, University of Amsterdam, Amsterdam, Netherlands, ¹³Department of Imaging, University College London Hospitals NHS Foundation Trust, London, United Kingdom, ¹⁴Vita-Salute San Raffaele University, Department of Urology, Milan, Italy, ¹⁵Department of Diagnostic and Interventional Radiology, Institute of Oncology, Leeds Teaching Hospitals Trust, St. James's University Hospital, Leeds, United Kingdom

Purpose: Evaluate the use of pre-cryoablation biopsy for small renal masses (SRMs) and the effects of increasing up take on histological results of treated SMRs.

Material and Methods: From 2015 to 2019, patients with sporadic T1N0M0 SRMs undergoing percutaneous, laparoscopic or open cryoablation from 14 European institutions within the European Registry For Renal Cryoablation (EuRECA) were included for the retrospective analysis. Univariate and multivariate logistic models was used to evaluate the trends, histological results and the factors influencing use of pre-cryoablation biopsy.

Results: 871 patients (Median [IQR] age, 69[14], 298 women) undergoing cryoablation were evaluated. The use of pre-cryoablation biopsy has significantly increased from 42%(65/156) in 2015 to 72%(88/122) in 2019 (p<0.001). Patients treated for a benign histology are significantly more likely to have presented later in the trend, where pre-cryoablation biopsy is more prevalent (OR: 0.64, 95% CI 0.51-0.81, p<0.001). Patients treated for undiagnosed histology are also significantly less likely to have presented in 2018 compared to 2016 (OR 0.31, 95% CI 0.10-0.97, p=0.044). Patients aged 70+ are less likely to be biopsies pre-cryoablation (p<0.05). R.E.N.A.L. nephrometry score of 10+ and a Charlson Comorbidity Index >1 are factors associated with lower likelihood to not have received a pre-cryoablation biopsy (p<0.05).

Conclusion: An increased use of pre-cryoablation biopsy was observed and cryoablation patients treated with a benign histology is more likely to have presented in periods where pre-cryoablation biopsy is not as prevalent. Comparative studies are needed to draw definitive conclusions on the effect of pre-cryoablation biopsy on SRM treatments.

1801.4

Long-term pain and functional outcomes of percutaneous AORIF (ablation-balloon osteoplasty-PMMA cement reinforcement-cannulated screw internal fixation) for periacetabular osteolytic metastases: a prospective cohort study

Lee F¹

¹Yale University, New Haven, United States of America

Purpose: To determine long-term pain and ambulatory functional outcomes following AORIF for massive metastatic osteolytic defects or pathological fractures around the acetabulum in a prospective cohort.

Material and methods: Pain and ambulatory functional outcomes of 48 patients who underwent percutaneous AORIF procedures were followed up to 3 years in this prospective cohort study. Pain & Ambulatory Functional Scores (Range: 1 Bed ridden with severe pain – 10 Normal walking/run without pain) were recorded before and after AORIF. Complications such as infection, bleeding requiring transfusion, readmissions within 30 days, failed reconstruction, conversion hip arthroplasties, and re-admissions were recorded. Bone density around the AORIF site was followed on radiographs and CT scans. AORIF uses cannulated screws as a universal portal for percutaneous RFA, balloon osteoplasty, and cement delivery. PMMA bone cement was mixed with zoledronate (0.8mg zoledronate/20 cc Cement) as a local adjuvant bone-enhancing drug.

Results: 20 out of 23 non-ambulatory patients became ambulatory after AORIF. 25 ambulatory patients remained ambulatory with less pain during survival. There were no complications related to AORIF. Outpatients were discharged home after AORIF, and inpatients returned to medical oncology floor. Two patients with comminuted acetabular fractures underwent hemiarthroplasty instead of total hip arthroplasty using megaprotheses at 5 months and 18 months after AORIF and life-saving oncologic drug therapies. Longer-term survivor showed improved bone mass or lack of osteolytic progression around the AORIF site.

Conclusion: AORIF is beneficial for longer-term survivors with periacetabular metastases with respect to local cancer control, bone integrity, pain, and ambulatory function.

1801.5

Transarterial chemoembolization plus Camrelizumab and Apatinib for hepatocellular carcinoma: a multicenter, retrospective, cohort study

Jin Z¹, Zhong B², Chen J¹, Zhu H¹, Teng G¹

¹Zhongda Hospital, Southeast University, Nanjing, China,

²Department of Interventional Radiology, The First Affiliated Hospital of Soochow University, Suzhou, China

Purpose: This study aimed to investigate the efficacy and safety of transarterial chemoembolization (TACE) plus camrelizumab (a humanized PD-1 monoclonal antibody) and apatinib (a small-molecule tyrosine kinase inhibitor) for patients with intermediate and advanced HCC.

Material and methods: This multicenter, retrospective, cohort study included HCC patients receiving either TACE plus camrelizumab and apatinib (combination group) or TACE monotherapy (monotherapy group) between January 2018 and May 2021. Propensity score matching analysis was used to match patients for several clinical prognostic factors. The primary outcome was progression-free survival (PFS). The secondary outcomes included objective response rate (ORR), overall survival (OS), and safety.

Results: A total of 534 patients with HCC were included from 59 academic hospitals in China, 84 of whom received TACE plus camrelizumab and apatinib in the combination group and 450 of whom received TACE alone in the monotherapy group. In the propensity-score matched cohorts (68 pairs), the median PFS and ORR in the combination group were significantly higher than those in the monotherapy group (PFS 13.7 months vs. 7.0 months, respectively; $p=0.046$; ORR 55.9% vs. 36.8%, respectively; $p=0.039$). At multivariable analysis, combination treatment was an independent factor for PFS (adjusted HR, 0.59; 95% CI, 0.37-0.94; $p=0.026$). There was no statistical difference in OS between the two groups. Grade 3 or 4 adverse events occurred in 17.6% and 2.9% of patients in the combination and monotherapy groups, respectively.

Conclusion: TACE plus camrelizumab and apatinib showed significantly better PFS and ORR versus TACE monotherapy for HCC with acceptable safety profile.

1801.6

Safety and efficacy of chemosaturation with percutaneous hepatic perfusion of Melphalan for metastatic uveal melanoma: an 8-year retrospective study of 250 interventions in 81 patients

Vigneswaran G^{1,2}, Gibson T², Patel S², Wheeler M³, Karydis I³, Gupta S⁴, Stedman B², Modi S²

¹Cancer Sciences, University of Southampton, Southampton, United Kingdom, ²Department of Interventional Radiology, University Hospital Southampton, Southampton, United Kingdom,

³Department of Oncology, University Hospital Southampton, Southampton, United Kingdom, ⁴Department of Anaesthesia, University Hospital Southampton, Southampton, United Kingdom

Purpose: Metastatic uveal melanoma is a devastating disease associated with a poor prognosis (10-25% at 1 year). Prior

studies of melphalan percutaneous hepatic perfusion (M-PHP) have shown promise in metastatic UM (mUM) patients with liver predominant disease but are limited by small sample sizes. We contribute our single centre findings on the safety and efficacy of M-PHP in the largest sample population to date.

Materials and methods: Retrospective analysis of outcome and safety data for all mUM patients receiving M-PHP at our institutions. Tumour response and treatment toxicity were evaluated using RECIST 1.1 and Common Terminology Criteria for Adverse Events (CTCAE) v5.03, respectively. Kaplan–Meier estimations were used to assess overall and progression-free survival with log-rank test and Cox-proportional regression to assess predictors of survival.

Results: 250 M-PHP procedures were performed in 81 patients (median- 3/patient). We demonstrated a hepatic disease control rate of 88.9% (72/81), hepatic response rate of 66.7% (54/81), and overall response rate of 60.5% (49/81).

At median follow-up of 12.9 months, median progression-free (PFS) and median overall survival (OS) were 8.4 months and 14.9 months, respectively. There were no fatal treatment-related adverse events (TRAE). Forty-three grade 3 or 4 TRAE occurred in 23 (28.4%) patients with a significant reduction in events between procedures performed in 2016-20 vs 2012-16 (0.17 per patient vs 0.90 per patient, $p<0.001$).

Conclusion: M-PHP provides excellent response rates and PFS compared with other treatments. With a decreasing side effect profile, combination therapy with systemic agents may be viable to further advance OS.

1801.7

Cryoablation of low risk breast cancers: an update of the ICE3 trial

Tomkovich K¹, Sevrakov A², Fine R³, Boolbol S⁴, Hicks R⁵

¹CentraState Medical Center / Princeton Radiology, Freehold, NJ, United States of America, ²Thomas Jefferson University, Philadelphia, United States, ³West Cancer Center & Research Institute, Germantown, United States, ⁴Dyson Breast Center, Poughkeepsie, United States, ⁵Regional Medical Imaging, Flint, United States

Purpose: The ICE3 trial is the first multi-center trial in the world to evaluate ultrasound guided cryoablation as a primary treatment for breast cancer.

Materials and methods: This HIPPA compliant IRB approved trial enrolled women ages 50 and older with unifocal ultrasound visible biopsy proven invasive ductal carcinoma at 19 sites throughout the United States. Patients were clinically lymph node negative with low grade ER+/PR+ or ER+/PR- and HER2- breast cancer measuring 1.5cm or less. All patients underwent ultrasound guided cryoablation freeze, thaw, and second freeze cycles of approximately 8 minutes each using the ProSense™ system (IceCure Medical) with the goal of a 10mm visible margin of ice around the tumor. All patients were offered hormone therapy, chemotherapy, and radiation therapy following ablation as per current guidelines. All patients were followed for signs of recurrence with mammography at 6 and 12 months and then annually for 5 years post ablation.

Results: 194 patients ages 55-94 were enrolled beginning in October 2014. Tumor sizes ranged from 3mm to 15mm. There was 100% procedural success and no serious adverse events were reported. 131 patients have completed at least 3 years follow up. 62 patients have completed 5 years follow up. There has been no clinical or imaging recurrence in 190/194 patients for an overall success rate of 98%.

Conclusion: Cryoablation for breast cancer is feasible and safe with a 100% procedural success rate and a clinical success rate of 98% consistent with expected recurrence rates following surgical lumpectomy.

1801.8

A comparative study of effectiveness and safety of percutaneous cryoablation and microwave ablation of renal cell carcinoma

Villalobos A¹, Dabbous H, Loya M, Majdalany B, Kocharyan H, Cristecu M, Lilly M, Bercu Z, Kokabi N

¹Emory University Hospital, Atlanta, United States of America

Purpose: To evaluate differences in safety and efficacy between percutaneous cryoablation (CRA) and microwave ablation (MWA) of renal cell carcinoma (RCC).

Materials and methods: Consecutive RCC patients treated with CRA and MWA at our single-institution between 2013-2016 were retrospectively included. Baseline characteristics (age, gender, race, BMI, tumor size, RENAL-nephrometry score) were evaluated. Peri- and post-procedural variables (number of probes, total CT-dose, procedural time, incidence of hematoma, critical-structure involvement, post-op hospitalization, Clavien-Dindo Class ≥ 1 , and complete-response) were also evaluated. Overall-survival from initial treatment was calculated using Kaplan-Meier estimation and compared using log-rank analysis. Variable differences were assessed with chi-square and student's t-test using JMP statistical software.

Results: 128 patients were evaluated (95 CRA; 33 MWA). Overall cohort was 56% male with mean age of 68 years. No statistically significant differences in baseline characteristics were noted (age, gender, race, BMI, tumor size, RENAL nephrometry score). Compared to MWA, CRA was associated with a greater number of probe utilization (2.4 ± 1.3 vs 1.5 ± 0.8 probes; $p < 0.001$) and longer procedural time (99 ± 39 vs 81 ± 37 min; $p = 0.02$). No differences in other peri- or post-procedural variables were noted (total CT-dose (2.9 ± 2.2 vs 2.6 ± 1.3 Gy*cm; $p = 0.3$), hematoma incidence (33% vs 24%; $p = 0.3$), critical structure involvement (14% vs 3.0%; $p = 0.06$), post-op hospitalization (24% vs 15%; $p = 0.3$), Clavien-Dindo Class ≥ 1 (24% vs 15%; $p = 0.3$), complete-response (82% vs 73%; $p = 0.3$), and overall-survival (3.8 vs 3.9 yrs; $p = 0.8$).

Conclusion: For patients with RCC, percutaneous CRA and MWA offer similar effectiveness and safety profiles despite CRA being associated with more ablation probes and longer procedural time.

1801.9

Y-90 radioembolization increases response rates in hepatocellular carcinoma patients receiving sorafenib

Öcal O¹, Schütte K², Sangro B³, Malfertheiner P⁴, Ricke J¹, Seidensticker M¹

¹Ludwig-Maximilians-University Munich, Department of Radiology, Munich, Germany, ²Niels-Stensen-Kliniken Marienhospital, Department of Internal Medicine and Gastroenterology, Osnabrück, Germany, ³Clínica Universidad de Navarra and CIBEREHD, Liver Unit, Pamplona, Spain, ⁴Ludwig-Maximilians-University Munich, Department of Medicine II, Munich, Germany

Purpose: This post-hoc analysis aimed to compare response rates and progression-free survival (PFS) in advanced hepatocellular carcinoma (HCC) patients who were treated with sorafenib alone or combined with radioembolization (RE).

Materials and methods: Follow-up images of the patients treated within a multicenter phase II trial (SORAMIC) were assessed according to mRECIST. A total of 177 patients (73 combination arm [sorafenib treatment followed by RE] and 104 sorafenib arm) were included in this study. Response and progression characteristics were compared between treatment arms. PFS and post-progression survival between treatment arms were compared using Kaplan-Meier survival analyses. Multivariate Cox proportional hazards models were used to identify factors influencing PFS in patients with HCC.

Results: The combination arm had a higher disease control rate (79.2% vs. 72.1%, $p = 0.075$), significantly higher objective response rate (61.6% vs. 29.8%, $p < 0.001$) and complete response rate (13.7% vs. 3.8%, $p = 0.022$). Progression was more common in the sorafenib arm (75% vs. 52.0%, $p = 0.001$). PFS (median 8.9 vs. 5.4 months, $p = 0.022$) and hepatic PFS were significantly longer in the combination arm (9.0 vs. 5.7 months, $p = 0.014$). The treatment arm was significantly associated with PFS in the multivariable analysis.

Conclusion: In advanced HCC patients receiving sorafenib, the addition of RE improves tumor control compared to sorafenib monotherapy. With better patient selection and superselective therapies, RE could be used to improve outcomes in patients with advanced HCC.

Posters

Kidney

1801.10

Accuracy of a novel hands-free robotic system for CT-guided needle insertion in percutaneous procedures is not affected by the frequency and magnitude of iterative corrections during needle advancement

Witkowska A¹, Shochat M², Bradbury D², Goldberg SN³, Grubbs G⁴, Flacke S¹

¹Lahey Hospital & Medical Center, Burlington, United States, ²XACT Robotics, Caesarea, Israel, ³Hadassah Medical Centre, Jerusalem, Israel, ⁴Sarasota Interventional Radiology, Sarasota, USA

Purpose: To assess spatial trajectory correction using a novel robotic system for CT-guided needle insertion.

Materials and methods: Combined analysis of two prospective, multi-center studies. The hands-free, CT-guided robotic system supports planning a three-dimensional path to target and iterative correction at selected checkpoints along the insertion path where the robot responds to target adjustments by deviating from a primarily linear trajectory according to the operators input.

Altogether, 80 clinically indicated procedures were included. CT-datasets were obtained for planning and needle insertion of 17-19g needles using the patient-mounted robotic system. Planning included target selection, skin entry point, and checkpoints. Success rate, needle tip to target distance, checkpoints and trajectory corrections were recorded.

Results: Study population consisted of 37 men and 43 women (68±13 years). 10% of lesions were smaller than 1cm. Skin to target distance was larger than 8cm in 40 procedures. In 72/80 procedures (90%) the robot positioned the needle successfully on target in a single insertion pass. Overall accuracy (needle tip to target distance) was 1.65±1.35mm (range 0.05-7.20mm).

Target adjustments were required in 43 procedures (53.8%) with the highest frequency in lung biopsies (15/20, 75%). Target corrections varied from 3-24mm. Accuracy after correction did not differ from patients where a linear trajectory could be used.

Conclusion: A hands-free robotic system allows accurate placement of trocar needles within 2mm of target location. Movement of the target during needle insertion can be corrected by the robot on the fly allowing for a single insertion pass without compromise in accuracy.

P-1

Prognostic value of neutrophil to lymphocyte ratio (NLR) and platelet to lymphocyte ratio (PLR) for small renal cell carcinomas (RCC) after image-guided cryoablation or radio-frequency ablation (RFA)

Asif A^{1,2}, Osman F³, Koe J³, Ng A⁴, Cartledge J⁵, Kimuli M⁵, Vasudev N⁵, Ralph C⁵, Jagdev S⁵, Bhattarai S⁵, Smith J⁵, Lenton J⁵, Chan V^{2,3}, Wah T⁵

¹Leicester Medical School, University of Leicester, Leicester, Leicester, United Kingdom, ²Division of Surgery and Interventional Science, University College London, London, United Kingdom, ³School of Medicine, Faculty of Medicine and Health, University of Leeds, Leeds, United Kingdom, ⁴UCL Medical School, University College London, London, United Kingdom, ⁵St.James's University Hospital, Leeds, United Kingdom

Purpose: The first study investigating the relationship between NLR or PLR and outcomes of percutaneous cryoablation or RFA for small RCCs with long-term outcomes.

Material and methods: Patients undergoing cryoablation or RFA for small RCCs(<7cm) from 2003-2016 at a regional centre for RCC were included. Optimal cut-offs for NLR/PLR were determined using the ROC curve and AUC using the Youden method. Outcomes were compared using Cox or logistic regression.

Results: 203 patients (Cryoablation:103, RFA:100) were included. Median follow-up was 75 months and 98 months, respectively.

Using the Youden method, high post-operative NLR values were associated with worsened local recurrence-free survival (LRFS)(NLR >5.38; HR: 5.13, p=0.037) and worsened Overall Survival (OS)(NLR >6.42; HR: 3.40, p<0.001) in all patients. High post-operative PLR values were associated with worsened OS in all patients (PLR >192; HR: 2.31, p=0.006) and RFA patients alone (n=100; PLR >260; HR: 8.27, p<0.001).

Using continuous Cox regression model, greater changes in peri-operative NLR were associated with worsened LRFS in cryoablation alone and all patients (Continuous; HR: 1.09, p=0.028). Higher post-operative NLR was also associated with worsened LRFS in cryoablation patients alone (HR: 1.10, p=0.046). Post-operative NLR (HR:1.17, p=0.002), change in peri-operative NLR (HR:1.19, p=0.001), and change in peri-operative PLR (HR:1.20, p=0.009) were all associated with worsened CSS in all patients. Pre-operative PLR and NLR were not associated with complications and change in renal function.

Conclusion: NLR and PLR are valuable prognostic factors for this group of patients and should be used to guide subsequent follow-up and monitoring of recurrence.

P-2

MRI at day 1 after renal cryoablation as tool to measure ablation margins and predict recurrences

Taïeb S, Pachev A, Assouline J, Desgrandchamps F, Masson Lecomte A, **de Kerviler E**¹
¹*Saint-Louis Hospital, Paris, France*

Purpose: Ablation margins represent a major predicting factor in ablation success. However, intraprocedural determination of margins is often challenging. The aim of this study is to compare the minimum ablation margins measured on intraoperative CT and on MRI performed at D1 after cryoablation for RCC, and their ability to predict local recurrence.

Materials and methods: In this single-center retrospective study, we included 105 consecutive patients with RCCs treated using CT-guided cryoablation. We compared the minimal ablation margins measured in the three planes intraoperatively on CT images and on MRI at D1 post-cryotherapy, blindly to patients' outcome.

Results: The mean minimum ablation margins measured on CT and MRI were 3.6 ± 2.2 and 3.5 ± 2.4 mm, respectively. The local recurrence rate was 7% with a median follow-up of 36 months. The minimum margin measured on MRI D1 was 0.6 mm in patients with recurrence and 3 mm in patients without recurrence. This difference was statistically significant ($p = 0.0002$). The mean minimum margin measured intraoperatively on CT was 2.3 mm in patients with recurrences and 3.7 mm in patients without recurrence. This difference was slightly above the significance level ($p = 0.0503$). All recurrences occurred on the endophytic tumor side. For these patients the minimal margin was endophytic in $N = 7/7$ on MRI and $N = 2/7$ on CT.

Conclusion: The measurement of the minimal ablation margins on MRI at D1 outperformed intraoperative CT scan in predicting local recurrence and its location in our cohort. Intraoperative CT suffers from poor tumor conspicuity inside the ice ball and needle artifacts.

P-3

Cone beam computed tomography image fusion in renal tumour ablation: preliminary data

Ierardi A¹, **Folco G**², Carnevale A³, Stellato E², De Lorenzis E⁴, Giganti M³, Biondetti P¹, Montanari E^{4,5}, Carrafiello G^{1,6}
¹*Radiology Unit, Fondazione IRCCS Ca' Granda Ospedale Maggiore Policlinico, Milan, Italy,* ²*Postgraduate School of Radiodiagnostics, Università degli Studi di Milano, Milan, Italy,* ³*Radiology Unit, Department of Translational Medicine, University of Ferrara, Ferrara, Italy,* ⁴*Urology Unit, Fondazione IRCCS Ca' Granda Ospedale Maggiore Policlinico, Milan, Italy,* ⁵*Department of Clinical Sciences and Community Health, Università degli Studi di Milano, Milan, Italy,* ⁶*Department of Health Sciences, Università degli Studi di Milano, Milan, Italy*

Purpose: to assess the value of image fusion applied to intraoperative cone beam (CB)CT and preprocedural contrast-enhanced CT or MR, as employed for the guidance of percutaneous microwave ablation (MWA) of renal neoplasms.

Material and methods: 15 patients (8 males, 7 females, mean age 65.3 ± 6.6 years, mean lesion size 20.4 ± 5.5 mm) underwent percutaneous MWA for renal tumor ablation. All procedures were performed in a dedicated angiography room; CBCT ablation planning included multimodality image fusion. Pre-operative contrast-enhanced CT was available in 12 patients and MRI in the remainder. All patients were considered inoperable due to comorbidities or advanced age. Exclusion criteria were: tumors visible at unenhanced CBCT, metastatic disease, uncorrected coagulopathy. Technical success (antenna deployment within target lesion at image fusion) and technical effectiveness (absence of residual tumor at 1-month follow-up) were calculated. Procedural time, complications and relapses were registered.

Results: MWA under CBCT-guidance with fusion technique was technically successful in 14 out of 15 cases (93%). Mean procedural time was 49.7 ± 8.8 min. No procedure-related complications were reported. No enhancing tissue was seen at ablation site at 1-month follow-up. All 15 cases were relapse-free at their last follow-up (mean follow-up time of 13 ± 4.2 months); no cancer-specific deaths were registered.

Conclusion: CBCT-CT/MR image fusion is technically feasible and seems effective in achieving correct targeting and complete ablation of renal lesions. This approach bears the potential to overcome most of the limitations of unenhanced CBCT guidance alone; larger series are needed to validate this technique.

P-4

Quadratus lumborum block for procedural and post-procedural analgesia during renal cell carcinoma percutaneous cryoablation

Fouladirad S¹, Homayoon B^{1,2,3,4}, Lourenco P^{1,2,3,4}
¹*Faculty of Medicine, University Of British Columbia, Vancouver, Canada,* ²*Surrey Memorial Hospital, Surrey, Canada,* ³*Jim Pattison Outpatient Care and Surgery Centre, Surrey, Canada,* ⁴*Department of Radiology, University of British Columbia, Vancouver, Canada*

Purpose: To assess the efficacy of the Quadratus Lumborum block (QLB) in the management of procedural and peri-procedural pain associated with small renal mass cryoablation. This is the first study to our knowledge that examines the use of QLB for pain management during percutaneous cryoablation of renal cell carcinoma.

Materials and Methods: A single-center retrospective review was done between October 2020 to October 2021 for patients that underwent cryoablation for renal cell carcinoma with quadratus lumborum block. The primary study endpoint included total dose of procedural conscious sedation and administered, and post-procedural analgesia.

Results: Technical success of the cryoablation was achieved across all cases. No patients required additional analgesic either during or after the procedure. No complications resulted from the use of the quadratus lumborum block.

Conclusion: The QL block appears to be an effective loco-regional block for the management of procedural and peri-procedural pain associated renal mass cryoablation. Larger studies are required to validate our findings.

P-5

Renal angiomyolipoma cases with the GPX embolic device

Holden A¹, Krauss M², Buckley B¹, O'Hara R³, Phillips C⁴, Jones J⁴
¹Auckland City Hospital, Auckland, New Zealand, ²Christchurch Hospital, Christchurch, New Zealand, ³University of Utah, Salt Lake City, USA, ⁴Fluidx Medical Technology, Salt Lake City, USA

Purpose: Embolization is an important tool in managing complications related to renal angiomyolipomas (AMLs) while preserving renal function. AMLs typically involve a bed of tortuous, distally tapering vessels. Based on these features, many AMLs meet the inclusion criteria for an ongoing clinical study examining the use of the GPX Embolic Device (a novel liquid embolic) in peripheral embolization, and several AML cases have been performed thus far.

Materials and methods: This is a single-arm, multi-center, open label, non-randomized, prospective, first in human (FIH) feasibility study evaluating the use of the GPX Embolic Device in the peripheral vasculature. Enrollment consists of twenty subjects with clinical needs appropriate for peripheral embolization, including AMLs. Technical success (including imaging follow-up, if available), freedom from adverse events, and handling/performance characteristics are being assessed.

Results: Five AML cases have been performed with the GPX Embolic System. In these cases, GPX exhibited excellent distal penetration and casting of the vasculature in addition to good visibility during and after delivery. Target regions were fully occluded at the first angiogram (taken immediately after delivery), and the procedures were considered technical successes. The GPX Embolic System also offered excellent control, allowing operators to fully occlude their targets while preserving parenchyma. Patients were all discharged within the expected timeframe (next day) and exhibited typical post-embolization symptoms with no device related adverse events.

Conclusion: To date, AML embolizations with the GPX Embolic Device have delivered positive results, with these cases meeting all desired clinical endpoints. A larger pivotal study is planned.

P-6

Efficacy and safety of combined embolization and radiofrequency ablation in stage 1 renal cell carcinomas

Mahnken A¹, König A¹, Heers H², Wessendorf J¹
¹Marburg University Hospital, Department of Diagnostic & Interventional Radiology, Marburg, Germany, ²Marburg University Hospital, Department of Urology, Marburg, Germany

Purpose: To retrospectively evaluate outcomes of a combined interventional approach to stage 1 (cT1cN0cM0) renal cell carcinomas (RCCs) by transarterial embolization (TAE) followed by percutaneous CT-guided radiofrequency ablation (RFA) in patients ineligible for surgery.

Materials and methods: 13 patients (9 male, 4 female, 69.6±16.6 y/o) with 14 RCCs (largest diameter: 40.4±6.7 mm, cT1a: 4, cT1b: 10) were treated by RFA a median of one day after TAE in a single center. Indications for minimal-invasive interventional therapy were bilateral RCCs (n=4), RCCs in a

single kidney after nephrectomy (n=3), increased surgical risk due to comorbidities (n=4) and rejection of surgical therapy (n=2). Technical success, effectiveness, safety, ablative margin, cancer-specific survival, overall survival and tumor characteristics were analyzed.

Results: All RCCs were successfully ablated after embolization with a minimum ablative margin of 1.2 mm. Median follow-up was 27 (1-83) months. There was no residual or recurrent tumor in the ablation zone. No patient developed metastasis. Two minor and two major complications occurred. Four patients with severe comorbidities died during follow-up due to causes unrelated to therapy. 1-year and 5-years overall survival was 74.1% each. Cancer-specific survival was 100% after 1 and 5 year. There was no significant decline in mean eGFR directly after therapy (p=0.226), however mean eGFR declined from 62.2±22.0 to 50.0±27.8 ml/min during follow-up (p<0.05).

Conclusion: The combination of TAE and RFA provides an effective minimal-invasive therapy to stage 1 RCCs in patients ineligible for surgery. The outcomes compare favourably with data from surgery.

P-7

Percutaneous IRE in the treatment of complex RCC

Narayanan G^{1,3}, Uzomah U³, Gandhi R^{2,3}, Mahendra A⁴, Pena C^{2,3}, Schiro B^{2,3}, Niekamp A^{2,3}

¹Miami Cancer Institute, Miami, United States, ²Miami Cardiac and Vascular Institute, Baptist Health South Florida, Miami, United States, ³Florida International University Herbert Wertheim College of Medicine, Miami, United States, ⁴Florida Atlantic University Charles E. Schmidt College of Medicine, Boca Raton, United States

Purpose: To evaluate the safety and effectiveness of percutaneous irreversible electroporation (IRE) in the treatment of T1a and T1b renal cell carcinoma (RCC) in complex locations.

Materials and methods: An IRB-approved, single center retrospective review was performed on nine RCC patients (M: F 8:1) who underwent 12 IRE procedures between August 2019 – September 2021. Median age was 78 years (Range 48-92 years) at the time of initial ablation. Eight patients had biopsy proven RCC. Six T1a and 3 T1b tumors were treated. Five were central in location and all within 1cm from vasculature. Three patients underwent repeat IRE and the 3 T1b patients had renal artery embolization followed by IRE within 10 days. Complete response was defined as lack of enhancement, partial response as residual enhancement, and treatment failure as persistent enhancement on follow-up contrast enhanced MR or CT. The median follow-up was 244 days (Range 55-719 days).

Results: Five patients (56%) had a complete response, with an average decrease of 28% in the size of the treated tumor. Four patients (44%) had a partial response of which 3 were T1b lesions. Two are scheduled for repeat treatment, 1 is under observation with a repeat treatment option on hold due to his age and 1 was lost to follow up. All patients tolerated the procedure well without any significant complications.

Conclusion: IRE is a safe and effective alternative in treating central T1a&b RCC near vasculature that may not be amenable to thermal ablation.

P-8

Ten-year outcomes of image-guided ablation and partial nephrectomy for T1 renal cell carcinomas

Chan V^{1,2}, Osman F¹, Cartledge J³, Gregory W⁴, Kimuli M³, Vasudev N³, Ralph C³, Jagdev S³, Bhattarai S³, Smith J³, Lenton J³, Wah T³

¹School of Medicine, Faculty of Medicine and Health, University of Leeds, Leeds, United Kingdom, ²Division of Surgery and Interventional Science, University College London, London, United Kingdom, ³St. James's University Hospital, Leeds, United Kingdom, ⁴Leeds Institute of Clinical Trials Research, University of Leeds, Leeds, United Kingdom

Objective: To compare 10-year outcomes and peri-operative outcomes of IGA and PN.

Material and methods: This is a retrospective cohort study of localised RCC (T1a/bN0M0) patients undergoing cryoablation (CRYO), radio-frequency ablation (RFA) or laparoscopic PN at our institution from 2003 to 2016. Oncological outcomes were compared using Cox regression and log-rank analysis. eGFR changes were compared using Kruskal-Wallis and Wilcoxon-rank tests.

Results: 296 (238 T1a, 58 T1b) patients were identified, 103, 100 and 93 patients underwent CRYO, RFA and PN, respectively. Median follow-up time was 75, 98 and 71 months, respectively. On univariate analysis, all oncological outcomes were comparable amongst CRYO, RFA and PN ($p > 0.05$). On multivariate analysis, T1a patients undergoing RFA had improved local-recurrence-free survival (LRFS) (HR 0.002, 95%CI 0.00-0.11, $p = 0.003$) and metastasis-free survival (HR 0.002, 95%CI 0.00-0.52, $p = 0.029$) compared to PN. In T1a and T1b patients combined, both CRYO (HR 0.07, 95%CI 0.01-0.73, $p = 0.026$) and RFA (HR 0.04, 95%CI 0.03-0.48, $p = 0.011$) had improved LRFS rates. Patients undergoing CRYO and RFA had a significantly smaller median decrease in eGFR post-operatively compared to PN (T1a: $p < 0.001$; T1b: $p = 0.047$). Limitations include retrospective design and limited statistical power.

Conclusions: IGA is potentially as good as PN in oncological durability. IGA preserves kidney function significantly better than PN. More studies with larger sample size should be performed to establish IGA as a first-line treatment alongside PN.

P-9

Safety and efficacy of cryoablation for renal tumors adjacent to the ureter and the pyeloureteral junction

Petsatodis E¹, Giankoulouf C¹, Zlika S¹, Galanis S¹

¹G. Papanikolaou Hospital / Interventional Radiology Department, Thessaloniki, Greece

Purpose: To report our experience of percutaneous cryoablation of renal tumors located less than 10 mm of the ureter or the pyeloureteral junction.

Materials and methods: A total of 15 patients between 2018-2020 were treated with percutaneous cryoablation for T1 (T1a – T1 b) renal tumors adjacent to the ureter and the pyeloureteral junction.

Results: 10 patients were male and 5 female with a mean age of 78 years old. Mean tumor size was 4,3 cm (range 1,3 – 6,8 cm). The ureter was identified as a vulnerable structure in 6 patients, the pyeloureteral junction in 6 and both structures in 3 patients. The mean minimal distance between the vulnerable structure and the tumor was 4 mm. Hydrodissection using warm dextrose 5 % solution was used in all cases with technical success in 14/15 cases. In one case that hydrodissection failed pyeloperfusion was used by percutaneous direct calyx puncture. The mean number of cryoprobes used was 4. Mean follow up was 18 months. In three patients a reintervention was performed due to tumor recurrence. All other patients had no imaging findings of residual disease or tumor progression. No immediate or delayed complications were reported.

Conclusions: Percutaneous renal cryoablation of tumors adjacent to the ureter and the pyeloureteral junction is safe and effective. Hydrodissection is an effective technique in order to protect these vulnerable structures.

P-10

Timing of renal biopsies in image guided renal ablations – Is there a difference in diagnostic yield

Qureshi A¹, Mahay U¹, Jehanzeb Q¹, Karkhanis S¹, McCafferty I¹

¹University Hospitals Birmingham NHS Foundation Trust, Birmingham, United Kingdom

Purpose: To evaluate diagnostic yield of renal mass biopsies performed on the same day of ablation versus prior to the day of the procedure.

Material and methods: Retrospective review of patient histology reports, which underwent ablation for a renal mass between 2012 and 2019, was performed. Patients were divided into biopsy performed on same day as ablation and those performed prior to the ablation. Biopsy results in these groups were subdivided into "diagnostic" for renal mass (malignancy/benign/oncocytoma) and "non-diagnostic".

Results: Sixty-eight histology reports were reviewed; 50 out of 68 patients underwent biopsy prior to the day of ablation, and 18, had a biopsy sample obtained at the time of the ablation.

Only 1 out of the 50 biopsies (2%) performed prior to ablation was non-diagnostic, however, went on to have ablation based on clinical and imaging suspicion. The remainder, 49 out of 50 (98%), were diagnostic for renal mass (1 benign/oncocytoma, 48 malignancy).

Of the 18 patients who had same day biopsies, 2 were non-diagnostic (11%). The remaining 16 (89%) were diagnostic for renal mass (3 benign/oncocytoma, 13 malignancy). The difference between the non-diagnostic yields was not significant however ($p > 0.05$).

Conclusion: Renal mass biopsies, on same day as ablation, have an important role in providing diagnostic samples similar to prior biopsies. This is especially relevant in reducing hospital attendances during a pandemic and in patients who may have to travel large distances to treatment centres. However, patients must be counselled about risks of ablating benign lesions.

P-11

Radiofrequency ablation for small renal cell carcinoma in the solitary kidney

Tomenko K¹, Policarpov A²

¹Sverdlovsk regional oncology dispensary, Ekaterinburg, Russian Federation, ²Russian scientific center for radiology and surgical technologies, St. Petersburg, Russian Federation

Radiofrequency ablation (RFA) of renal tumors is a minimally invasive technology aimed at preserving the functioning kidney parenchyma and reducing the risk of developing renal complications.

Purpose: To evaluate our experience of percutaneous RFA for the treatment of renal cell carcinoma (RCC) in the solitary kidney with respect to renal function and oncological outcome.

Material and methods: From 2008 to 2020, 44 renal tumors were treated with RFA in 42 patients with a solitary kidney. Mean patient age was 67 (46-84) years. Percutaneous approach was used in 40 patients (41 tumors) and intraoperative open approach in 2 patients (3 tumors). Average tumor size was 22 mm (11-26 mm). All patients underwent a biopsy prior to ablation showed renal cell carcinoma.

Results: Technical success was noted in 100% of tumors. There were no major post procedural complications. Also no difference in preoperative and postoperative calculated creatinine clearance was noted ($p = 0.14$). Average follow-up was 38 months (14-65) and showed local tumor progression in 2 patients (4,7%). Both patients were successfully treated with a second RF-ablation without recurrence in follow-up.

Conclusion: When performing RFA, it is possible to achieve long-term local control of the tumor without any adverse effects on kidney function. According to our data, RFA in RCC in a single kidney can be effective and safe alternative treatment to open surgical resection. RFA can be considered as the first-line minimally invasive nephron-sparing procedure for selected patients presenting a small carcinoma nodule.

P-12

Percutaneous approaches for lesions in the upper renal pole or the suprarenal glands

Filippiadis D¹, Spiliopoulos S¹, Palialexis K¹, Grigoriadis S¹, Kelekis A¹, Brountzos E¹, Kelekis A¹

¹University General Hospital „ATTIKON“, National and Kapodistrian University of Athens. Greece, Marousi/Athens, Greece

Learning objectives: To provide a pictorial review of different percutaneous approaches for access of lesions in the upper renal pole and suprarenal glands
To discuss advantages and disadvantages of each specific approach

Background: Based on the RENAL Nephrometry score location of a target lesion in the kidney can be defined among others with respect to the upper and lower renal polar lines which are determined by the renal vascular pedicle. On the other hand for suprarenal glands a direct posterior approach is not always feasible without traversing pulmonary parenchyma.

Clinical findings/procedure details: Different percutaneous approaches for access of lesions in the upper renal pole and suprarenal glands include apart from direct posterior, postero- or anterolateral approaches the indirect ones such as trans-hepatic or trans-pulmonary, angled posterior or posterolateral approaches as well as placing the patient in ipsilateral decubitus position.

Conclusion: Different approaches for lesions in the upper renal pole and suprarenal glands can be performed allowing for technically simpler access without limiting safety and efficacy of the procedure.

P-13

Tract seeding post percutaneous renal cell carcinoma biopsy: review of the literature

Georgiadou M¹, Nikolaou V¹

¹General Hospital of Nikaia-Piraeus, Nikaia, Greece

Learning objectives: To review from literature cases of tumor seeding following percutaneous biopsy of renal cell carcinoma and assess methods of prophylaxis of this complication as well as the therapeutic management with minimally invasive methods.

Background: Renal cancer accounts for 5% and 3% of all adult malignancies in men and women respectively. According to ESMO (European Society for Medical Oncology) clinical practice guidelines for renal cell carcinoma (2019) a renal tumor core biopsy is recommended before treatment with ablative therapies and in patients with metastatic disease before starting systemic therapy. Tumor seeding is the implantation of tumor cells along the needle tract while performing fine needle aspiration biopsy or core needle biopsy. It is considered a very rare complication (0.01%).

Clinical findings/procedure details: Potential risk factors for seeding are the size of the needle, the number of passes, biopsy without coaxial sheath, the length of needle tract, non-negative pressure while withdrawing and low-grade papillary tumors. The biopsy needle traverses numerous tissues and the tumor may theoretically seed into one or more of these.

Conclusion: Despite the low incidence and the few reported cases in the literature, seeding is equal to a recurrence for a patient, therefore scope of the interventional radiologist should be to eliminate this complication. This could be achieved using prophylactic measures such as using the same pass for the biopsy and the ablation procedure with the aim of frozen section.

P-14

Pre-operative embolization of renal cell carcinoma (RCC): rational, results of the literature and 16-year real-world mono-center analysis

Tinoush P¹, Pereira P², Do T¹, Pan F³, Vollherbst D⁴, Schmitt N⁴, Richter G⁵, Kriegsmann K⁶, Kriegsmann M⁷, Hatiboglu G⁸, Nyarangi-Dix J⁸, Kauczor H¹, Sommer C¹

¹Clinic for Diagnostic and Interventional Radiology, University Hospital Heidelberg, Heidelberg, Germany, ²Center for Radiology, Minimally-invasive Therapies and Nuclear Medicine, SLK Kliniken Heilbronn GmbH, Heilbronn, Germany, ³Department of Radiology, Union Hospital, Tongji Medical College, Huazhong University of Science and Technology, ⁴Heidelberg University Hospital, Department of Neuroradiology, Heidelberg, Germany, ⁵Clinic of Diagnostic and Interventional Radiology, Stuttgart Clinics, Stuttgart, Germany, ⁶Department of Hematology, Oncology and Rheumatology, University Hospital Heidelberg, Heidelberg, Germany, ⁷Institute of Pathology, University Hospital Heidelberg, Heidelberg, Germany, ⁸Department of Urology, University of Heidelberg, Heidelberg, Germany

Learning objectives: The reader learns why the intervention is useful and indicated in various settings, receives updates of the published literature, and gains practical insights into our institutionalized strategy.

Background: Pre-operative embolization of RCC has been described as a technically safe and clinically effective intervention for decades. When surgical resection is required, however, different institutions follow heterogeneous concepts in terms of pre-operative embolization.

Clinical findings/procedural details: The benefits of embolization prior to total or partial nephrectomy include: reduced intra-operative and post-operative blood loss and hemorrhage, less tumor involvement of adjacent organs and reduction of tumor thrombi resulting in shorter operative time and safer resection. In the literature, markedly different results are reported, and the importance of proper choice of embolics and embolization technique is discussed (PMID: 20603414). In our 16-year real-world mono-center analysis, pre-operative embolization was performed in 159 patients with renal tumors (2003-2018). Different embolics (e.g. glue, iodized oil, microspheres and coils) and embolization techniques (e.g. free-flow or capillary embolization) were used. An institutional standard is implemented.

Conclusions: Pre-operative embolization of RCC is technically feasible, safe and highly effective. In our center, the procedure is regularly requested by urologic colleagues, especially but not only in the setting of locally advanced RCC with cava thrombosis. The rationale is to make radical resection easier, faster, and safer with optimized clinical outcomes. An individualized combination of embolics is used and the interval between embolization and resection is typically 0-3 days. According to the literature, pre-operative embolization of RCC is experiencing a revival.

P-15

Microwave ablation in a challenging location – treatment of HCC adjacent to the adrenal gland

Beermann M¹, Eigel B², Lindeberg J

¹Danderyds hospital, Danderyd, Sweden, ²Cascination AG, Bern, Switzerland

A 67 year old man with a non-cirrhotic liver was diagnosed with multiple HCCs in 2016 and had his first operation in September of that year.

Because of recurrent tumors, he had new resections and ablations in 2017, 2018 and 2019.

In 2020 a growing hypervascular lesion was diagnosed adjacent to the right adrenal gland and the diaphragm. There was a strong suspicion of HCC metastasis, and a MDT conference advocated microwave ablation as more surgery was not an option.

The ablation was performed in January of 2021. Needle placement was planned and executed with the help of the CAscination system. Ablation with Amica, 60 W for 1.5 minutes + 1.5 minutes (break because of rising blood pressure). Follow-up with CT every third month for almost a year showed stable conditions without signs of regrowth.

MWA close to, or within, the adrenal gland is challenging because of the risk of triggering an acute hypertensive crisis. However, with correct pre-treatment (alpha-adrenergic blocking medication), availability of direct acting vasodilators and short acting alpha-adrenergic antagonists during the procedure and cautious heat admission, it is a possibility when surgery is not an option.

In percutaneous MWA of the adrenal gland the location may also be a challenge as it can be difficult to visualize the target. In this specific case, the CAscination worked perfectly as it allows for long, precise needle trajectories to deep targets without loss of visibility.

P-16**Multidisciplinary approach to a complex case of VHL RCC: use of 3D model for a precise preoperative planning and intraoperative guiding of multiple kidney ablation and partial nephrectomies**

Guazzarotti G¹, Larcher A², Damascelli A¹, Palumbo D¹, Capitanio U², Montorsi F², Bertini R², Salonia A², De Cobelli F¹
¹Radiology Department – IRCCS San Raffaele Hospital, Milan, Italy,
²Urology Department – IRCCS San Raffaele Hospital, Milan, Italy

Clinical history/Pre-treatment imaging: A 56-year-old male with a history of Von-Hippel-Lindau(VHL) disease and previous multiple partial nephrectomies and ablations on both kidneys underwent a screening MRI of the abdomen, which demonstrated multiple bilateral renal solid lesions, along with complex and simple cysts. Left kidney was proven to be silent at renal scan. A team of engineers developed a 3D-model to count, map and classify all the lesions (Image 1).

Treatment options/Results: Multidisciplinary team suggested left radical nephrectomy together with a combination of partial nephrectomies and tumour ablations of the right kidney. 2/11 right kidney lesions were treated with partial nephrectomy, 8 with intraoperative microwave ablation under US-guidance after cold irrigation of the pelvis via ureteral stent; the last lesion has been proven to be a scar from previous treatment. The procedure was performed with constant navigation of the 3D-model. At 3-months follow-up, eGFR was 26 and MRI revealed no signs of renal cell carcinoma(RCC) (Image 2).

Discussion: Management of VHL RCC is extremely challenging because of complex anatomy, previous surgical or ablative treatment and the imperative need to minimize the inevitable injury to renal parenchyma. This implies the need for a precision management, performed by an experienced multidisciplinary team. Complex cases could benefit of 3D-model for planning and guiding intervention.

Take home points:

- Multidisciplinary nephron-sparing approach with partial nephrectomies and ablation is a crucial issue in VHL RCC
- 3D-model could improve nephron-sparing approach in Patients with VHL RCC

P-17**Contrast-enhanced ultrasound guided microwave ablation of recurrent renal cell carcinoma in a chronic renal failure patient**

Palaniswamy M¹, Krishnamurthy Rajendra K²
¹Gleneagles Global Health City, Chennai, India, ²Dr Kush Imaging & Interventions, Chennai, India

Clinical history/Pre-treatment imaging: 72-year-old male, who is a known case of Bilateral renal cell carcinoma, underwent bilateral partial nephrectomy, 5 years back on the right side and 10 years back on the left side. He was diagnosed to have a 3.2 x 2.6 cm mass in the left kidney on routine follow-up. As his serum creatinine was elevated (2.6 mg/dL), a non-contrast FDG PET was done, which showed FDG uptake within the lesion.

Treatment options/Results: Interdisciplinary meeting was held, and a decision was made to do a Microwave ablation of the recurrent RCC in view of moderate cardiac risk for surgery. Contrast-enhanced ultrasound was used to delineate the RCC which showed delayed enhancement as compared to the renal parenchyma. The Microwave antenna was inserted into the target lesion under ultrasound guidance and microwave ablation of the renal cell carcinoma was performed. Post ablation contrast ultrasound showed no enhancement within the lesion and ablation zone.

Discussion: Percutaneous thermal ablation is usually performed under CT and/or ultrasound guidance. CT guidance frequently utilizes iodinated contrast for tumor targeting, with additional radiation and contrast required at the end of the procedure to ensure satisfactory ablation margins. Contrast-enhanced ultrasound(CEUS)is an emergent imaging technique utilizing microbubble contrast agents to demonstrate blood flow and tissue perfusion. Thermal ablation has emerged as the mainstay treatment for RCC and CEUS is beneficial in reducing radiation and iodinated contrast-related side-effects.

Take-home points: Contrast-enhanced ultrasound (CEUS) can replace conventional Contrast enhanced CT guided ablations for patients with acute/chronic renal failures.

Liver

P-18

Prospective study on the immunological effects of conventional transarterial chemoembolization and high dose-rate brachytherapy in patients with hepatocellular carcinoma

Schmidt R¹, Gebauer B¹, Roderburg C², Torsello G¹, Fehrenbach U¹, Mohr R³, Auer T¹, Pardo G¹, Lim W¹, Can E¹, Tacke F³, Hamm B¹, Hammerich L³, Savic L¹

¹Charité Virchow Klinikum - Department of Radiology, Berlin, Germany, ²Uniklinik Düsseldorf, Department of Gastroenterology, Hepatology and Infectiology, Düsseldorf, Germany, ³Charité Virchow Klinikum, Department of Gastroenterology and Hepatology, Berlin, Germany

Study: Immunologic effects of minimally-invasive therapies in patients with hepatocellular carcinoma (ImmuMITT: <https://www.drks.de/DRKS00026994>)

Purpose: To characterize immune cell profiles in patients with hepatocellular carcinoma (HCC) and alterations induced by conventional transarterial chemoembolization (cTACE) and high dose-rate brachytherapy (BT).

Methodology: This single-site clinical prospective trial has been consecutively recruiting 126 patients undergoing cTACE, BT, or combined cTACE/BT (07/2020-11/2021). Institutional review board approval and informed consent were obtained. Peripheral blood was sampled before, 24h and 8 weeks after therapy for spectral fluorescence-activated cell sorting analysis. A 24-color multiplex staining panel was applied to quantify lymphoid and myeloid cell populations, and their expression of checkpoint-molecules including PD(L)-1, CTLA4, TIM3, and LAG3. Additionally, core-needle biopsies for translational tissue analysis were obtained in patients undergoing BT and cTACE/BT. Moreover, multiparametric MRI was acquired before and 8 weeks after therapy for response assessment. CT was acquired 24h after cTACE or during brachytherapy, respectively.

Endpoints: Primarily, measuring the impact of peripheral immunological phenotypes on tumor susceptibility and response to loco-regional therapy, and identifying non-invasive imaging biomarkers in CT/MR imaging, that correlate with the immunological phenotype. Secondly, evaluating outcome measures including overall and progression-free survival in the context of the previously assessed parameters.

Impact: The study could potentially reveal favorable constellations and therapy-induced alterations of anti-tumoral immune cell response following loco-regional therapies and assist in identifying imaging features as non-invasive surrogate markers of the functional immune status. These findings may help improve the management of HCC patients, specifically with regards to combined treatments of loco-regional and immuno-oncological therapies.

P-19

A new safe and efficient transarterial chemoembolization (TACE) method; degradable starch microspheres (DSM TACE), effects on tumor necrosis of primary and secondary liver tumors

Aktas A¹, Sat Bozcuk H², Ozdogan M³, Yildiz A³, Suslu H², Cicek Ozdol N⁴

¹Antalya Bilim University, Antalya, Turkey, ²Antalya Medicalpark Hospital, Antalya, Turkey, ³Antalya Memorial Hospital, Antalya, Turkey, ⁴Antalya Research and Training Hospital, Antalya, Turkey

Purpose: To evaluate the effectivity of degradable starch microspheres (DSM) in transarterial chemoembolization (TACE) in palliative treatment of liver tumors.

Material and methods: Increase in tumor necrosis, increase in necrosis to tumor ratio and decrease in axial, coronal diameters and SUVmax values as tumor activity was retrospectively evaluated as effectivity.

Results: There was a total 88 DSM TACE procedures to 37 liver lesions of 23 patients, mean age 43 (26-78). 5(13,5%) hepatocellular carcinoma(HCC), 22(59,5) colorectal carcinoma(CRC) and others were 3 cholangiocellular, 2 ovarian, 2 breast, 3 surrenal carcinomas. 34 lesions had PET-CT (%92), 3 lesions had magnetic resonance imaging follow-ups. 20(54) were right and 16(43) bilobar lesions. The difference between pre- treatment and post- treatment axial and coronal diameters was evaluated; changes in single lob administration was 13,7±9,4(11), 12,9±12(10) and bilobar administration change was 16±21(8), 10,1±11(7,5) respectively. The change in tumor necrosis ratio was 29,9±24(22,8) in single lobe and 18,6±15(15,4) in bilobar DSM TACE. The change in SUVmax values in single 3,9±2,6(3,5) and 7,7±5,7(7,5) in bilobar. Wilcoxon test was used to compare values and all results was correlated. There was increase in the extend of tumor necrosis, decrease in tumor dimensions and SUVmax values of PET-CT. The pre-treatment or post-treatment changes were the same in both primary and metastatic lesions.

Conclusion: DSM as transient embolic agent can be used with variety of chemotherapeutics is safe and causes tumor necrosis that is highly effective and should be used as combination treatment option for non-resectable liver tumors.

P-20

Clinical significance of the initial and best responses after chemoembolization in the reatment of intermediate-stage hepatocellular carcinoma with preserved liver function

Alrashidi I¹, Kim J², Park C²

¹King Salman Specialist Hospital, Hail, Saudi Arabia,

²Asan Medical Center, Seoul, South Korea

To evaluate the clinical implications of initial and best responses during repeated TACE for (HCC).

726 patients with a diagnosis of intermediate-stage HCC with Child-A liver function between 2007 and 2016 were treated with TACE as the first-line treatment. Overall survival was compared between treatment categories after implementation of landmark analysis, based on the modified response evaluation criteria in solid tumors.

Of the 726 patients, an objective response complete response or partial response was observed as the initial response in 78.1% of patients. Regarding the best response during the TACE series, 87.2% of patients were overall responders. The median OS of initial responders (n = 483) was not significantly different from that of subsequent responders at the 1-year landmark (stable disease [SD] after first TACE but CR or PR after repeated TACE; n = 61; 46.2 vs 40.1 months, respectively; P = .145). Likewise, the median OS of initial CR patients (n = 326) was not significantly different from that of the subsequent CR group (n = 126) at the 1-year landmark (PR or SD after first TACE but CR after repeated TACE; 53.4 vs 46.3 months, respectively; P = .455). Multivariate Cox analyses showed that the objective responses, the initial responses (hazard ratio [HR], 0.638; P = .001), and the best responses (HR, 0.304; P < .001) had the significant prognostic significance for OS. Both the initial and best responses during repeated TACE were significantly associated with OS in patients with intermediate-stage HCC and preserved liver function.

P-21

Combined chemoembolization and radiotherapy versus chemoembolization alone for hepatocellular carcinoma invading the hepatic vein or inferior vena cava

Alrashidi I¹, Kim J²

¹King Salman Specialist Hospital, Hail, Saudi Arabia,

²Asan Medical, Seoul, South Korea

Purpose: To evaluate the efficacy and safety of transarterial chemoembolization (TACE) plus radiotherapy compared with TACE alone for patients with hepatocellular carcinoma (HCC) invading the hepatic vein (HV) or inferior vena cava (IVC).

Materials and methods: Data from 79 patients who underwent TACE plus radiotherapy as a first-line treatment for non-metastatic HCC invading the HV or IVC between 2006 and 2018 were retrospectively evaluated. These findings were compared with data from a historical control group, consisting of 80 patients who received TACE alone between 2000 and 2006.

Results: Baseline characteristics were similar in both groups. Median progression-free survival (PFS) (8.1 vs. 4.4 months, P = 0.003) and overall survival (OS) (18.3 vs. 9.5 months,

P = 0.002) were longer in the TACE plus radiotherapy than in the TACE alone group. Multivariate analysis showed that PFS and OS were significantly associated with treatment type. Subgroup analyses found that TACE plus radiotherapy showed better OS than TACE alone in patients with Child-Pugh class A, maximal tumor size < 9 cm, tumor number < 4, serum alpha-fetoprotein level ≥ 400 ng/mL, infiltrative tumor, IVC tumor thrombus, and combined portal vein invasion. The major complication rates were similar between the TACE plus radiotherapy (16.5%) and the TACE alone (13.8%) group (P = 0.664).

Conclusion: Both TACE plus radiotherapy and TACE alone showed similar safety in treating non-metastatic HCC invading the HV or IVC. TACE plus radiotherapy seems effective to prolong OS and PFS compared to TACE alone in this specific patient group.

P-22

Feasibility, safety and tumor control of balloon-occluded trans-arterial chemoembolization with Irinotecan (b-DEBIRI) for the treatment of colorectal cancer liver metastasis: preliminary results

Argirò R¹, Morelli C, Morosetti D, Gasparrini F, Lucatelli P, Floris R, Roselli M, Crociati S, Formica V

¹Azienda Ospedaliera Universitaria Policlinico Tor Vergata di Roma – Interventional Radiology Unit, Roma, Italy

Purpose: To evaluate technical feasibility, safety and tumor control b-TACE with irinotecan loaded Polyethylene-Glycol microspheres (b-DEBIRI) in patients with liver-limited metastatic colorectal cancer.

Materials and methods: 20 patients with bilobar CRC liver metastases were included. Each liver lobe received one session of b-DEBIRI (100mg irinotecan pre-loaded in 2mL of 100±25µm microspheres). Technical embolization endpoint was complete drug administration. Balloon-occluded arterial stump pressure (BOASP), adverse events (AEs), complications and post-embolic syndrome (PES) were assessed. Procedural oncological outcomes were evaluated according to RECIST 1.1 criteria at 1-3 month follow-up with MDCT-MRI for all patients, at 6 months follow-up in 6 patients and at 1 year in one patient. **Results:** Mean number of metastasis per patient was 10.8 (2-36) with a mean diameter of 20mm (5.2-52.1mm); mean total pre-procedural volume was 77,2cc³ (1.8-356.7cc³). Average BOASP was 63.3±18.5mmHg (p<0,0001). No major AEs were recorded. PES occurred in 33% of procedures with no prolongation in-hospital stay.

At 1-3 month follow-up all patients were in partial response (PR) and average tumor debulking volume was 73% (42.5-89.6%) (p<0,0001).

None of the patients was scheduled for systemic chemotherapy in the 3 months follow-up period. At 6 months follow-up 4 patient remained in stable disease (SD) and 2 patients were in progressive disease (PD). The two patients in PD underwent other b-DEBIRI sessions with PR after treatment. The patient with 1 year of follow-up remained in PR. **Conclusion:** This series demonstrates technical feasibility and safety of b-DEBIRI, with evidence of local tumor control and significant tumor debulking.

P-23

Combined MW ablation and B-TACE for treatment of liver metastases: feasibility, safety profile and preliminary results

Argirò R¹, Gasparini F, Morosetti D, Lucatelli P, Nezzo M, Ciccarese G, Anselmo A, Formica V
¹*Policlinico Tor Vergata, Roma, Italy*

Purpose: To report single center retrospective experience on combination of balloon-occluded MWA(b-MWA) with contemporary balloon-occluded TACE(b-TACE) in patients with liver metastases >3,5 cm.

Materials and methods: 10 patients with 2 intrahepatic cholangiocarcinoma (ICC) and 8 single secondary liver metastases (colorectal cancer metastasis, mCRC=5; sarcoma metastasis=1; breast metastasis=1; lung metastases=1) were treated. Maximum mean diameter of lesions was 42 mm (± 6.5). Treatments were performed in a single-step approach with single/double MW antenna with contemporary selective catheterization and inflation of balloon-microcatheter. Ablation was followed by b-TACE with 100 μ m particles pre-charged with doxorubicin or irinotecan. Necrotic area were assessed at post-procedural CT/MR. Complications were categorized according to CIRSE classification. Oncological results at 1,3–6 and 12 months were evaluated using RECISTv1.1.

Results Mean maximum volume of necrotic area was 72 cm³ (± 30) with mean maximum diameter of 58 mm (± 8 mm). Volumetric incrementation in comparison with MW vendor chart consisted in a medium percentage of volumetric incrementation of necrotic area of 81 %. No major complications occurred; PES occurred in 6 of 10 patients. At 1-3 month all patients were in complete response (CR). 4/10 patients reached 6 months follow-up and 3 remained in CR and 1 experiences local recurrence. One patient reached 12 months of follow-up in CR. Progression of disease occurred in one patient for extra-hepatic progression at 6 months follow-up

Conclusion: b-MWA followed by b-TACE lead to an increase in size of necrotic area. The results permitted to achieve promising oncological results in patients with >3.5 cm liver metastases.

P-24

Proof of concept of volumetric MR-temperature monitoring during microwave ablation of liver tumor in a patient

Bour P¹, Dietrich O⁵, Faller T¹, Ozenne V^{2,3,4}, Öcal O⁵, Lentini S⁵, Chemouny S¹, Quesson B^{2,3,4}, Ricke J⁵, Seidensticker M⁵
¹*Certis Therapeutics, Pessac, France*, ²*IHU LIRYC, Fondation Bordeaux Université, Pessac, France*, ³*UMR5536, CRMSB, Université de Bordeaux, Bordeaux, France*, ⁴*INSERM, CRCTB, U1045, Pessac, France*, ⁵*Department of Radiology, University Hospital, Munich, Germany*

Purpose: In the context of microwave ablation of liver tumors, MRI has the potential to provide pre-ablation 3D visualization of the tumor, interactive imaging to guide probe insertion and

the ability to monitor the energy delivery using temperature and thermal dose mapping. We present here a proof of concept of monitoring two ablations in a patient.

Material and methods: The patient was treated under general anesthesia in a 1.5T MRI scanner (Siemens, Germany) with the AveCure microwave system (MedWave, USA). MRI provided pre- and post-ablation 3D imaging, interactive imaging for needle placement and real-time temperature monitoring during the ablation. Multi-slice fast MR-thermometry (13 slices) using respiratory triggering were run during two consecutive ablations, allowing volumetric thermometry (2.3x2.3x3 mm³ voxel size) and thermal dosimetry over the entire tumor volume (CERTIS Therapeutics, France). Follow-up imaging included T1-weighted imaging 1-day post-ablation.

Results: The two ablations were successful, without noticeable artifacts visible on temperature images acquired continuously during treatment (12 minutes energy delivery). The treated volume from the thermal dose (240 CEM43) were 9.6 cm³ and 10.5 cm³ for both ablations, respectively. Lesion maximal extents in its longitudinal/transverse directions were measured 63/26 mm on the dose and 70/31 mm on the post-ablation image, respectively. This would suggest a complete tumor treatment.

Conclusions: This study shows the feasibility of a fully MRI-guided microwave tumor ablation. The volume depicted by the thermal dose and the lesion image were found herein similar.

P-25

Predicting the hepato-pulmonary shunt Fraction on contrast-enhanced CT in patients with hepatocellular carcinoma before transarterial radioembolization

Busch F^{1,2}, Hamm C¹, Pöhlmann A³, Shewarega A⁴, He Y¹, Schmidt R¹, Xu H¹, Gebauer B¹, Savic L¹
¹*Charité – Universitätsmedizin Berlin, Corporate Member of Freie Universität Berlin and Humboldt Universität zu Berlin, Department of Radiology, Campus Virchow-Klinikum, Berlin, Germany*, ²*Charité – Universitätsmedizin Berlin, Corporate Member of Freie Universität Berlin and Humboldt Universität zu Berlin, Department of Anesthesiology, Division of Operative Intensive Care Medicine, Campus Virchow-Klinikum, Berlin, Germany*, ³*Charité – Universitätsmedizin Berlin, Humboldt-Universität zu Berlin, and Berlin Institute of Health, Institute of Biometry and Clinical Epidemiology, Berlin, Germany*, ⁴*Yale School of Medicine, Department of Radiology and Biomedical Imaging, New Haven, USA*

Purpose: This study aimed to identify imaging biomarkers on contrast-enhanced (CE)CT that predict the hepato-pulmonary shunt fraction (HPSF) in patients with hepatocellular carcinoma (HCC) before transarterial radioembolization (TARE).

Material and methods: This IRB-approved (EA2/071/19) retrospective analysis included 56 patients with HCC recommended for TARE. Patients underwent tri-phasic CECT within six weeks before an intraarterial HPSF evaluation study using Tc-99m albumin. Besides clinical parameters, imaging features were extracted from CECT, including nonrim-/arterial-phase enhancement (APHE), washout, enhancing capsule,

portal vein patency, radiogenomic venous invasion, growth pattern, largest lesion size, and multiplicity. To determine the predictive value of those imaging features for the HPSF, we developed a prediction model with data-driven variable selection for linear regression using backward elimination after testing for multicollinearity with Pearson's coefficient r .

Results: Mean HPSF was $13.11\% \pm 7.6\%$ (range: 2.8%-35.97%). Size of largest lesion ($p=0.002$), nonrim-APHE ($p=0.003$), and washout ($p<0.001$) were identified as non-invasive predictors of HPSF on CECT. Specifically, the prediction model revealed that HPSF increased proportionally to largest lesion size. When stratified according to size of largest lesion, HPSF was generally higher in patients with nonrim-APHE (e.g. 5cm-7.5cm: 9.49% vs. 1.76%; >15cm: 17.71% vs. 9.98%) and increased even further when no washout was present (e.g. 5cm-7.5cm: 18.87% vs. 11.13%; >15cm: 27.08% vs. 19.35%).

Conclusion: The analysis of imaging biomarkers on CECT may enable a non-invasive estimation of the HPSF in patients with HCC before TARE. These preliminary results could assist in the patient selection for TARE, while sparing ineligible patients the angiographic shunt evaluation study.

P-26

Efficacy and safety of transarterial chemoembolization with DC Beads LUMI in the treatment of HCC: experience from a tertiary centre

Carriero S¹, Biondetti P², Ierardi A², Bevilacqua M¹, Ruffino A¹, Lanza C¹, Angileri A², Carrafiello G²

¹Università degli Studi di Milano, Milano, Italy, ²Fondazione IRCCS Ca Granda- Ospedale Maggiore Policlinico, Milano, Italy

Purpose: The aim of this study was to describe safety and efficacy profiles of transarterial chemoembolization (TACE) using DC Beads LUMI.

Material and methods: We retrospectively analyzed 90 patients with HCC who underwent TACE with DC Bead LUMI between November 2018 and November 2020 at Fondazione IRCCS Cà Granda Policlinico Hospital in Milan, Italy. Response was evaluated using modified response criteria in solid tumors (mRECIST) with following outcomes: complete response (CR), partial response (PR), stable disease (SD) and progressive disease (PD).

Efficacy endpoints were objective response rate (ORR) and disease control rate (DCR), evaluated both overall and for targeted tumors at first 1-month follow-up imaging. ORR is the sum of CR and PR, while DCR of ORR and SD. Safety assessment was based on the quantitative and qualitative recording of the adverse events, classified according to Clavien-Dindo classification.

Results: 72 patients were enrolled, and 95 procedures were carried out. ORR and DCR of target tumors were 77,6% and 90,7%, respectively and Overall ORR and DCR were respectively 71,5% and 82%. Clavien-Dindo grade I and grade II complications were recorded, respectively in 11.6% and 6.3% procedures. No grade III-IV-V complications occurred.

Conclusion: TACE using DC Beads LUMI is a safe and effective treatment option for patients with HCC.

P-27

The first-line systemic therapy in advanced hepatocellular carcinoma: an updated network meta-analysis

Chen J¹, Jin Z¹, Zhu H¹, Teng G

¹Center of Interventional Radiology and Vascular Surgery, Department of Radiology, Zhongda Hospital, Medical School, Southeast University, Nanjing, China

Purpose: Systemic therapy is the standard treatment for advanced hepatocellular carcinoma (HCC). The recent ORIENT-32 study showed the significant survival benefit of sintilimab (an anti-PD-1 antibody) plus IBI305 (a bevacizumab biosimilar) in advanced HCC. This study updates a previous network meta-analysis of systematic treatment options in the first-line setting in patients with advanced HCC.

Material and methods: We searched PubMed, Embase, and Web of Science for abstracts and full-text articles published from database inception through July 2021. Phase 3 trials that evaluated systematic therapies including vascular endothelial growth factor inhibitors, checkpoint inhibitors, or their combinations in advanced HCC, in the first-line setting for advanced HCC were included. Main outcomes were overall (OS) and progression-free survival (PFS). The random effects model was used to pool the overall effect via R package "netmeta".

Results: Nine trials at low risk of bias were included. Network meta-analysis showed that sintilimab plus IBI305 and atezolizumab plus bevacizumab were all superior compared with other systematic agents in OS and PFS. Sintilimab plus IBI305 is equivalent to atezolizumab plus bevacizumab in OS (hazard ratio 0.98, 0.65-1.50) and PFS (hazard ratio 0.98, 0.85-1.12). The combination of sintilimab and IBI305 also showed superior to lenvatinib, sorafenib and nivolumab.

Conclusion: This network meta-analysis of 9 trials found that both sintilimab plus IBI305 and atezolizumab plus bevacizumab can be considered the standard of care in the first-line setting in patients with advanced HCC. Other potential combinations and the efficacy in patients with suboptimal liver function should be explored in the future

P-28

Evaluation of a new CT-guided robotic system for thermal ablation of liver tumors: a prospective pilot study

De Baere T¹, Guiu B²

¹Institut Gustave Roussy, Villejuif, France, ²Hôpital Universitaire St-Eloi, Montpellier, France

Purpose: To assess the feasibility and safety of an innovative robotic system for needle insertion in CT-guided thermal ablation of hepatic lesions.

Materials and methods: Radiofrequency (RFA) or microwave (MWA) ablations of liver tumors were performed on 21 patients (24 lesions, hepatocellular carcinoma = 6, metastases = 18) with a mean size of 15.6 mm (standard deviation (SD): 7.2 mm) with the assistance of a CT-guided robotic system. Interventions were performed along an Institutional Review Board (IRB)-approved first in man study. The main criteria reviewed were feasibility, defined as the possibility to perform the procedure

secondary to the needle insertion, the number of adjustments, which were defined as a reiteration of robotically assisted needle insertion when needle positioning is considered insufficient in first instance, and robotic-guided procedure safety, namely adverse events related to the needle insertion phase. Patients were followed up at 6 months to assess local tumour control.

Results: Application of the robotic system was judged feasible in 19 cases (95.0%) by a Data Safety Monitoring Board (DSMB) (95% CI: [76.39%; 99.11%]) in the Per-Protocol population. Mean (SD) number of needle adjustments was 0.4 (0.7). No adverse events were encountered. At 6 months, local tumour control was obtained in 76.4% of the patients, in line with current literature data.

Conclusion: This multicentric pilot study suggests that robotic-guided planning and insertion is highly feasible, requiring only few needles adjustments, and providing safe and efficient CT-guided thermal ablation of liver lesions.

P-29

DEB-TACE and TAE for hepatocellular carcinoma: a quantitative analysis of tumor enhancement on CBCT-hepatic arteriography and post-procedural CBCT

Della Corte A¹, Parisi S¹, Augello L¹, Guazzarotti G¹, Palumbo D¹, Gusmini S¹, De Cobelli F¹

¹Department of Radiology, IRCCS San Raffaele Hospital, Milan, Italy

Purpose: Recent evidence suggests that quantification of intra-tumoral lipiodol accumulation after cTACE of HCC on immediate post-procedural cone-beam CT is an early predictor of tumor progression. In our study we investigate the relevance of quantification of tumor enhancement on CBCT-hepatic arteriography (HA) and post-procedural CBCT in patients treated with DEB-TACE or TAE.

Materials and methods: From February 2020 to November 2021, 23 consecutive patients underwent DEB-TACE (n=10) or TAE (n=13) of 38 HCCs. Inclusion criteria for analysis were: availability of CBCT-HA and post-procedural CBCT, evidence of post-procedural intra-tumoral contrast retention. Mean density on CBCT-HA (mHU₁) and post-procedural CBCT (mHU₂) were calculated by manual tumor contouring. The difference between mHU₂ and mHU₁ was defined as ΔmHU_{21} .

Results: Nine patients (13 HCCs) met inclusion criteria, of which n=5 underwent TAE (n=8 HCCs, 62.5%) and n=4 underwent DEB-TACE (n=5 HCCs, 38.5%). After a median follow-up of 6 months, local progression occurred in 7 HCCs (53.8%), of which 5 after TAE (38.5%) and 2 after DEB-TACE (15.4%). In the TAE subgroup, mHU₁ was 342.6HU whereas mHU₂ was 192.8HU ($\Delta mHU_{21} = -150.5HU$); ΔmHU_{21} was lower among patients exhibiting local progression (-243.6HU vs 4.7HU). In the DEB-TACE subgroup, mHU₁ was 263.5HU whereas mHU₂ was 187.3HU ($\Delta mHU_{21} = -76.2HU$); ΔmHU_{21} was lower among patient without local progression (-138.1HU vs -62HU).

Conclusion: Quantification of enhancement on CBCT-HA and post-procedural CBCT may reflect relative intra-tumoral bead accumulation, particularly in patients treated by TAE, with possible effects on tumor control. Larger studies with longer follow-up are needed to support this hypothesis.

P-30

Analysis of the effect of microwave ablation of hepatocellular carcinoma on neutrophil-to-lymphocyte ratio and correlation with local tumor progression

Della Corte A¹, Sallemi C², Ratti F³, Monfardini L², Gusmini S¹, Cipriani F³, Pennella R¹, Santangelo D¹, Burgio V⁴, Casadei-Gardini A⁴, Aldrighetti L³, De Cobelli F¹

¹Department of Radiology, IRCCS San Raffaele Hospital, Milan, Italy, ²Department of Radiology, Fondazione Poliambulanza Istituto Ospedaliero, Brescia, Italy, ³Hepatobiliary Surgery Division, IRCCS San Raffaele Hospital, Milan, Italy, ⁴Unit of Oncology, IRCCS San Raffaele Hospital, Milan, Italy

Purpose: Neutrophil-to-Lymphocyte ratio (NLR) recently demonstrated a predictive value for hepatocellular carcinoma (HCC) recurrence after thermal ablation. Microwave ablation (MWA) has been shown to induce changes in the immune landscape after HCC treatment. This study aims at identifying predictors of local tumor progression (LTP) and of post-treatment NLR kinetics after MWA.

Materials and methods: From October 2014 to September 2021, 108 consecutive patients underwent percutaneous MWA of 119 HCCs with a 2450Hz/100W generator. Forty-five HCCs (42 patients) met inclusion criteria for analysis (technique efficacy, availability of pre- and post- treatment NLR, follow-up >6 months, absence of complications). NLR prior to therapy and at 1-month follow-up were analyzed; NLR difference between the two time-points was defined as ΔNLR_{1stFU} .

Results: After a median follow-up of 25 months, LTP occurred in 18 HCCs (40%). At univariate analysis, risk factors for LTP included ΔNLR_{1stFU} (HR=1.2, p=0.033) and $\Delta NLR_{1stFU} > 0$ (HR=2.8, p=0.05). In a multivariate model comprising $\Delta NLR_{1stFU} > 0$, etiology of cirrhosis and subcapsular location, the only independent predictor of LTP was $\Delta NLR_{1stFU} > 0$ (HR=3.2, p=0.038). $\Delta NLR_{1stFU} > 0$ occurred in 24/42 patients (57.1%). In this subgroup, higher rates of female patients (p=0.026), higher mean baseline NLR (p<0.0001) and lower mean energy/size (p=0.006) were observed. Upon ROC curve analysis, energy/tumor size <1414 J/mm predicted $\Delta NLR_{1stFU} > 0$ with 76% sensitivity and 70% specificity (AUC=0.74).

Conclusion: NLR increase in response to ablation was the only independent predictor of LTP, supporting the role of balance between systemic inflammation and immunity in recurrence after MWA. Ablation energy/tumor size predicted NLR increase, reinforcing the concept of immune ablation.

P-31

Use of tumor growth rate as a predictor of objective response for patients treated with SIRT for hepatocellular carcinoma

Do Amaral R¹, Girardet R², Vietti-Violli N¹, Dromain C¹, Watte G², Villard N¹, Denys A¹, Schaefer N¹, Tsoumakidou G¹, Duran R¹
¹CHUV, Lausanne, Switzerland, ²UFCSA, Porto Alegre, Brazil,
³Réseau Hospitalier Neuchâtelois, Neuchâtel, Switzerland

Purpose: To evaluate the value of pretreatment tumor growth rate (TGR) as an imaging predictor of post-treatment objective response (OR) in patients treated with SIRT for hepatocellular carcinoma (HCC).

Materials and methods: This ongoing analysis retrospectively included patients treated with SIRT for HCC. Pre-baseline, baseline, and follow-up MRI or CTs were retrospectively evaluated by two independent radiologists. mRECIST at 6 months after the first SIRT and TGR at pretreatment was evaluated. Receiver operating characteristic (ROC) curve analyses were used to select the TGR threshold that best predicts OR at 6 months.

Results: A total of 46 patients, 39 male (84.8%), mean 66.5 years +/- 9.5 years (range 39 - 87 years) were included. At follow-up, 78% of patients presented OR at imaging. The pretreatment TGR was 8.59 [IQR=2.8-22.3]/month with TGRs for the OR group and non-responders being respectively 6.9 [IQR=2.7-14.9] and 23.4 [IQR=2.2-28.7]/month. A TGR threshold of 22.19%/month had the best predictive value for OR with an area under the curve of 0.65 (95%CI 0.43-0.88), with a sensibility of 60% and specificity of 83.3%, and accuracy of 78.3%.

Conclusion: Pretreatment TGR threshold can be used as a predictor of objective response on follow-up exams at 6 months for patients treated with SIRT with high accuracy.

P-32

Same-day Yttrium-90 radioembolization: feasibility with glass microspheres

Perez Enguix D¹, **Farias Lisboa P¹**, Bello P¹, Torres I¹, Belloch V¹, Olivas C¹, Martinez J¹
¹Hospital Universitario y Politécnico La Fe, Valencia, Spain

Purpose: To evaluate the feasibility of a same-day yttrium-90 (90Y) radioembolization protocol with glass microsphere (including pretreatment, angiography, lung shunt assessment, and radioembolization) for the treatment of hepatocellular carcinoma (HCC) and cholangiocarcinoma.

Materials and methods: Between March 2021 and December 2021, Five patients underwent same-day 90Y radioembolization under the guidance of the Interventional Radiology and the Nuclear Medicine Department. Pretreatment planning was performed by reviewing baseline imaging and estimated perfused liver volume bearing the tumor and using bicompartimental MIRD dosimetry method (liver and lung) and 3-D software (Simplicity) Maximum lung shunting fractions of 10 % were assumed. Subsequently, hepatic angiography, cone-beam CT, and 99mTc-MAA scintigraphy were performed followed by treatment.

Results: All patients successfully underwent planning angiography with the administration of 99mTc-MAA and 90Y radioembolization as a single-session treatment. No cases were canceled for elevated LSF or vascular anatomic reasons. Three patients had hepatocarcinoma and two had cholangiocarcinoma. The mean age was 62.2 years. The median size of cholangiocarcinoma was 68 mm and 39 mm for hepatocarcinoma. Median lung shunting was 2,02 % (1,2-3,2%), and median administered activity was 2,03 GBq (1,1-3,48 GBq). All patients were performed segmentary treatment. There were no adverse effects to treatment.

Conclusion: Same day 90Y evaluation and treatment with glass microsphere is feasible while maintaining the principles of safe and effective 90Y infusion including tumoricidal dosimetry, minimization of nontarget embolization, and minimization of lung dose. This translates into expeditious cancer care and significant cost savings.

P-33

188Re-SSS lipiodol radioembolization in HCC patients: results of a phase one study

Garin E¹, Bouvry C, Palard X, Rolland Y, Lepareur N, Le Sourd S, Ardisson V, Laffont S, Campillo-Gimenez B, Bellissant E, Edeline J
¹Cancer Institute Eugène Marquis, Rennes, France

Background: 188Re labelled lipiodol can be used for radioembolization but use of usual compounds is limited by in vivo instability. The goal was to evaluate in the phase 1 study Lip-Re-1, safety, bio distribution and response of 188Re-SSS lipiodol, a new compound more stable.

Method: 3+3 activity escalation study in HCC patients progressing after sorafenib. Primary endpoint was safety using limiting toxicity (related adverse event of NCI CTCAE grade ≥3, within 2 months). Secondary endpoints included bio distribution (scintigraphic acquisitions between 1 to 72h; blood, urine and faeces collection over 72h), and response (mRECIST).

Results: 14 heavily pre-treated HCC patients were treated with a whole liver approach. The mean injected activity was 1.5±0.4GBq for activity level 1 (n=6), 3.6±0.3GBq for level 2 (n=6) and 5.0±0.4GBq for level 3(n=2). The study was stopped by anticipation for other reasons than toxicity. Safety was acceptable with only 1/6 patient of level 1 as of level 2 experiencing limiting toxicity (1liver failure, 1lung disease). Uptake was seen only in tumor, liver, lung and sometime in bladder. Blood activity was 0.91±0.3% to 2.84±1.8% of injected activity. Cumulative urinary elimination and faecal eliminations at 72 hours were very low, respectively only 4.8±3.7% and 0.68±0.83 %. Partial response was observed in 25% (0% in the first activity level, 43% in the others).

Conclusion: high in vivo stability of 188Re-SSS lipiodol was confirmed and response was encouraging. The activity level of 3.7 GBq, proved to be safe, will be used in the phase 2 study Lip-Re-2, nationally funded.

P-34

Synchronous treatment with percutaneous microwave ablation and transarterial chemoembolization with irinotecan loaded polyethylene glycol beads for liver metastases larger than 4cm: safety, feasibility, and midterm follow up from single center experience

Gjoreski A¹, Risteski F, Jovanoska I¹, Dungevski G¹, Grozdanovska Angelovska B², Mitreski N²

¹General City Hospital „8th September“, Skopje, North Macedonia, Republic of, ²University Clinic for Radiotherapy and Oncology, Skopje, North Macedonia, Republic of

Purpose: To evaluate the feasibility, safety and efficacy of a single step locoregional treatment approach with ultrasound-guided microwave ablation (MWA) and chemoembolization with irinotecan loaded microspheres (DEBIRI TACE) in patients with colorectal liver metastases (CLRM) ≥ 4 cm.

Materials and methods: A total of 13 patients with solitary or multiple CLRM (up to 5 lesions, one of which ≥ 4 cm) were enrolled in this study. Patients were treated from October 2019 until December 2020. The treatment strategy consisted of same MWA followed by DEBIRI TACE for intensification of the effect. Adverse events and periprocedural complications were clinically assessed. Local efficacy was evaluated at 1-, 3-, 6- and 12- months intervals with imaging studies and measured by mRECIST criteria.

Results: 21 tumors ranging in size from 27-62mm in diameter were analyzed. Patients mean age was 66.4 ± 6.185 years. Complete response of the target lesion treated with combined approach was achieved in 68.8% and partial response in 31.2% on the first follow up. The median follow up period was 18.6 months. Complete treatment rate was 76.1% (16/21). The objective response rate was 78.3%. 12 months survival rate was 84.61%. Progression free survival (PFS) and overall survival (OS) were 6.2 months and 14.3 months respectively. A total of 4 patients died during the follow up period due to tumor progression. No major periprocedural complications were recorded.

Conclusion: Preliminary results from this cohort shows that single session MWA in combination with DEBIRI TACE is safe and effective treatment option for selected patients with CLRM larger than 4cm.

P-35

Safety of CT-guided microwave ablation of subcardiac liver tumors

Kis B¹, Johnson W², Weekley A², Parikh N¹, El-Haddad G¹, Mhaskar R²

¹Moffitt Cancer Center, Tampa, United States of America,

²University of South Florida Morsani College of Medicine, Tampa, United States of America

Purpose: Tumor location in close proximity to the heart is believed to be a contraindication for microwave ablation (MWA) due to suspected increased risk of life-threatening complications including arrhythmias, bleeding, cardiac tamponade, and diaphragmatic hernia. The purpose of this study was to investigate the complications following CT-guided MWA of subcardiac hepatic tumors.

Materials and methods: This retrospective study included 19 patients who underwent CT-guided MWA of 22 subcardiac tumors (6 hepatocellular carcinomas and 16 metastases) from January 2016 through December 2020. Hydrodissection was not used. Subcardiac ablation was defined as the ablation zone extended ≤ 5 mm from the myocardium. The safety of MWA of subcardiac tumors was evaluated based on procedural and post-procedural complications, and intra-procedural ECG changes.

Results: The technical success rate was 100%. The median follow-up was 20.86 months. Tumor largest diameter and tumor volume were 2.14 ± 1.03 cm and 5.05 ± 8.59 cm³, respectively. Tumor distance was 0.92 ± 0.74 cm and ablation zone distance was 0.34 ± 0.11 cm from the heart. The ablation zone largest diameter and ablation zone volume were 4.77 ± 1.20 cm and 28.72 ± 33.84 cm³, respectively. There was no 30-day mortality. One grade 3 complication occurred and there were 19 events of grade 1 or 2 complications. No instances of cardiac complications or significant procedural ECG changes.

Conclusion: CT-guided MWA of subcardiac hepatic tumors is safe even without hydrodissection, and MWA should be considered as an option for managing subcardiac tumors.

P-36

Long-term comparative study of the local tumour control of different ablation technologies in primary and secondary liver malignancies

Kovács A¹, Bischoff P¹, Zhou W¹, Haddad H¹, Pinkawa M¹

¹MediClin Robert Janker Klinik, Bonn, Germany

Purpose: The aim of the work was to evaluate local tumour control (LTC) by image-guided thermal and non-thermal local ablation techniques (LAT) in liver malignancies in the long-term course.

M&M: In patients treated with LAT between 1/2013 and 10/2020 pre-interventional planning was performed on MRI and CT, and imaging follow-up on MRI. Target lesions were characterised by histology, dimensions in three spatial axes, volume, vascularisation and challenging (CL) or non-challenging localisations. LAT were: RFA, MWA, CRYO, ECT and IBT.

Results: 211 LAT were performed in 155 patients. Mean follow-up including MRI for all patients was 11 months. Most frequent indications were CRC metastases in 40%, breast cancer (BrC) metastases in 23% and HCC in 7%. Lesions treated with ECT and IBT were significantly larger and significantly more often located in CL in comparison to RFA, MWA and CRYO. Best LTC (all data for 12 months are given below) resulted after RFA (93%), followed by ECT (81%), CRYO (70%), IBT (68%) and MWA (61%), and further for HCC (93%), followed by CRC (83%) and BrC (72%), without statistically significant differences. LTC in hypovascular lesions was worse (64%), followed by intermediate (82%; $p=0.01$) and hypervascular lesions (92%; $p=0.07$). Neither diameter, nor volume, nor CL had a significant impact on LTC (<3 cm:81%; 3-6cm:74%; >6 cm:70%) (<10 cm:80%; 10-20cm:86%; >20 cm:67%)(75% in CL vs. 80% in nonCL). In CL, best LTC resulted after ECT(76%) and IBT(76%).

Conclusion: In interventional oncology units different LATs should be available in order to be able to offer the best individualised therapies, regardless of lesion size and location.

P-37

Application of multimodal analgesia in pain management of patients with HCC after transarterial chemoembolization with drug-eluting beads for hepatocellular carcinoma

Li J¹

¹Shandong Cancer Hospital and Institute, jinan, China

Purpose: To investigate the effect of multimodal analgesia on the negative emotion and pain of patients undergoing transarterial chemoembolization with drug-eluting beads (DEB-TACE) of hepatocellular carcinoma (HCC). **Material and methods:** 142 patients with HCC who will be treated by D-TACE in our hospital between October 2019 and March 2021 will be divided into two groups according to the random number table method. The control group and the multi-mode group, 71 cases each. Then compare the changes of negative emotion and pain degree of the two groups of patients.

Results: From the analysis of the pain degree of patients at 12 h, 24 h, and 48 h after D-TACE treatment, the NRS scores of the observation group were significantly lower than those of the control group, and the difference was statistically significant ($P < 0.05$). In terms of the improvement of the postoperative mental state of the patients, the scores of anxiety and depression control of the observation group were (42.04 ± 3.10) and (43.20 ± 3.56) points, respectively, while the control group was (57.39 ± 2.67) points respectively. And (58.89 ± 3.89) points, the difference was statistically significant ($P < 0.05$). In terms of nursing satisfaction, the satisfaction rate of patients in the observation group was 98.21%, and that of the control group was 83.98%, the difference was statistically significant ($P < 0.05$).

Conclusion: Multi-modal analgesia therapy for liver cancer patients receiving D-TACE treatment can effectively improve the analgesic effect of patients and improve their negative emotions. It is expected to be further promoted in clinical practice.

P-38

Callispheres drug-loaded microspheres for transhepatic arterial chemoembolization in patients with intermediate to advanced hepatocellular carcinoma

Li J¹

¹Shandong Cancer Hospital and Institute, jinan, China

Purpose: To study and analyze the therapeutic effect of Callispheres drug-loaded microspheres transhepatic arterial chemoembolization (D-TACE) applied to patients with intermediate and advanced hepatocellular carcinoma. **Material and methods:** 80 patients with intermediate and advanced hepatocellular carcinoma admitted to Shandong Cancer Hospital between August 2019 and June 2020 were selected and divided into control group (40 patients) and experimental group (40 patients) by randomized number table method, the control group adopted conventional hepatic artery chemoembolization (TACE), the experimental group adopted iodinated oil + Callispheres drug-loaded microspheres.

The control group was treated with conventional hepatic artery chemoembolization (TACE), and the test group was treated with iodinated oil + Callispheres drug-loaded microspheres (D-TACE). The treatment efficacy and survival rate of patients in both groups were observed and analyzed.

Results: The disease remission rate of the experimental group was 84.56% higher than that of the control group, which was 59.02% ($\chi^2=3.783, P=0.038$), and the disease control rate of the experimental group was 90.36% higher than that of the control group, which was 65.28% ($\chi^2=4.876, P=0.029$); the survival rate at 12 months after surgery was 61.30% in the experimental group, which was significantly higher than that of the control group, which was 22.29%, The difference between the two groups was statistically significant ($\chi^2=4.985, P=0.027$). **Conclusion:** Callispheres drug-loaded microspheres transhepatic arterial chemoembolization (D-TACE) has significant therapeutic effects in patients with intermediate to advanced hepatocellular carcinoma, effectively relieving the disease and prolonging survival time.

P-39

Clinical observation of D-TACE combined with lenvatinib for advanced hepatocellular carcinoma

Li J¹

¹Shandong Cancer Hospital and Institute, jinan, China

Purpose: To investigate the efficacy and complications of Callispheres drug loaded microspheres embolization intervention (D-TACE) combined with Lenvatinib for advanced liver cancer.

Material and methods: 30 patients with advanced hcc in our department who met the inclusion criteria were treated with D-TACE combined with lenvatinib, and the clinical efficacy was evaluated.

Results: The disappear rate of blood flow signals within tumor was 88.6%, the AFP turn to normal levels was 78.1%, tumor shrink rate was 59.8%, objective response rate (ORR) and disease control rates (DCR) were 52.3% and 84.7%, survival rate of 6 months and 12 months were 84.2% and 63.5% respectively. In 3 cases of complete remission (CR) and 12 cases of partial remission (PR), 16 patients were still receiving treatment, did not appear unexpected toxicity, side effects were controllable.

Conclusion: D-TACE combined with lenvatinib in the treatment of advanced HCC can significantly improve the short-term efficacy, and does not increase the toxic and side effects.

P-40

Early radiological response to 166Holmium radioembolization: single center experience

Lorenzoni G¹, Bargellini I¹, Bozzi E¹, Cervelli R¹, Bianchi F², Boni G², Traino C³, Cioni R¹, Crocetti L¹

¹Pisa University Hospital/Department of Interventional Radiology, Pisa, Italy, ²Pisa University Hospital/Department of Nuclear Medicine, Pisa, Italy, ³Pisa University Hospital/Department of Health Physics, Pisa, Italy

Purpose: To retrospectively analyze early radiological tumor response to 166Holmium radioembolization (166Ho-RE) in a series of patients with primary and secondary liver tumors.

Materials and methods: We retrospectively collected the data of patients treated with 166Ho-RE from January 2018 to July 2021. Post-treatment dosimetry was assessed by SPECT-CT. Target and overall tumor responses were assessed on triphasic CT at 6 ± 2 weeks, using Response Evaluation Criteria in Solid Tumors (RECIST) 1.1 for all tumor types, and, additionally, modified RECIST (mRECIST) for hepatocellular carcinoma (HCC) and arterially enhancing metastases. In patients with disease control, subsequent response was assessed at 12 ± 2 weeks, to identify early best radiological response.

Results: Twenty-six patients were included (21 male; mean age 70.6 ± 8.7 years) with intrahepatic cholangiocarcinoma (ICC; n=5), HCC (n=12) and metastases (n=9). Median administered activity was 3.54 GBq and median average tumor absorbed dose (TAD) was 107 Gy. Best target and overall OR rates were 50% and 42.3%, respectively, with corresponding DC rates of 76.9% and 57.7%. Early tumor shrinkage as to achieve PR by RECIST 1.1 was observed in 7/26 patients, allowing liver transplantation in one HCC case and resection in an ICC patient. Target response was significantly associated to TAD, with a minimum threshold of 118 Gy to achieve OR (AUC 0.85).

Conclusions: 166Ho-RE is a safe and effective treatment option in primary and secondary liver tumors. Early reduction in tumor size is evident in over 25% of patients. Further studies are needed to implement personalized dosimetry.

polyvinyl-alcohol particles. DEM-TACE was performed with superabsorbent polymer microspheres (Hepasphere, Merit Medical) with diameter (dry state) 30-60 microns, preloaded with doxorubicin (75 mg/vial of microspheres). Each patient received at least 2 TACE sessions with subsequent on demand TACE depending on tumor response and patient's status. Tumor response was evaluated with mRECIST system. Overall survival (OS) and time to progression (TTP) were calculated (Kaplan Meier method) and compared. Complications were also recorded and compared.

Results: 32 patients underwent c-TACE (mean: 2.46 sessions/patient) and 32 DEM-TACE (mean: 2.43 sessions/patient). Baseline demographic and clinical characteristics of the 2 groups were not statistically significant ($p > 0.05$). Tumor response was: 0/32 and 2/32 patients with complete response, 10/32 and 11/32 with partial response, 12/32 and 11/32 with stable disease, 10/32 and 8/32 with progressive disease for c-TACE and DEM-TACE, respectively. Difference in objective response between groups was not statistically significant ($p = 0.60$). Median OS and median TTP was 30 vs 36 months ($p = 0.003$) and 4 vs 5 months ($p = 0.027$) for c-TACE and DEM-TACE, respectively. All patients experienced post-embolization syndrome, but no major complication was observed.

Conclusions: DEM-TACE with 30-60 Hepasphere appears to achieve better OS and TTP compared to c-TACE, while maintaining a satisfactory safety profile.

P-42

withdrawn by authors

P-41

Conventional versus drug-eluting microspheres chemoembolization of hepatocellular carcinoma. A randomized comparison of 64 patients

Moschouris I¹, Kiakidis T², Liarakos A³, Spanomanolis N¹, Bisyrri K¹, Malagari K²

¹General Hospital Tzanio, Radiology Dpt, Piraeus, Greece,

²Evgenidion University Hospital, Radiology Dpt, Athens, Greece,

³General Hospital Tzanio, 2nd Dpt of Surgery, Piraeus, Greece

Purpose: To compare conventional transarterial chemoembolization (c-TACE) and drug-eluting microspheres TACE (DEM-TACE) as interventional treatments for patients with hepatocellular carcinoma (HCC) not eligible for curative treatment.

Materials and methods: 64 HCC, BCLC-B patients were randomized. c-TACE was performed with a mixture of Lipiodol-doxorubicin (5ml-50mg) followed by embolization with

P-43**Non-hypervascular hepatobiliary phase hypointense lesions detected in patients with hepatocellular carcinoma: risk factors for progression after treatment**

Öcal O¹, Zech C², Fabritius M¹, Sangro B³, Malfertheiner P⁴, Ricke J¹, Seidensticker M¹

¹Ludwig-Maximilians-University Munich, Department of Radiology, Munich, Germany, ²University Hospital Basel, Radiology and Nuclear Medicine, Basel, Switzerland, ³Clínica Universidad de Navarra and CIBEREHD, Liver Unit, Pamplona, Spain, ⁴Ludwig-Maximilians-University Munich, Department of Medicine II, Munich, Germany

Purpose: The aim of this study was to identify clinical and imaging parameters for the progression of non-hypervascular hepatobiliary phase hypointense lesions during follow-up in patients with hepatocellular carcinoma.

Material and Methods: Out of 538 patients screened within the SORAMIC trial, a total of 67 patients with 106 lesions were identified. All patients were allocated to treatment according to the trial scheme. 61 of 67 patients received systemic treatment with sorafenib, either alone or combined with locoregional therapies during the trial period. Follow-up images after treatment obtained according to the trial protocol were reviewed for subsequent hypervascularization or >1cm size increase. The risk factors for progression were assessed using univariable and multivariable analyses.

Results: On a median 178 (range, 48-1072) days follow-up period, progression was encountered in 18 (16.9%) lesions in 12 (17.9%) patients. Univariable analysis revealed size >12.6 mm ($p=0.070$), ECOG-PS ($p=0.025$), hypointensity at T1-weighted imaging ($p=0.028$), hyperintensity at T2-weighted imaging ($p<0.001$), hyperintensity at DWI images ($p=0.007$), and cirrhosis ($p=0.065$) as risk factors for the progression during follow-up. Hyperintensity at T2 images ($p=0.011$) was an independent risk factor for progression in multivariable analysis, in addition to cirrhosis ($p=0.033$) and ECOG-PS ($p=0.030$).

Conclusion: Non-hypervascular hepatobiliary phase hypointense lesions carry a risk for subsequent progression after treatment in patients with HCC. T2 hyperintensity, cirrhosis, and higher ECOG-PS could identify lesions with increased risk. Lesions with these risk factors should be considered for further diagnostic evaluation or treatment.

P-44**Ablation completeness assessment by intraprocedural image fusion decreases local tumor progression rate after percutaneous liver thermal ablation**

Overduin C¹, Jenniskens S¹, Arntz M¹, Tjwa E², Stommel M³, van den Boezem P³, Fütterer J¹

¹Medical Imaging, Radboud University Medical Center, Nijmegen, Netherlands, ²Gastroenterology, Radboud University Medical Center, Nijmegen, Netherlands, ³Surgery, Radboud University Medical Center, Nijmegen, Netherlands

Purpose: To assess local outcome of percutaneous liver ablation before and after introduction of intraprocedural ablation completeness assessment.

Material and Methods: Patients treated with percutaneous thermal ablation for hepatic malignancy between January 2017 and December 2020 who were ≥ 12 months after treatment were retrospectively included. Since October 2019, image fusion for ablation completeness assessment was introduced to our clinical workflow. Pre- and immediate post-ablation contrast-enhanced CT scans were co-registered using Vitrea CT liver analysis application (Canon Medical, Japan). Upon visual inspection of adequate registration, fusion overlay was used to assess ablation completeness. When incomplete ablation was suspected, additional ablation could be performed at the discretion of the treating physician. Local tumor progression (LTP) was assessed on follow-up imaging.

Results: 96 patients with 119 liver tumors met the inclusion criteria. Image fusion assessment had been used in 27/119 (23%) cases. Median follow-up was 18 months (range: 2-46). LTP was observed in 1/27 (4%) cases assessed with image fusion versus 33/92 (36%) in those without. Median time to local tumor progression was 7 months (range: 1-33). 1-yr LTP-free survival was significantly improved between cases assessed with versus without image fusion (93% vs. 71% respectively) ($p=0.013$). Additional ablation was performed in 9/27 (33%) cases assessed with image fusion versus 12/92 (13%) without.

Conclusion: Intraprocedural ablation completeness assessment resulted in additional ablation in ~20% of lesions and decreased local tumor progression rate following percutaneous liver ablation. Further research into the impact and implications of ablation confirmation analysis are paramount for adequate implementation.

P-45

Our experience with FLEXdose Delivery Programme: opinions and results

Paladini A¹, Spinetta M, Borzelli A, Pane F, Sassone M, Galbiati A, Guzzardi G

¹AOU „Maggiore della Carità“, Novara, Italy

Purpose: Thanks to new Barcelona's guidelines, SIRT has an important role in the management of Patients affected by unresectable HCC. The treatment has an excellent safety profile and many studies document its effectiveness. On the other hand, HCC is a very complex pathology and it is not uncommon to deal with technical difficulties during its treatment. Flex-dose could be the answer to difficult vascular anatomy.

Material and methods: Between January 2020 and November 2021, we treated 15 patients affected by unresectable HCC following the new Flex-dose delivery program. The interventional radiologist was able to „customize“ the treatment basing on the vascular anatomy of the HCC, in order to perform SIRT by splitting therapy in one or more target vessels. Response to treatment was assessed with CT scans performed 6 and 9 months after treatment.

Results: 18 patients were included in the study. Complete treatment was performed in 15 of them, with two exclusions due to pulmonary shunt > 20% and one death for other reasons. Follow-up documented according to mRECIST: CR (28.5%), PD (14.3%) and PR (57.2%) values were assessed. No intra and post-operative complications reported.

Conclusion: Thanks to flex-dose delivery program large portions of healthy liver parenchyma could be spared by radio-embolic therapy. Moreover, the interventional radiologist could better deliver the dose into target lesion. As a consequence we think that flex-dose delivery program could increase the cohort of patients that can be treated with TARE.

P-46

Safety and efficacy of percutaneous cryoablation for liver tumours in patients with history of a biliary tract procedure

Piana G¹, Thierry L¹, Dassa M¹, Izaaryene J¹

¹Paoli Calmettes Institute / interventional radiology, Marseille, France

Purpose: A history of biliary tract procedure is a known relative contraindication to percutaneous liver radiofrequency ablation due to an increased risk of liver abscess. The purpose of this study is to evaluate whether percutaneous cryoablation could be a safe and effective alternative in such cases.

Material and methods: Between November 2018 and September 2021, 12 patients with history of biliary tract procedure (10 biliodigestive anastomosis, 1 biliary stent, 1 biliary sphincterotomy) underwent 23 CT-guided percutaneous cryoablation for 27 hepatic tumours (20 metastases, 6 hepatocarcinoma, 1 cholangiocarcinoma).

The rates of technical success, complete ablation, complication, and local tumour progression were retrospectively evaluated.

Results: Median duration follow-up was 12 months.

Mean tumour diameter was 18mm. Technical success rate was 95.5%. Complication rate was 26% according to the CTCAE classification. No complication \geq grade 2 (especially no liver abscess) occurred. 6 grade 1 complications (2 subscapular haematomas, 1 pleural effusion, 1 lung atelectasis, 1 mild abdominal pain and 1 spontaneously resolved febrile episode) were identified. Average length of hospital stay after the procedure was one day. Complete ablation rate was 89 %. Local tumour progression rate was 9 % (2 recurrences respectively diagnosed at 8 month and 12 month).

Conclusion: Percutaneous cryoablation for liver tumours in patients with history of biliary tract procedure seems to be safe and effective without increased risk of liver abscess.

P-47

Efficacy and safety of local treatments in hepatocellular carcinoma (HCC): a propensity score-based comparison of stereotactic body radiation therapy versus thermal ablation

Porette D¹, Franzese C¹, Ceriani C¹, Pedicini V¹, Lanza E¹, Comito T¹, Scorsetti M¹

¹Humanitas Research Hospital, Rozzano, Italy

Purpose: Hepatocellular carcinoma (HCC) is the third cause of death worldwide. Our aim was to analyse a large monocentric group of HCC patients treated with thermal ablation (TA) or stereotactic body radiation therapy (SBRT).

Material and methods: We included HCC treated with TA or SBRT between 2010 to 2020. Inclusion criteria for TA were: diagnosis of HCC with pathological confirmation or typical imaging features; tumors deemed inoperable; Child-Pugh B, HBV positive, with metabolic syndrome. Median follow-up was 19 months. 1- and 2-years LC was 78.6% and 65.7% for TA and 87.9% and 79.5% for SBRT. After application of propensity score, the superiority of SBRT was not confirmed ($p = 0.235$). OS at 1 and 2 years was 95.4% and 81.6% for TA and 78.6% and 48.0% for SBRT. After adjusting for propensity score, OS was comparable between the two groups ($p = 0.060$).

Results: We included 576 lesions and 334 patients, 201 (60.2%) underwent TA and 133 (39.8%) underwent SBRT. Patients were more likely treated with SBRT if BCLC stage C, Child-Pugh B, HBV positive, with metabolic syndrome. Median follow-up was 19 months. 1- and 2-years LC was 78.6% and 65.7% for TA and 87.9% and 79.5% for SBRT. After application of propensity score, the superiority of SBRT was not confirmed ($p = 0.235$). OS at 1 and 2 years was 95.4% and 81.6% for TA and 78.6% and 48.0% for SBRT. After adjusting for propensity score, OS was comparable between the two groups ($p = 0.060$).

Conclusion: we confirm the efficacy and safety of TA and SBRT for the management of HCC. With the use of propensity score we demonstrated comparable results between the two treatment options.

P-48**Time to degradation and long-term disappearance of image-able drug eluting microspheres following embolization up to 5 years later**

Rivera J¹, Hazen L¹, Kassim M¹, Christou A¹, Lee K¹, Garcia C¹, Levy E¹, Xu S¹, Saad W¹, Negussie A¹, Karanian J¹, Pritchard W¹, Mikhail A¹, Wood B¹

¹National Institutes of Health / Center for Interventional Oncology, Bethesda, United States of America

Purpose: To characterize the changes in appearance on CT of image-able microspheres in the months and years following liver tumor embolization.

Materials and methods: 17 patients were assessed with 117 CT scans following 31 embolization sessions with radiopaque microspheres. The CT features were assessed subjectively and using image processing metrics to assess the distribution and degree of radiopacity from the initial follow-up CT to most recent CT. CTs showing measurable signs of opacity degradation or changed location were recorded. The follow up interval was recorded when sphere degradation was initially noticeable on review by IR radiologist.

Results: 17 patients and 117 CTs (mean 6.9 CTs/patient) revealed 31 embolization sessions (mean 1.8 sessions/patient, range 1-4 sessions) over a 5 year follow-up period. Imageable microsphere degradation over time was noted, all the way to regional partial vs total disappearance between the initial and long-term follow up CTs. Serial and gradual degradation of radiopacity is demonstrated on CT in multiple patients with up to 5 years of serial CTs.

Conclusion: Patterns of long-term opacity of radiopaque microspheres in humans is poorly defined (stability, degradation or change). Pre-clinical swine survival studies had demonstrated 90 day stability in CT appearance of iodinated imageable microspheres, without substantive visible degradation. The rate of imageable microsphere degradation is variable among a pilot population of patients. CT appearance of imageable iodinated microsphere beads showed some acute stability however long-term degradation in the years following embolization. This included total disappearance of beads and columns in some cases.

P-49**Successful endovascular embolization of hepatic artery in patients with hemoperitoneum due to bleeding ruptured hepatocellular carcinoma (HCC)**

Borzelli A¹, Amodio F¹, Sassone M², Coda C², Giurazza F¹, Corvino F¹, Cangiano G¹, Paladini A², Cavaglià E¹, Silvestre M¹, de Magistris G¹, Niola R¹

¹Vascular and Interventional Radiology, AORN A.Cardarelli, Napoli, Italy, ²SCDU Radiologia Diagnostica ed Interventistica, AOU Maggiore della Carità, Novara, Italy

Purpose: Evaluate feasibility, safety and clinical efficacy of selective hepatic artery endovascular embolization in patients with hemoperitoneum due to ruptured HCC

Material and methods: Between January 2019 and January 2022 we retrospectively considered 18 patients

(11 M 7F; medium age 64) with liver cirrhosis and history of HCC, all of them hemodynamically stable, with lowering of serum hemoglobin values and CT evidence of hemoperitoneum, with active bleeding due to ruptured HCC. We considered for each patient: the percentage of hemoglobin value lowering, the entity of hemoperitoneum and the evidence of contrast blush on CT. All patients underwent subsequent selective endovascular embolization of hepatic artery division branches supplying the ruptured HCC; embolic agents used were coils, PVA and Gelfoam. We considered as success of procedures the absence of active bleeding at post-embolization angiogram and at follow-up CT of abdomen, with significant improvement of serum hemoglobin values, and as complications related to procedures the rebleeding rate and the incidence of hepatobiliary complications during follow-up. **Results:** In 16 patients (90%) selective hepatic artery embolization was successful, with no evidence of rebleeding at follow-up and significant improvement of serum hemoglobin values, while 2 patients (10%) died during follow-up due to hemorrhagic shock after the embolization. Among the 16 surviving patients, 2 of them (10%) developed hepatobiliary complications: hepatic abscess in 1 patient and biloma in the other one. The hepatobiliary complications were successfully managed by image-guided percutaneous drainage; none of the patients underwent hepatic resection or surgical approach. **Conclusions:** Transcatheter endovascular embolization is a feasible, safe and clinically effective procedure in cirrhotic patients with hemoperitoneum due to ruptured HCC, not only to immediately stop bleedings, but also to reduce the rate of surgical approach in such delicate patients.

P-50**Percutaneous biliary drainage in patients with non-dilated intrahepatic bile ducts: the importance of peripheral portal vein-oriented puncture**

Borzelli A¹, Corvino F¹, Sassone M², Coda C², Amodio F¹, Giurazza F¹, Paladini A², Pane F³, Cangiano G¹, de Magistris G¹, Cavaglià E¹, Niola R¹

¹Vascular and Interventional Radiology, AORN A.Cardarelli, Napoli, Italy, ²SCDU Radiologia Diagnostica ed Interventistica, AOU Maggiore della Carità, Novara, Italy, ³Radiology, AORN S.G. Moscati, Avellino, Italy

Purpose: Highlight the role, safety and clinical efficacy of peripheral portal vein-oriented non-dilated bile duct puncture for percutaneous transhepatic biliary drainage, describing execution technique and materials used

Material and methods: Between June 2018 and January 2022 we retrospectively considered 22 patients (12M 10F; medium age 58) affected by benign (8) and malignant (10) bilio-enteric anastomotic stricture and iatrogenic biliary leakage (4). A US-guided percutaneous transhepatic puncture, employing a 21G needle, was performed, along the running course of a peripheral non-dilated bile duct (usually B6 for the right lobe; B3 for the left lobe) or along the respective accompanying portal vein division branch, if the bile duct was too narrow to be clearly visualized. Thus, an insertion angle <30° between the needle and the bile duct running course was actualized: the needle was then advanced slightly over the portal vein.

The needle was moved slightly back, injecting a small amount of contrast agent, to get opacification of the target bile duct, followed by insertion of .018" guidewires. Biliary drainages were then performed employing 5Fr introducer-sheaths and catheters, .035" hydrophilic and stiff guidewires and 8,5Fr catheters for the drainage

Results: Technical success was 95%(21/22): a right side approach was performed in 14 cases, a left side approach in 8 cases. In 19 patients the drainage was successful in a single-step approach, in the remaining 3 patients a second attempt was necessary. The procedure was successful in 2 cases, but in 1 patient the second attempt failed, probably because of poor compliance of the patient. No major complications reported; we observed as minor complications (13%) only 2 cases of transient hemobilia and 1 case of cholangitis with fever

Conclusion: Peripheral portal vein-oriented bile duct puncture is safe and effective to perform transhepatic biliary drainage in patients with non-dilated bile ducts.

P-51

Adopting stereotactic CT-guided radiofrequency ablation – an initial hospital experience

Shaïda N¹, Eigl B²

¹Addenbrookes Hospital, Cambridge, United Kingdom,

²Cascination AG, Bern, Switzerland

Purpose: Stereotactic ablation is an advancement of conventional CT-guided ablation that utilises computer-assisted planning, execution, and confirmation of the procedure. One advantage of stereotactic ablation is the widening of access windows from in-plane trajectories to more angulated, off-plane trajectories. Physicians can create and accurately execute trajectories with optimised spatial relations to the tumour and risk structures.

Materials and methods: We reviewed our first 10 stereotactic ablations and illustrate the characteristics of the planned and executed trajectories.

In 2021, stereotactic radiofrequency ablation of liver cancer featuring the CAS-One IR system was introduced at our hospital. Tumour diameter (longest diameter in the axial plane), trajectory access (i.e., intercostal), in- and off-plane angles (Axial and Sagittal), length of instrument insertion and accuracy of placement were assessed.

Results: 11 tumours with a median diameter of 25 mm (17-36) were treated in 10 sessions with a total of 17 instruments. All trajectories were intercostal with in- and off-plane angles of -65° (-76 to -41) and 19° (5 to 27), respectively. Instruments were inserted over a length of 108 mm (101-123), resulting in a lateral and angular displacement of 4 mm (4-7) and 3° (2-6), respectively. The instruments were only advanced/retracted along the insertion direction with no need for repositioning. No complications occurred.

Conclusion: The use of computer assistance in percutaneous procedures resulted in high accuracy in placement from the very first case and enabled targeting strategies that would have been challenging with the traditional freehand approach.

P-52

Comparison of transarterial chemoembolization (TACE) with drug-eluting embolics loaded with doxorubicin versus idarubicin in intermediate stage hepatocellular carcinoma: a propensity score matching phase II study

Hanameel F¹, Guerrab A¹, Beydoun N¹, Silvain C⁴, Herpe G¹, Velasco S¹, Ingrand P³, Tasu JP^{1,2}

¹Department of interventional radiology, University Hospital of Poitiers, Poitiers, France, ²LaTim, UBO and INSERM 1101, University of Brest, Brest, France, ³CIC 1402, Clinical Investigation center, Bio-statistic and epidemiology, University of Poitiers, Poitiers, France, ⁴Department of hepatology, University hospital of Poitiers, Poitiers, France

Purpose: The objective of this study was to compare idarubicin-based TACE (Ida-TACE) with doxorubicin-based TACE (Dox-TACE) for rate of objective response and overall survival.

Materials and methods: A prospective study was conducted between May 2017 and February 2021 in one center including patients with indication for TACE for intermediate stage HCC. Inclusion criteria were patients with Child-Pugh score A or B, BCLC B without prior history of TACE. TACE were performed with 10 mg of idarubicin charged with LifePearlTM (Ida-TACE, studied group). A control group of patients treated by chemoembolization with 50-75 mg of doxorubicin charged with DC-Beads (Dox-TACE, control group) was retrospectively selected to match the study group. TACE feasibility, response according to mRECIST at 4-6 weeks, adverse events rate and overall survival was compared between the two groups. Statistical analysis was performed using SAS software 9.4. Type 1 error was 0.05.

Results: Twenty-three patients were included in the studied group and matched with twenty-three patients in a control group. The matching propensity score included age, Child-Pugh score, and size of HCC. Feasibility was 100% in the study group. Complete response was 47.8% and 39.1% in studied group and control group, respectively (exact McNemar's test P=0.73). Complication rates were similar in both groups. Despite a tendency to a better overall survival with Ida-TACE, overall survival was not significantly improved (hazard ratio 0.41; 95% CI [0.14 - 1.18]; logrank P=0.091).

Conclusion: This study failed to find advantages for Ida-TACE compared to Dox-TACE.

P-53

Role of cone-beam CT in the intraprocedural evaluation and guidance of percutaneous thermal ablation of hepatocellular carcinoma

Tradi F¹, Louis G¹, Chopinet S², Vidal V¹

¹Department of Diagnostic and Interventional Radiology, La Timone University Hospital, Marseille, France, ²Department of Digestive Surgery and Liver Transplantation, La Timone University Hospital, Marseille, France

Purpose: To assess the usefulness of C-arm cone beam computed tomography (CBCT) with intra-arterial injection for the treatment of hepatocellular carcinoma (HCC) by radiofrequency ablation (RFA).

Methods: This retrospective study analyzed data from patients with HCC that underwent RFA guided by angio-CBCT. Inclusion criteria were HCC not visible under ultrasound or with a maximal diameter > 3cm. Preoperative and postoperative characteristics, including operation time, ablation time, radiation dose, complications using the CIRSE classification system and hospital stay were recorded for all patients. The technical success of RFA and local tumor progression after RFA session were evaluated by dynamic contrast-enhanced imaging methods at 1, 3, 6 and 12 months.

Results: Between 2017 and 2021, 50 patients (40 male; mean age 65 years old) for a total of 62 nodules were included (mean diameter: 21 ± 12 mm). No technical failure occurred. Median time from arterial puncture to RFA probe position confirmation was 36 min (+/-7 min). Median number of RFA probe positioning or repositioning to reach the target tumor was 1 (1-3). Segmental portal vein thrombosis was depicted and ablated on 4 patients and multifocal HCC was depicted on 5 patients and addressed by chemoembolization during the same session. The complete ablation rate was 94% (58/62 nodules). Local free progression was 90% at 12 months. Four grade 3 complications occurred, no grade 4 or 5 complications occurred.

Conclusion: CBCT guidance is a sensitive diagnostic and accurate guidance modality for percutaneous thermal ablation in patients with HCC.

P-54

Augmented reality assisted CT guided puncture: a phantom study

Van Den Bosch V¹, Salim H², Chen N², Stroosma O², Bruners P¹, Kuhl C¹, Pedersoli F¹, Isfort P¹

¹Uniklinik RWTH Aachen, Aachen, Germany, ²Philips Research Europe, Eindhoven, Netherlands

Purpose: To investigate the feasibility of a novel AR system using the HoloLens 2 for performing CT-guided liver interventions.

Material and methods: A new kind of AR system was developed, offering projection of CT-images and live optical tracking of the needle position as well as a bull's eye view as well as a visualization of the distance to the target. The experiment was performed using a custom-made abdominal agar-agar phantom that contained digitized target locations. Three radiologists with different levels of expertise performed the experiment, performing 40 punctures, thereof 20 free-hand and 20 with AR-guidance. A CT-simulator software was used for the free hand punctures, sparing long CT-scanning times and so allowing more punctures to be executed. Semi-structured interviews were performed after the experiment. For the statistical analysis, a two-tailed Wilcoxon Signed-Rank test was performed.

Results: Duration of intervention was significantly ($p < 0.05$) improved in all operators with a mean of 110,9 seconds in the free hand punctures and 38,7 seconds in the AR punctures. The mean accuracy was 4,7 mm in the free hand group, while being 5,0 mm in the AR group ($p > 0.05$). All radiologists rated the AR-setup positively. In particular, the use of underlying CT imaging, a familiar method in everyday clinical practice, was rated as advantageous.

Conclusion: This AR-system significantly reduces intervention time and has furthermore the potential to dramatically reduce the radiation burden to the patient. Thereby accuracy remains comparable.

P-55

Arterial enhancement as predictive factor of the response to radioembolization of intrahepatic cholangiocarcinoma: qualitative and radiomics assessments on MRI

Vlasselael M¹, Levillain H², Chao S², Paquier Z², Flamen P³, Vouche M¹

¹Jules Bordet Institute, Department of Radiology, Brussels, Belgium,

²Jules Bordet Institute, Medical Physics Department, Brussels,

Belgium, ³Jules Bordet Institute, Nuclear Medicine Department, Brussels, Belgium

Purpose: radioembolization for intrahepatic cholangiocarcinoma is considered a promising therapeutic option because it may offer local tumor control and potential downsizing for resection. This study aimed to identify, on MRI, predictive factors of response to radioembolization focusing on arterial enhancement characteristics and to see if quantitative analysis using radiomics better predicts response to treatment than qualitative analysis in the context of the growing interest in radiomics.

Materials and methods: multicentric study including retrospectively patients who underwent radioembolization between 2004 and 2020 with pre- and post-radioembolization MRI. Conventional and radiomic analyses were conducted on arterial enhanced T1-weighted sequence. The endpoint was the objective response assessed using mRECIST or RECIST if the lesion was not enhanced initially.

Results: 28 lesions were analyzed. Responder lesions had a higher arterial enhancement than non-responder lesions (arterial enhancement pattern, $p < 0.0001$; mean intensity, $p = 0.0005$; skewness, $p = 0.02$). The qualitative analysis of the arterial enhancement pattern showed a sensitivity of 1 and a specificity of 0.83. The radiomic signature including mean intensity and skewness determined 4 cut-offs. One cut-off gave the best sensitivity of 0.94 and another one the best compromise between sensitivity and specificity at respectively 0.75 and 0.83. Both analyses showed that arterial enhancement was a predictive factor of the response to radioembolization with kappa tests showing a moderate agreement.

Conclusion: hyper-enhanced lesions are more likely to respond to radioembolization. Arterial phase enhancement could be quantified by radiomics but the qualitative analysis was more sensitive and specific to predict treatment response.

P-56

Safe liver thermal-ablation: technical consideration

Andresciani F¹, Pacella G¹, Altomare C¹, Stiffi M¹, Sertorio A¹, Grasso R¹

¹University Campus Bio-Medico of Rome, Rome, Italy

Percutaneous ablation is an accepted treatment modality for primary hepatocellular carcinoma (HCC) and liver metastases. The technology used has evolved rapidly in the last decades, with substantial improvements in terms of procedural security, expanding the indications of a percutaneous approach. Possible percutaneous approach include radiofrequency ablation (RFA), microwave ablation (MWA), cryoablation, irreversible electroporation (IRE), electrochemotherapy (ECT), laser and high intensity focused ultrasound (HIFU). It is therefore necessary that the Interventional Radiologist correctly choose the best ablative technique, based on the visibility and position of the tumor, also deciding the most appropriate imaging modality as a guide for the procedure. Finally, any ablative technique can produce complications, which can be classified as puncture-related and thermal complications; it is therefore necessary to choose whether to use various protection techniques to avoid damage to surrounding structures and organs. The aim of this work is to provide a guide on choosing the best ablative technique and suggestions to minimize the risk of complications during the execution of locoregional liver treatments.

P-57

Strategies to avoid biliary injuries during thermal ablation of primary and secondary liver tumors close to the biliary tree

Barabino E¹, Nivolli A¹, Ivaldi D¹, Gazzo P¹

¹Ospedale Santa Corona Pietra Ligure, Pietra Ligure (SV), Italy

Learning objectives: the aim of this educational review is to illustrate the techniques that could be employed to avoid biliary injuries during the thermal ablation of liver tumors close to the bile duct and its branches.

Background: during thermal ablation, the heat sink phenomenon protects most of the vascular structures of the liver (hepatic artery, portal vein, and hepatic veins) from thermal injuries; however, the flow within the biliary ducts is not sufficient to protect them from thermal damages that could cause stricture or occlusion. In recent years, several different techniques were developed to avoid biliary complications during thermal ablation of tumors close to the biliary tree.

Clinical findings/procedure details: this paper offers a pictorial review of the strategies to avoid biliary injuries and analyzes their advantages and drawbacks. Techniques to protect the biliary tree from thermal injuries can be included in 3 categories: (1) the avoidance of thermal injuries through the understanding of the principles of thermal ablation and of the

different technical characteristics of antennae, (2) strategies that create a physical or thermal barrier between the lesion and the biliary tree and (3) techniques that protect the bile ducts from within using cold perfusion.

Conclusion: several techniques could be employed to protect the biliary tree from thermal injuries. The interventional radiology could make use of these strategies to provide effective protection of the major bile ducts, to reduce the rate of biliary stricture or occlusion, and to make safer the treatment of lesions close to the biliary tree.

P-58

Tips and tricks for liver transarterial radioembolization from an experienced cancer center

Ciampi-Dopazo J¹, Ruiz-Villaverde G¹, Rodriguez-Fernández A, Navarro-Vergara P¹, Pardo-Moreno P¹, Sánchez-Ballestín M², Guirola-Ortiz J²

¹Hospital Universitario Virgen de las Nieves (Granada), Granada, Spain, ²Hospital Universitario Lozano Blesa, Zaragoza, Spain

Learning objectives: To describe patient selection.

To discuss relevant technical aspects about Transarterial Radioembolization (TARE). To describe clinical and image findings during treatment follow-up.

Background: TARE with yttrium-90 (90Y)-labeled microspheres has become an accepted, efficacious, and well-tolerated option for patients with liver malignant tumors (primary and metastases). This approach is appealing, as the mechanism of action is independent from other locoregional treatments and potentially complementary to systemic therapies. A multidisciplinary approach is necessary because of the complexity of the procedure.

Clinical findings/procedure details: An optimal selection of the patients and good planning arteriography are essential to obtain benefit and reduce complication rate.

The multidisciplinary board includes medical oncology, surgical oncology, radiation oncology and interventional radiology. Inclusion criteria are well defined in some oncological centers and these evaluate performance status and image/blood biomarkers.

Planning angiography before TARE treatment is essential to study tumor-feeding vessels and anatomic variants. Technetium-99m-labeled macroaggregated albumin is injected into the hepatic arteries to determine the magnitude of hepatopulmonary shunting and calculate tumor-absorbed dose in consequence these factors limit complications (will be detailed in text). Radioembolization can be performed via segmental or lobar approach. Efficacy variables are evaluated which includes progression-free survival, hepatic progression-free survival, objective response rate, disease control rate defined by RECIST version 1.1. It is essential a strict patient follow-up after performing TARE to rule-out toxicity.

Conclusions: Although TARE has been used mostly in hepatocellular carcinoma and metastases, indications are constantly evolving as the only treatment or in combination with other systemic or locoregional treatments.

P-59

Tips & tricks to an effective and precise liver thermal ablation

Rossi D¹, Mauri G², Bonomo G², Camisassi N², Della Vigna P², Maietti D², Varano G², Orsi F²

¹Postgraduate School of Radiodiagnostics, University of Milan, Milan, Italy, ²Division of Interventional Radiology, IEO, European Institute of Oncology IRCCS, Milan, Italy

Learning objectives:

- To describe several image-guidance modalities and their use in ablation, in particular:
 - Knowing the advantages of a full hybrid CT operational room
 - Real-time US guidance
 - Fusion imaging to combine intraprocedural acquired CT and US images
- To describe useful manoeuvres to enhance safety, precision and effectiveness of image-guided liver ablations such as:
 - Patient positioning, external compression, hydrodissection or gas insufflation to effectively displace at-risk organs

Background: Image-guide liver ablations are increasingly used to provide a minimally invasive treatment to patients with tumours, with good clinical results and low complications rates. Different imaging modalities can be applied to ablation, each with their specific advantages and disadvantages. Moreover, treatments might be complex if there is limited access for image guidance or a close proximity to critical structures, which can be unintentionally injured. Several manoeuvres can be applied to enhance their safety and effectiveness.

Procedure details include:

- Different image-guidance modalities with reference to our standard-of-care operating room setting consisting in a hybrid angiography CT solution and a US machine with dedicated fusion imaging software.
- The optimal image guidance, a routine application of fusion imaging and virtual navigation in the guidance and monitoring of the ablation procedure.
- Several protective manoeuvres with their pros and cons to avoid damaging to surrounding structures.
- Details regarding the comprehensive Patients' management before, during and after liver ablation.

Conclusion: A deep knowledge of all currently available ablation and image-guiding techniques, protective maneuvers and optimal operational room setting is needed to all interventional radiologists daily involved in liver ablation.

P-60

A case of disappearing liver metastases treated with microwave ablation and US-MRI fusion imaging guidance with the integration of pre-chemotherapy MRI

Barabino E¹, Arnò M¹, Pittaluga G¹, Gazzo P¹

¹Ospedale Santa Corona Pietra Ligure, Pietra Ligure (SV), Italy

Clinical history/pre-treatment imaging: Liver metastases that disappear after chemotherapy are known as "vanishing or disappearing metastases"; these lesions are difficult to manage because of their uncertain biological behavior. We present our solution to perform microwave ablation of disappearing liver metastases in a colorectal adenocarcinoma patient.

Treatment options/Results: A patient with a colorectal adenocarcinoma presented with 4 liver metastases after one year from surgery. After chemotherapy 2 metastases showed a significant volumetric reduction and 2 demonstrated complete radiological response. The patient was referred to our department to perform microwave ablation but, at the ultrasound evaluation, only one metastasis was visible. We resolved to perform the procedure employing US/MRI fusion guide and the pre-chemotherapy MRI, which showed all 4 metastases, as reference. MWA was performed using a 16g antenna. Radiological follow-up after 12 months showed no signs of recurrence.

Discussion: Fusion imaging has been reported valuable in guiding loco-regional treatments, however, the reference exam is usually performed a few days before the procedure to guarantee a high-fidelity matching with US images. In our case, the critical issue was the complete disappearance of two lesions which could result in incomplete treatment. With our procedure, we managed to treat all the possible sites in a single session with marginal parenchymal sacrifice and, to date, no local recurrence.

Take-home points: Locoregional therapies are effective in treating liver metastases, but intra-procedural detection of disappearing ones remains troublesome. US/MRI fusion imaging integrated with pre-chemotherapy imaging could be effectively employed in the treatment of disappearing liver metastases.

P-61

Transarterial chemoembolization in hepatocellular carcinoma with portal vein tumor thrombosis

Conde Vasco I¹, Costa N, Caetano A, Torres D, Veloso Gomes F, Bilhim T, Coimbra É

¹Unidade de Radiologia de Intervenção – Centro Hospitalar Universitário de Lisboa Central, Lisboa, Portugal

Learning objectives: To explore the treatment options in patients with hepatocellular carcinoma and portal vein tumor thrombus and understand the potential benefits of transarterial chemoembolization.

Background: Portal vein tumor thrombus (PVTT) in hepatocellular carcinoma (HCC) is a common entity due to the tendency of this tumor to invade the portal venous system. Hepatocellular carcinoma patients with portal vein tumor thrombus may show worse liver function, less treatment tolerance and worse prognosis than patients without portal vein tumor thrombus, and they may be at higher risk of comorbidity related to portal hypertension.

Nevertheless, consensus policies for managing HCC with PVTT have not been established. Recently there have been advances in the evidence of different treatments of HCC with PVTT. TACE is one of those treatments, although it is officially contraindicated for HCC patients with PVTT.

Clinical findings/procedure details: The current study reports three cases of hepatocellular carcinoma with portal vein tumor thrombus treated with transarterial chemoembolization. Complete response was achieved in all cases. There were no major adverse events reported.

Conclusion: These case reports suggest that transcatheter arterial embolization may be a suitable strategy for palliative treatment of patients with advanced HCC with PVTT.

P-62**Effective balloon-occlusion transcatheter arterial chemoembolization (B-TACE) as treatment of hepatocellular carcinoma**Eatzi T¹, Venkat S¹, Briley K¹, Zikria J¹, Bhatia S¹¹University Of Miami Miller School Of Medicine, Miami, United States

Clinical History: We describe a case of a 64-year-old male patient with hepatitis C cirrhosis complicated by hepatocellular carcinoma (HCC) treated with balloon-occlusion transcatheter arterial chemoembolization (B-TACE) with drug eluting beads (DEB). At presentation, the mass had an infiltrative appearance measuring 2.9 cm in seg VIII with an alpha-fetoprotein (AFP) level of 9,769.

Treatment Options/Results: The patient underwent two DEB-TACE procedures with doxorubicin. The first showed partial response and a decline of AFP to 877. The second B-TACE demonstrated complete response from mRecist with his AFP dropping to 3.0 within one month. 31.5 months post-procedure, AFP remained below 3.5 ng/mL. The patient now works with good performance status, denying acute illness or hospitalization. B-TACE resulted in more sustained fatigue and pain than would conventional. There were no complications to report.

Discussion: TACE is an accepted treatment for Barcelona Clinic Liver Cancer Stage B (BCLC-B) or Intermediate HCC that can be performed in cirrhotic patients,[1] showing a survival benefit over supportive care alone.[2] Approximately 85-95% of HCC patients concurrently have cirrhosis.[3] B-TACE, recently developed in Japan,[4] delivers a higher concentration of chemotherapy with a lower systemic chemotoxicity than does TACE via end-hole catheter.

Take-home Points: B-TACE is a distinguishable, safe, and effective treatment for unresectable HCC that can be used in cirrhotic patients. Successful cases, such as ours, substantiate the further need for investigation into the efficacy, risks, and benefits of B-TACE in this setting. We posit that B-TACE may have a role in the locoregional treatment algorithm of infiltrative HCC.

P-63**Liver isolation oxaliplatin (LIOX) for continued treatment with platinum agents**Ho-Shon K^{1,3,5}, Khin N^{2,4}, Rogan C^{1,3,7}, Lane R^{2,5,6,7}

¹Macquarie University Hospital, Macquarie University, Australia, ²AllVascular Limited, St Leonards, Australia, ³Royal Prince Alfred Hospital, Camperdown, Australia, ⁴University of Technology Sydney, Sydney, Australia, ⁵Macquarie University, Australia, ⁶Royal North Shore Hospital, St Leonards, Australia, ⁷Sydney Adventist Hospital, Wahroonga, Australia

A 75-year-old (MSS, KRAS positive, BRAF wildtype) presented with metachronous pulmonary and hepatic metastases from rectal adenocarcinoma. Initial management with FOLFOX and bevacizumab for 8 cycles, with good effect, was halted due to neurotoxic effects. The patient was referred for repeated intra-arterial liver isolation oxaliplatin (LIOX). A CT-angiogram was used to determine suitable vascular anatomy and CT to

measure target lesions of the liver (70mm and 46mm). An arterial access device was then implanted on the patient's left axillary artery by a vascular surgeon to facilitate LIOX. The patient received 4 LIOX treatments over the course of 51 days while the access system remained in situ to accept multiple catheters for each infusion. Treatments were day cases under fluoroscopy and general anaesthetic. Arterial and portal blood flow was obstructed using two compliant embolectomy catheters (5Fr shaft, 12mm balloon) in the coeliac trunk and SMA arteries and a micro-balloon catheter (2.7Fr shaft, 4mm balloon) in the hepatic artery proper. With the balloons deployed, dextrose (100mL) and oxaliplatin (50mg/m²) were sequentially infused through the microcatheter during the first 10 minutes and the balloons kept inflated for another 10 minutes. All catheters were removed after each procedure and the access system closed.

The patient's CT scan after the final treatment confirmed a reduction in the target lesions (47mm and 32mm) and another scan 3 months later with continued response. The patient's tolerance to the same chemotherapy administered through LIOX, which could no longer be tolerated intravenously, is suggestive of the role of LIOX.

P-64**SIRT in addition to PVE to promote left lobe hypertrophy**Long J¹, Patel S¹, Armstrong T², Stedman B¹, Modi S¹

¹University Hospital Southampton – Department of Interventional Radiology, Southampton, United Kingdom, ²University Hospital Southampton – Department of Hepatobiliary Surgery, Southampton, United Kingdom

A 78 year old male had an anterior resection for sigmoid adenocarcinoma. Follow-up liver MRI demonstrated 3 right liver metastases and a small left lobe.

Following discussion at tumour board the patient was planned for right hepatectomy, but due to concerns over a small future liver remnant (FLR), was referred for portal vein embolization (PVE).

At baseline, FLR was 31% (611ml/1967ml). After PVE, FLR only increased to 37% (801ml/2157ml). This was not felt to be sufficient, and it was suggested right lobe Selective Internal Radiation Therapy (SIRT) may provide dual benefit of encouraging further left lobe hypertrophy in addition to controlling right sided metastases. 6weeks following SIRT there was marked hypertrophy of the FLR and atrophy of the right liver. FLR had increased to 48% (961ml/1993ml). The patient had successful right lobectomy with no significant adverse events and remains disease free to date (16 months post op). Mortality following major liver resection is 3.3-7% with a normal background liver. Mostly, this results from liver failure which is related to FLR. PVE has been shown to increase the FLR by 40-50%, but the frequency of insufficient hypertrophy precluding resection is 0.6-3.6%. To date no studies have assessed the use of SIRT in patients with insufficient growth of the liver remnant in combination with/after PVE.

1. SIRT may have a role in encouraging FLR growth where PVE alone has been insufficient.
2. The use of SIRT also may prevent metastatic progression when the time frame to surgery is uncertain.

P-65

Successful stereotactic ECT for treatment of a large hepatic metastasis at the liver dome

Luerken L¹, Einspieler I¹, Bäuml W¹, Haimerl M¹, Schlitt A¹, Stroszczynski C¹

¹University Hospital Regensburg, Department of Radiology, Regensburg, Germany

Clinical History/Pre-treatment imaging: 78-year-old, female patient with a Granulosa Cell Tumour, diagnosis and resection 2005. Different chemotherapies 2006-2013. Resection of a pelvic local recurrency 2017. Newly diagnosed hepatic metastasis at the hepatic dome in Seg. VIII with a max. Diameter of 5.7 cm in contrast enhanced MRI.

Treatment options/Results: Resection of the tumour was not possible because the risk of surgery was considered too high due to the refusal of blood transfusions (Jehovah's Witness). MWA/RFA was considered suboptimal because of the proximity to the diaphragm, central liver vein and heart. The lesion was too large for IRE. Interdisciplinary Tumor Board decision for ECT. A navigation system (Cascination CasOne IR) was used for the placement of 6 electrodes (IGEA Cliniporator Vitae) under general anaesthesia. 8 minutes after intravenous application of 25.000 IU Bleomycin, ECT was performed without complications.

Contrast enhanced MRI 6 weeks, 3 months, 6 months and 9 months post ECT showed complete response of the tumor.

Discussion: Although a relatively new treatment option for deep seated hepatic tumours with consecutive lack of evidence, ECT was performed because the risk of surgery in this case was considered too high and other percutaneous ablation techniques were considered suboptimal treatment options due to the individual anatomical situation and tumor size. Stereotactic navigation was performed to achieve precise electrode placement under avoidance of at-risk structures like large hepatic vessels and the heart.

Take-Home-Points: Stereotactic ECT has the potential to successfully treat large hepatic tumours, even in difficult locations.

P-66

A complex case of liver venous deprivation

Modica F², Barone R², Caruso S¹, Maruzzelli L¹, Miraglia R¹

¹IRCCS-ISMETT, Palermo, Italy, ²Sezione di Radiologia, Dipartimento di Biomedicina, Neuroscienze e Diagnostica Avanzata, Policlinico Universitario „Paolo Giaccone“, Palermo, Italy

Clinical history/Pre-treatment imaging: Sixty-three y/o patient, with voluminous liver metastasis in the right lobe from gastrointestinal stromal tumor with compression of the main right hepatic vein (RHV). The future liver remnant (FLR) (segments 1-4) was 573 cc and was considerate at risk for post right-hepatectomy (segments 5-8), liver failure (minimal FLR required 714 cc). Liver venous deprivation (LVD) was planned in order to induce a fast hypertrophy of the FLR.

Treatment options/Results: Right portal vein branches embolization was performed using a Glubran/Lipiodol mixture. Percutaneous distal RHV puncture was performed.

A flebography showed occlusion of the RHV due to tumor compression and collaterals draining in the peripheral portion of the middle hepatic vein (MHV). By transjugular approach the MHV was catheterized and a plug deployed in the peripheral portion of the vein, with fluoroscopy and ultrasound guidance, at the level of the confluence of the collaterals with preservation of the mid-distal MHV. Embolization of the peripheral collaterals was completed with a mixture of Glubran/Lipiodol by percutaneous approach. CT scan performed after two weeks showed a significant hypertrophy of the FLR, 720 cc. The patient underwent successful right hepatectomy with preservation of the mid-distal MHV.

Discussion: Fluoroscopic and sonographic guidance, allowed us a precise deployment in MHV of the plug at the level of the confluence of the collaterals, preserving mid-distal MHV patency for a successful right hepatectomy.

Take-home points: In the setting of LVD before right-hepatectomy, peripheral MHV embolization, with a combined trans-hepatic/transjugular approach is a challenging but faceable procedure.

P-67

Stereotactic ablation of a lesion high up in the liver dome following an unsuccessful freehand attempt

Noorani S¹, Eigl B¹

¹North Hampshire Hospitals NHS Foundation Trust, Basingstoke, United Kingdom

Clinical History: An 80-year-old patient presented with a 13mm colorectal liver metastasis in Segment VIII on follow-up. Freehand microwave ablation with a transthoracic trajectory was attempted and unsuccessful due to breathing motion despite breath hold. The patient was at high risk of a pneumothorax. The procedure was abandoned. The patient developed urinary retention from excessive contrast enhanced scanning. Avoidance of a pneumothorax was important. The patient required a fast recovery time and discharge due to being a fulltime carer for his wife and son. CAS-One IR was used for the first time in our clinic one week after the freehand attempt to plan and execute a highly angled out-of-plane trajectory.

Treatment Options / Results: The patient was under GA and respiratory motion control, which enabled using apnoea during scanning and needle insertion. After navigating needle placement, a 4mm needle displacement was compensated for through optimisation of the ablation parameters to cover the lesion with a clinical margin. Post-ablation analysis showed complete coverage of the tumour and 86% coverage of the 5mm clinical margin. Total treatment time was one hour, and the patient was discharged the following morning.

Discussion: The tumour was successfully targeted and ablated without traversing the lung thus, preventing a pneumothorax. A reduction of radiation dose to the patient/staff and minimal contrast runs was observed. Post ablation analysis supported the decision for sufficient coverage of the tumour and clinical margin.

Take home points: Stereotactic ablation allowed precise treatment of a difficult lesion where initial freehand ablation was aborted.

P-68

Transjugular implantation of a biliary stent (TIBS) in a patient with uncorrectable coagulopathy, malignant obstruction and ascites

Ram H¹, Batra A¹, Singhal S¹, Jha S¹, Khandelwal A¹, Baijal S¹
¹Medanta the medicity Hospital, Gurgaon, India

Clinical history: Computerized tomography of a 54-year female with 15 days of yellow discoloration of eyes, pruritus, and abdomen pain revealed a suspicious mass in the head of the pancreas with chronic calcific pancreatitis, and a plastic stent in a dilated common bile duct (Fig1). She developed ascites, cholangitis, septicemia and was shifted to an ICU.

Treatment options: She was referred for percutaneous biliary drainage (PTBD). Coagulation parameters revealed a diagnosis of consumptive thrombocytopenia (S.Platelet 7×10^3). Other results included total bilirubin of 13.3 mg/dl, ALK of 375 U/L, and a prothrombin time (PT) of 14.2 sec (INR 1.38). Due to thrombocytopenia, ascites, and a rapidly deteriorating patient, transjugular access to the right hepatic vein (RHV) allowed puncture of the right posterior sectoral duct (RPSD) and deployment of a self-expandable metallic stent across the biliary stricture. The track between the RHV and RPSD was embolised with coils (Fig2). The patient improved (serum bilirubin – 1.37 mg/dl) and was discharged in a stable condition after 9 days.

Discussion: In patients with severe coagulopathy and/or ascites, transjugular access to the liver has been used for several procedures.

TIBS has been used for patients in whom a PTBD is contraindicated. Two patients out of twelve cases in the only series in English literature had both uncontrolled ascites as well as coagulopathy (Shim DJ Diagn Interv Radiol. 2019 Nov; 25(6): 465–470). The median survival and stent occlusion-free survival of the cohort was 19 days.

Take-home points: TIBS provides biliary access and internal drainage in high-risk patients with malignant obstructive jaundice.

P-69

Successful palliation of a strict biliary hilar malignant obstruction using self-expanding metallic stents with a complex percutaneous transhepatic combined “side-by-side” and “stent-in-stent” technique

Borzelli A¹, Amodio F¹, Sassone M², Coda C², Cavaglià E¹, Giurazza F¹, Corvino F¹, Paladini A², Pane F³, Cangiano G¹, de Magistris G¹, Niola R¹

¹Vascular and Interventional Radiology, AORN A.Cardarelli, Napoli, Italy, ²SCDU Radiologia Diagnostica ed Interventistica, AOU Maggiore della Carità, Novara, Italy, ³Radiology, AORN S.G.Moscati, Avellino, Italy

Clinical History/Pre-treatment Imaging: 66-year-old woman with obstructive jaundice caused by hilar cholangiocarcinoma and severe biliary system disconnection revealed by CT of abdomen

Treatment Options/Results: Two-step procedure: first internal-external biliary drainage at the right lobe performed across the VI-VII duct, to let bile out and decompression of

right biliary tree. After 4 days, US-guided puncture of main left biliary duct and V-VIII duct followed by hilar stenosis cross by hydrophilic guidewires. Bilioplasty was performed at the biliary tree hilum and across all the common biliary duct followed at first by release of 3 bare stents: 2 in overlapping fashion (9x60mm-9x80mm) across the VI-VII biliary duct, the main right duct until the common bile duct and 1 (10x60mm) into the main left biliary duct with “side-by side” technique. The procedure was completed by release, after bilioplasty of V-VIII biliary duct, of another bare stent (9x40mm) with “stent-in-stent” technique into the V-VIII duct through the mesh of the bare stent already released across VI-VII duct and main right biliary duct

Discussion: Although in literature is reported that in obstructive jaundice even the drainage of just 50% of biliary system can be effective, in this severe hilar disconnection, only the complex shape of stents allowed significant reduction of serum bilirubin level to let the patient start chemotherapy and improvement of her life quality

Take-home Points: In obstructive jaundice the drainage of both lobe biliary system is mandatory to relief from the symptoms associated with jaundice and so to improve significantly the quality of life of these patients and their mean survival period.

P-70

Computer-assisted planning, execution and verification of three overlapping ablations

Shaïda N¹, Eigl B²

¹Addenbrookes Hospital, Cambridge, United Kingdom,

²Cascination AG, Bern, Switzerland

Clinical History / Pre-treatment Imaging: A 60-year-old patient was initially diagnosed with a 44mm HCC lesion in Liver segment VI. After three unsuccessful TAE attempts, the decision was made to treat the resultant 39mm lesion with Stereotactic Radiofrequency ablation using CAS-One IR. The patient is on the liver transplant list and has a history of Liver cirrhosis, COPD, type two diabetes, smoking and alcohol consumption.

Treatment Options / Results: The patient was under general anesthesia and respiratory motion control by means of apnea during imaging and needle navigation. The size of the tumour required an overlapping ablation with three needles, which was optimised to cover the tumour and the clinical margin. Using the navigated approach, the needles were placed without the need for repositioning. Post-ablation verification showed 100% coverage of the tumour, with 65% of ablation margins exceeding the planned margin of 5 mm. The follow up MRI scan on 6th December showed no tumour recurrence.

Discussion: The presented approach enabled the treatment of a large lesion after three failed TAE attempts. Where conventional freehand ablation would have been demanding, the three needles were placed using the stereotactic guidance without the need for repositioning. Immediate assessment after ablation supported the decision of a complete ablation.

Take home points: Multi-probe stereotactic ablation with intraprocedural ablation assessment represented an efficient, tissue-sparing treatment option for a large tumour and improved the patient's prospects for transplantation.

P-71

Transcholecystic common bile duct catheterization and cooling for central bile duct protection during percutaneous thermal ablation of HCC

Tradi F¹, Vidal V¹

¹Department of Diagnostic and Interventional Radiology, La Timone University Hospital, Marseille, France

Clinical history/Pre-treatment imaging: A 3cm hepatocellular carcinoma was diagnosed in a 74 year old patient with a history of liver cirrhosis related to hepatitis C virus infection. The tumor was located on segment IV in front of and just above the common hepatic duct. The Child-Pugh score was A5. Oesophageal varices were ligated. The Platelet count was 75G/L with no ascites. The patient had no co-morbidities.

Treatment options/Results: A stage migration strategy was decided on multidisciplinary team meeting (MDT) with chemo-embolization to minimize the risk of bile duct damage. After two sessions, the tumor relapsed. A percutaneous thermal ablation with bile duct protection was then decided on MDT. Under ultrasound, the gallbladder was punctured. The right hepatic duct was catheterized after a loop on the Oddi sphincter, the tumor was targeted under angio-CBCT and the ablation performed while the biliary tree was cooled by cold serum. The patient was discharged at day 5 with no complication. The 1-month control confirmed a complete ablation with decrease of AFP to 26ng/mL and no biliary stricture on the MRI. The patient had a recurrence of the HCC at 1 year, complicated by hilar compression, followed by recurrent cholangitis with progressive liver dysfunction. The patient finally died 42 month after the diagnosis of HCC, 15 months after the ablation.

Discussion: Biliary complications appear to be low after biliary cooling during RFA close to central biliary tree. More evidence is required to assess the tumour recurrence rates.

Take-home points: If available non thermal ablation such as irreversible electroporation is recommended for such cases.

P-72

Infiltrative hepatocellular carcinoma – a case report

Vihetelič P¹, Lešnik Zupan L, Popovič P

¹University Medical Centre Ljubljana, Clinical Institute of Radiology, Ljubljana, Slovenia

Clinical history: We report a case of a 69-year old male with infiltrative hepatocellular carcinoma (HCC) in cirrhotic liver. Patient presented with pain in the right upper abdomen. Elevated alpha-fetoprotein (AFP) was found. Contrast-enhanced CT and MRI showed a 12-cm sized lobulated hypervascular mass with washout and several smaller satellite nodules in the right liver, suspicious for infiltrative HCC. There was no associated portal vein tumor thrombosis. Percutaneous biopsy confirmed HCC. Patient was classified as BCLC B stage.

Treatment: Patient was included in the SORAMIC study and was successfully treated with SIRT and sorafenib. Following disease progression four years after the first procedure, patient was treated with RFA and TACE, with both procedures achieving complete response according to mRECIST criteria.

After further progression, he was again treated with Sorafenib and later with Regorafenib as a second line of treatment. Overall survival was 81 months until the last follow-up control in February 2021.

Discussion: Due to nonspecific symptoms and signs, most patients have advanced-stage disease at the time of diagnosis, with limited therapeutic options. Treatment is assigned according to BCLC staging system. The median survival of patients with infiltrative HCC treated with intra-arterial therapy is reported to be 10-13 months. Our case shows that survival of some patients can be improved with combined treatment methods as the disease progresses.

Take-home points: Infiltrative HCC is a rare subtype of HCC with a poor prognosis. Treatment requires a multidisciplinary approach and usually includes intra-arterial therapy such as TACE or systemic chemotherapy like sorafenib.

P-73

Complete response of unresectable primary hepatic neuroendocrine tumor: a case report and literature review

Zhang X, Zhou X

¹Department of Interventional Therapy, National Cancer Center/ National Clinical Research Center for Cancer/Cancer Hospital, Chinese Academy of Medical Sciences and Peking Union Medical College, Beijing, China

Clinical history: A 43-year-old man was visited our hospital presenting with backache. The results of the imaging examinations (CT, MRI, Gallium 68 PET-CT) and pathological examination confirmed the diagnosis of unresectable primary hepatic neuroendocrine tumor (uPHNET), an extremely rare neuroendocrine tumor.

Results: The patient was initially administered for four cycles of chemotherapy with temozolomide, 5-fluorouracil and ondansetron to downsize tumors, which was evaluated as stable disease (SD) according to the Response Evaluation Criteria in Solid Tumors version 1.1 (RECIST 1.1). Subsequently, the patient underwent transcatheter arterial chemoembolization (TACE) treatment, which downsize tumors and convert uPHNET to resectable. A complete response (CR) was achieved after surgery according to RECIST 1.1, and the patient was disease-free so far.

Discussion: Primary hepatic neuroendocrine tumor (PHNET) is an extremely rare neuroendocrine tumor. Its clinical characteristics and imaging features are difficult to diagnose precisely. The confirmation of PHNET diagnosis requires both pathological examination and the exclusion of non-hepatic origins. Due to the rarity, there are currently no evidence-based guidelines available for the treatment of PHNET, especially unresectable tumors. Complete surgical tumor resection was considered to be the optimal scheme. For uPHNET, however, the optimal treatment modality continues to be debated. Our reported case is a good example demonstrating that pre-operative TACE could be an appropriate approach to shrink tumor.

Take-home points: Due to the rarity, the optimal treatment modality continues to be debated for uPHNET. A CR was achieved in our case demonstrating that pre-operative TACE could be an appropriate approach to shrink tumor.

Lung

P-74

Contrast-enhanced ultrasonography (CEUS) guided lung biopsies for peripheral pulmonary lesions

Andresciani F¹, Pacella G¹, Altomare C¹, Bruno A¹, Cea L¹, Grasso R¹

¹University Campus Bio-Medico of Rome, Rome, Italy

Purpose: To evaluate feasibility, efficacy and safety of contrast-enhanced ultrasonography (CEUS) guided lung biopsies for peripheral pulmonary lesions.

Materials and methods: a total of 35 contrast-enhanced ultrasonography (CEUS) lung biopsies performed in our University Hospital were reviewed and compared with a group of 40 patients who already underwent standard US guided lung biopsies. Procedural data (i.e. needle characteristics, number of samples) and biopsy sensitivity, specificity and overall diagnostic accuracy were evaluated in both groups.

Results: Detection of necrosis within pulmonary lesions was significantly higher with CEUS than with US and subsequently this ensured a better diagnostic accuracy, reducing the chance of a non-diagnostic sample. The accuracy of CEUS-guided biopsy was 97% (34/35). No complications were recorded in the CEUS group, while 1 case of Pneumothorax happened in the standard group.

Conclusion: our findings suggest that CEUS can help identifying necrotic areas within pulmonary lesions, thus avoiding a non-diagnostic sampling and thereby, has an important role in imaging-guided biopsy of peripheral lesions.

P-75

Deep learning based software application on transthoracic lung core biopsy findings

Basile D¹, Stranieri G, Geninatti C, Calandri M, Veltri A

¹San Luigi Gonzaga, Orbassano, Italy

Purpose: To evaluate the applicability and the performance of an AI software on determine the mutational status of NSCLC lesions and investigate the „explainability“ of that software.

Material and methods: We performed transthoracic core biopsy on lung lesions to obtain tissue for histologic diagnosis. We studied those samples with NGS (Next Generation Sequencing) in order to detect their complete mutational status. We inputted the same CT images used for guidance in the CNN(Convolutional Neural Software)to evaluate its performance in assigning the specific mutation. To investigate Explainability „heatmaps“ for attention focus were generated by the software itself and evaluated by expert radiologists.

Results: Analysis was performed on 131 NSCLC lesions. 34% of them were „oncogene addicted“. The most represented gene involved were ERBB4(46,6%),TP53(38,9%),EGFR(22,9%),KRAS (13,7%),SMAD4 (13,7%). The AI Algorithm was able to correctly assign mutations with a AUC(Area under curve)variable from 0,61 to 0,75 for EGFR and from 0,7 to 0,84 for KRAS.

For the other genes, the AUC were around 0,5. The „heatmaps“ showed attention area in discriminating mutational status were focal in 50% of cases in EGFR,with performace up to 90%in that population alone.

For KRAS the most represented pattern for the heatmaps was on the margins(41%). The heatmaps for EGFR and KRAS focused on the same areas in 32%of cases.

Conclusion: This study show the applicability, in an experimental setting, of a AI software to determine mutational status in NSCLC. Studies on explainability are still lacking in the literature and they're of paramount importance to understand the „black box“ of artificial intelligence.

P-76

CT guided transthoracic biopsy of nodules smaller than 2cm using automatic biopsy systems in an oncology tertiary care oncology centre: analysis of factors affecting complications and diagnostic accuracy

Gupta B¹, Aggarwal M², Lingegowds D³, Chatterjee A⁴

¹TATA MEDICAL CENTRE KOLKATA, KOLKATA, India,

²Tata medical centre, Kolkata, India, ³Tata medical centre,

Kolkata, India, ⁴Tata medical centre, kolkata, India

Purpose: To evaluate the diagnostic accuracy of CT guided percutaneous biopsy of small lung nodules using automatic biopsy systems. To analyse factors affecting diagnostic yield and complications.

Methods: This was a retrospective analysis of 169 consecutive patients from February 2019 to August 2020 with small lung nodules [< 2 cm] underwent CT-guided TCNB in our tertiary care oncology centre. The indication for lung biopsy was determined from a multidisciplinary discussion among oncologists, respiratory physicians, and interventional radiologists.

Results: A total of 169 biopsies were performed using automatic biopsy gun systems. Out of which 157 biopsies could yield a definitive diagnosis, the diagnostic accuracy being 92.9% with 55 benign(32.5%) and 102 malignant (60.4%) on final histopathological examinations. Subcentimeter nodules are more likely to be benign or indeterminate and more than 1cm are more likely to be malignant (P value 0.00034). Pneumothorax was the most frequent complications seen in 22% patients with 18g needle being the most significant risk factor associated with pneumothorax (OR=2.6). Hemorrhage was seen in 20 patients (12 %) in our study. There was no clinically significant factor identified that caused greater chances of hemorrhage.

Conclusion: Small nodules (of < 2 cm) represent a technical challenge for diagnosis. CT-CNB is an excellent diagnostic tool, its accuracy being high. 18 g gun was associated with significant increased risk of pneumothorax in smaller lung nodules.

P-77*withdrawn by authors***P-78****Long-term survival following percutaneous thermal ablation for sarcoma lung metastasis**

Tradi F¹, Habert P¹, Kheiri M¹, Vidal V¹, Duffaud F², Gaubert J¹
¹Department of Diagnostic and Interventional Radiology, La Timone University Hospital, Marseille, France, ²Department of Medical Oncology, La Timone University Hospital, Marseille, France

Purpose: To evaluate the prognosis after percutaneous thermal ablation in participants with sarcoma lung metastases

Material and methods: From 2008 and 2016, consecutive patients who underwent percutaneous thermal ablation for lung metastasis of sarcoma were retrospectively included. Inclusion criteria were: oligo-metastatic pulmonary disease controlled by chemotherapy and not eligible to surgery with the maximal diameter of each tumor < 4cm. The main study criteria were: overall survival, progression-free survival, survival without chemotherapy; the secondary study criteria were: the duration without treatment and without chemotherapy after each procedure. Follow-up CT scans were analyzed for local control. Primary tumor type, location, grade, disease-free interval, prior resection/ chemotherapy, number and size of lung tumors, uni- or bilateral disease, complications using the CIRSE classification, and overall and progression-free survival were recorded.

Results: 40 patients (22 women, mean age 51 years old) were included corresponding to 72 percutaneous thermal ablation sessions targeting 102 lung metastasis. Mean tumor size was 14mm (4-40). The median follow-up period was 58.1 months. The local tumor control was 96% (69/72) with 3 local recurrences. The median overall survival was 48 months ([95% CI] 41-77), the median progression-free survival was 10 months ([95% CI] 28-61), the median chemotherapy-free survival was 23 months ([95% CI] 31-65) and the median time without chemotherapy was 10.9 months. The most frequent complication was pneumothorax (62%). No grade 4 or 5 complication occurred.

Conclusion: Percutaneous thermal ablation represent a validated, effective and safe treatment option for sarcoma lung metastasis.

P-79**Comparison of expected imaging findings following percutaneous microwave and cryoablation of pulmonary tumors: ablation zones and thoracic lymph nodes**

Wrobel M^{1,2}, Cahalane A¹, Pachamanova D³, Leppelmann K¹, Silverman S⁴, Sharma A¹, Shyn P⁴, Mercaldo N¹, Fintelmann F¹
¹Massachusetts General Hospital, Department of Radiology, Boston, USA, ²Ludwig-Maximilians-University, Department of Radiology, München, Germany, ³Babson College, Wellesley, USA, ⁴Brigham and Women's Hospital, Department of Radiology, Boston, USA

Purpose: To compare temporal changes of lung ablation zones and thoracic lymph nodes following microwave ablation (MWA) and cryoablation.

Materials and methods: This retrospective cohort study compared lung ablation zones and thoracic lymph nodes on CT following MWA and cryoablation performed 2006-2020. Serial ablation zone volumes were measured within 12 months following ablation using semi-automated threshold-based segmentation. The sum of bidimensional products of lymph node diameters was measured before (baseline) and up to 6 months following ablation. Cumulative incidence curves estimated the time to 75% ablation zone volume reduction and linear mixed-effects regression models compared the temporal distribution of ablation zone volumes and lymph node sizes between modalities.

Results: Ablation zones volumes of 59 tumors treated in 45 sessions (16 MWA, 29 cryoablation) in 36 patients were evaluated. Differences in the time to 75% volume reduction between modalities were not detected. Following MWA, half of ablation zones required an estimated time of 340 days to achieve 75% volume reduction compared to 214 days following cryoablation ($p=.30$). Thoracic lymph node sizes after 33 sessions (13 MWA, 20 cryoablation) differed between modalities (baseline-32 days, $p=.01$; 32-123 days, $p=.001$). Following MWA, lymph nodes increased on average by 38mm^2 (95%CI, 5.0–70.7; $p=.02$) from baseline to 32 days, followed by a decrease of 50mm^2 (32-123 days; $p=.001$). Changes in lymph nodes following cryoablation were not detected (baseline-32 days, $p=.33$).

Conclusion: The rate of ablation zone volume reduction did not differ between MWA and cryoablation. Thoracic lymph nodes enlarged transiently after MWA but not after cryoablation.

P-80**Does lung inflation, total ablation energy and nodule location influence post-treatment microwave ablation zone dimensions**

Xu Y¹, Padley S¹, Devaraj A¹, Desai S¹, Ridge C¹

¹Department of Radiology, Royal Brompton Hospital, London, United Kingdom

Purpose: To assess the influence of operator dependent and independent factors on predicted and achieved ablation zones on the day 1 post-treatment CT study.

Materials and methods: Ablations performed using Medtronic Emprint™ with lung isolation using a dual-lumen endotracheal tube, between 2018 and 2021 at our institution were reviewed. Lung inflation was visually assessed. Ablation energy (time x wattage) was categorised as high (>35kJ), medium (25-35kJ) or low (<25kJ). The resistance to ablation was graded, depending on nodule location and the associated heat sink effect; additional factors affecting the resistance included emphysema, fibrosis, intra-procedural haemorrhage and pneumothorax-related atelectasis. Ablation zone sizes (maximum length and width of ground-glass halo along the needle tract) were measured on day 1 post-treatment CTs and compared to vendor references. Ablations requiring multiple needle positions or with indeterminate boundaries were excluded.

Results: 47 lesions from 31 patients (19 female, average age 63) were included. Ablation zone length is 6 mm greater than predicted with good inflation, and 0.5 mm less than predicted with poor inflation ($p=0.018$). Ablation zone width was less than predicted at high energy (6mm < predicted), but at medium energy and low energy was within 1mm of the predicted size ($p=0.03$). The statistical significances are maintained on univariate analyses ($p=0.008/0.025$). Ablation zone size is not affected by nodule location or resistance.

Conclusion: The degree of pulmonary inflation is associated with ablation size, being 6 mm longer than predicted with good inflation. Increased ablation energy does not achieve the predicted width using a single needle position.

P-81**Percutaneous embolization of the MWA antenna tract by autologous blood as early treatment of pneumothorax requiring drainage**

Saltiel S¹, Ponti A, Tsoumakidou G, Duran R, Denys A, Villard N

¹CHUV, Lausanne, Switzerland

Learning objectives: Describe a technique to treat an early bronchopleural fistula through the MWA antenna tract.

Background: Lung percutaneous thermal ablation is a minimal invasive effective technique to treat lung tumors. The most frequent complication of this percutaneous treatment is pneumothorax, requiring drainage in 10 to 50% of cases. Delayed pneumothorax is rare and a sign of bronchopleural fistula. Several authors reported that the injection of autologous blood through the coaxial needle during percutaneous lung biopsy reduce the risk of pneumothorax. In case of lung MWA, the use of a coaxial needle is not always possible and therefore injection of autologous blood is not feasible because the antenna is not hollow. In such cases, we propose to use a secondary 21G needle and to place its tip at the contact of the MWA antenna in lung parenchyma. After completion of the ablation, during the pulling back maneuver of the antenna, autologous blood is injected through the 21 G needle in order to fill the space of the antenna tract.

Clinical findings/procedure details

70-year-old woman with a stage IV sigmoid adenocarcinoma with hepatic and pulmonary metastases. Currently, oligometastatic patient with progression only of a right upper lobe lung lesion.

Conclusion: Embolization by autologous blood of the tract of the thermo-ablation needle after percutaneous ablation of lung tumor can prevent pneumothorax. There was no complication to this procedure, already described for lung biopsy.

Musculoskeletal

P-82

Factors affecting core needle biopsy in musculoskeletal lesions

Gala K¹, Kulkarni S, Shetty N, Chandra D, Chavan A, Janu A
¹Tata Memorial Hospital, Mumbai, India

Purpose- To evaluate the diagnostic yield and accuracy and factors affecting the core needle biopsy in CT guided biopsies in musculoskeletal lesions.

Methods and methods: This is a retrospective analysis of 180 number of procedures were performed in 154 number of patients (females-66, males-88). The data was collected for diagnostic yield and diagnostic accuracy. The various lesion related information which was recorded were size, site, nature of the lesion (lytic, sclerotic, lytic with soft tissue, mixed or only soft tissue), lesion PET avid or not, location of the lesion. Various procedure related information like approach of the needle, size and type of the needle approach of the biopsy, technically targeted and complication were recorded. Classification of lesion into true positive, true negative, false positive and false negative.

Results: The overall diagnostic yield was 76.11% and diagnostic accuracy is 89%. Lytic lesions had diagnostic accuracy of 97.3%, lytic with soft tissue had 96.8% while mixed lesions had 75% and sclerotic lesions had 57.1% ($P < 0.001$). The size of lesion if < 10 mm the diagnostic accuracy was 100%, 10-25mm had 85.4%, 25-50mm had 88.6% and > 50 mm had 94.6% ($P = 0.2$). Diagnostic accuracy in respect to needle size 11G gives 82.1%, 13 G gives 100%, 18G gives 93.9%, 11+18G gives 90.9% and 13+18G gives 100% ($P = 0.15$). We had 2(1.11%) complication out of 180.

Conclusion: CT guided core needle biopsy is easy, safe, effective method for evaluation of the musculoskeletal biopsy with high diagnostic yield and accuracy.

P-83

Palliative embolization for extra-spinal bone metastases

Papalexis N¹, Peta G¹, Errani C², Miceli M¹, Facchini G¹
¹Istituto Ortopedico Rizzoli, Department of Diagnostic and Interventional Radiology, Bologna, Italy, ²Istituto Ortopedico Rizzoli, Department of Orthopaedic Oncology, Bologna, Italy

Purpose: To present a palliative treatment for painful extra-spinal bone metastases from variable primary cancers using selective arterial embolization.

Materials and methods: We studied the files of 63 patients (35 male and 28 female, mean age 56.8; range 38 to 79 years) treated between 2018 and 2021 with selective arterial embolization for painful extra-spinal bone metastases from variable primary cancers. We evaluated the technical success of the embolization with post-procedural angiography, the clinical effect in pain relief, analgesic drug consumption, and tumor size reduction. All embolization-related complications were recorded.

Results: Post-embolization angiography showed occlusion of more than 90% of the pathological feeding vessels in all procedures. Pain score and analgesic drug consumption were reduced by 50 % in 60 patients (95.2%). The mean duration of pain relief was 8.6 months (range 1-12 months). Metastatic tumor size reduced from a mean of 5.3 cm (range 3.2-7.1 cm) pre-embolization to a mean of 4.2 cm (range 2.9-4.8 cm) at the 6-month follow-up. 6 patients (9.5%) experienced grade 1 or 2 embolization-related complications according to the CIRSE Classification System. No major complications were recorded.

Conclusion: Selective arterial embolization showed to be a minimally invasive and effective treatment for controlling pain in patients with extra-spinal bone metastases, with minor risk for side effects, and performed just under local anesthesia.

P-84

Prevention of complications in bone and soft tissue ablation

Andresciani F¹, Altomare C¹, Pacella G¹, Sertorio A¹, Stiffi M¹, Grasso R¹
¹University Campus Bio-Medico of Rome, Bari, Italy

Percutaneous thermal ablation is increasingly being used to treat bone and soft tissue neoplasms. Indications include palliation of pain in case of metastatic disease, local control of oligometastatic disease and prevention of fractures in case of lesions localized in the spine, near the course of nerves and in the supporting bones, which would lead to greater morbidity. As with pulmonary, hepatic and renal ablation, musculoskeletal ablation involves risks, which can be reduced through adequate planning and procedural monitoring. The complications that can occur are related to the positioning of the probes or to thermal damage during the ablation itself; the risks of greatest interest are lesions of nerve or skin structures, fractures and gas embolism.

The purpose of this communication is to describe the potential complications of thermal ablation in the musculoskeletal field, to highlight the anatomical structures vulnerable to injury during ablation and to illustrate techniques to minimize the risk of damaging them.

P-85**Percutaneous cryoablation of musculoskeletal tumors, technical considerations and advantages over other thermal ablation techniques**

Farias Lisboa P¹, Boukhoubza A¹, Picado A¹, García R¹, Martínez J¹

¹Hospital Universitario y Politécnico La Fe, Valencia, Spain

Learning Objectives: To understand the mechanism of action of cryoablation and cryobiology.

To become familiar with technical considerations of cryoablation. To know the advantages over other thermal techniques and complications associated with percutaneous cryoablation treatment.

Background: Image-guided percutaneous cryoablation is a safe and effective therapeutic method widely used in the treatment of musculoskeletal tumors. It can be used both for palliative treatments of metastatic bone lesions and for the curative treatment of benign bone tumors.

Clinical Findings/procedure details: Cryoablation is one of many thermal ablation techniques but has very specific characteristics that are particularly interesting for tumor treatment. The type and extent of tissue reaction depend on the severity of the cold damage. This is controlled by the use of freezing and thawing processes and the temperatures that are achieved. The total cold damage is a mixture of direct and indirect effects. Application-relevant advantages of cryotherapy compared to other techniques are the anesthetic effect of cold and continuous monitoring of the size of the ice is possible even with MR guidance.

Cryoablation of bone tumors performed with palliative curative intent is generally considered safe, with a reported complication rate of 6.4%–24%. Complications may occur due to unintended thermal damage to nontarget anatomic structures in close proximity to the ice ball. Several thermoprotective techniques are used.

Conclusion: Percutaneous cryotherapy can be considered a safe and effective technique in the treatment of benign and malignant musculoskeletal tumors. Cryotherapy could be considered the first option in benign tumor lesions, such as osteoid osteoma.

P-86**Percutaneous interventions in the management of painful bone metastases: a critical analysis review**

Gong A¹, Levin A, Lyons G

¹Johns Hopkins School Of Medicine, Baltimore, United States

Learning Objectives:

1. Evidence for percutaneous ablation of painful osseous metastases
2. Various ablative modalities available to providers
3. Evidence for percutaneous cementoplasty for lytic or unstable metastases
4. practical considerations for patient selection for percutaneous therapy.

Background:

Ablation serves as an effective adjunct therapy for those for whom pharmacologic therapy, with or without radiation therapy, is inadequate. Thermal ablation and cryoablation can provide durable pain relief and reduce need for opioid therapy.

Clinical Findings/Procedure Details:

1. Thermal ablation:
 - a. RF ablation (RFA)
 - i. Reduces baseline pain from metastatic bone lesions by >50% in a safe, effective and minimally-invasive method.
 - b. Laser-induced interstitial thermotherapy (LITT)
 - i. Advantages include predictable treatment area, lack of interference with medical devices such as pacemakers and metal implants, and lower cost. However, laser therapy ablation supports a relatively small ablation zone per optic fiber and is not ideal for treatment of larger metastases.
 - c. Microwave ablation (MWA)
 - i. Compared to LITT and RFA, MWA may provide the advantage of larger, more predictable tumor ablation temperatures and a lower complication rate than other modalities
2. Cryoablation
 - a. Multiple probes can be used to create controlled, overlapping ablation zones—and increase the treatment volume
3. Cementoplasty
 - a. For extra-spinal lesions, cementoplasty may be combined with both thermal ablation and cryoablation to reduce pain, stabilize load-bearing bones, and reduce motion at the fracture site.

Conclusion:

- Thermal ablation and cryoablation are both effective, each with unique tradeoffs.
- Painful bone metastases associated with impending or incomplete pathologic fractures of load-bearing bones, may benefit from cementoplasty.

P-87**Cryoablation of a large liposarcoma of the thigh with a high precision navigation system**

Benz RM¹, Schroeder C, Harder D², Krasniqi F³, Gehmert S⁶, Krieg AH⁶, Brönnimann M¹

¹*Inselspital Bern/ Diagnostische, Interventionelle und Pädiatrische Radiologie/ Interventionelle Radiologie, Bern, Switzerland,*

²*Universitätsspital Basel, Klinik für Radiologie und Nuklearmedizin, Basel, Switzerland,* ³*Universitätsspital Basel, Onkologie, Basel, Switzerland,* ⁴*Universitätsspital Basel, Orthopädie und Traumatologie, Basel, Switzerland,* ⁵*Universitätsspital Basel, Tumore und Kinderorthopädie, Basel, Switzerland,* ⁶*Universitäts-Kinderspital beider Basel, Orthopädie, Basel, Switzerland*

Clinical history/Pre-treatment imaging: 94y/o male with a dedifferentiated liposarcoma (N0, cM0) of 12 x 7 cm of the quadriceps muscle. The patient refused surgery; hence, definitive radiation was performed with successful size reduction. However, increase of tumor size with pain, tissue tension and reduced mobility occurred after 2 years.

Treatment options/Results: The patient still refused surgery and chemotherapy, due to age and morbidity. Palliative radiation was not possible given the definitive radiation 2 years ago. Thus, cryoablation was offered because of minimal invasiveness, patient tolerability, the low procedure risk, and its quality to soften tissue. High precision in planning and positioning of the probes was required because of proximity to the femoral nerve and skin. Therefore, a navigation and planning system (CAS-One IR, CASCINATION AG) was used. Treatment was technically successful and uneventful. Tumor showed softening and reduction of symptoms in the postoperative course.

Discussion: The size, complex shape and adjacent critical structures required meticulous planning of type and amount of cryoprobes, as well as their position. This was facilitated by the CAS-One IR software which includes estimated treatment zones. A maximal tumor coverage was achieved with precise positioning of the probes (mean lateral error of 1.7 mm) thereby protecting critical structures. Crossing of needles or treatment areas was prevented during placement of probes in a timely manner (placement of 8 probes in 70 min, including 2 control scans).

Take-home points: Overall, the navigation system allowed high precision in planning and treatment with a relevant reduction of procedure time.

P-88**Irreversible electroporesis in pelvic fibromatosis**

Atkuri P, Kulkarni S, Shetty N, Gala K, Chandra D, **Gupta A**

¹*Tata Memorial Hospital, Mumbai, India*

Clinical history/Pre-treatment imaging: 31 years old lady presented with non tender firm swelling in right iliac fossa since 8 years. MRI showed mass arising from right rectus muscle infiltrating into the space of retzius which is consistent with low grade spindle cells suggestive of fibromatosis. Patient was started on metronomic chemotherapy (SORAFENIB). The lesion responded initially over the years; however, after 5 years there was a new lesion with right vesicoureteric junction and right urinary bladder wall involvement (Figure 1) with resultant right sided hydronephrosis for which she under went right sided percutaneous nephrostomy insertion with Double J stenting.

Treatment options/Results: Debulking of the tumor was considered using cryoablation for bulk of the mass and Irreversible electroporation was performed for the component encasing the ureter (since IRE is said to be more protective for normal tissues and vessels)

Follow up imaging showed significant regression of the tumor bulk with free in of ureteric margins

Discussion: Cryoablation and IRE are effective debulking strategies in treatment of musculoskeletal soft tissue tumors. IRE is protective for indigenous tissues, blood vessels with sharp ablation margins and has wide range of applications

Take-home points:

- Cryoablation and IRE are effective debulking strategies
- IRE is protective for indigenous tissues, blood vessels with sharp ablation margins

Novel therapies

P-89

Role of radiofrequency ablation (RFA) as a salvage treatment in recurrent fibromatosis

Gala K¹, Kulkarni S, Shetty N, Chandra D
¹Tata Memorial Hospital, Mumbai, India

Purpose: To evaluate the safety and efficacy of percutaneous Radiofrequency Ablation (RFA) in managing recurrent fibromatosis.

Materials and methods: Retrospective study, patients with recurrent fibromatosis who underwent RFA after the failure of at least one form of treatment (medical/surgical/radiotherapy). Forty patients (18 males and 22 females) with a median age of 29 years (range, 6 – 68 years, mean- 30.8 years) underwent 109 sessions of RFA. The clinical and imaging evaluation was done before RFA and 1, 6, 12 and 24 months post RFA. The clinical evaluation was done by Visual Analogue Score (VAS) for pain assessment and Musculoskeletal Tumor Society (MSTS) score for functional assessment and imaging response by MRI using RECIST criteria.

Results: 38 patients were evaluated at 12 months and 27 patients at 24 months and mean duration of follow-up was 38.5 months (5-110 months). There was a significant improvement in pain score at 12 months (VAS:3, $p<0.001$) and 24 months (VAS:2.45, $p<0.001$) compared to pre-procedure VAS of 4.94. The MSTS score improved from a pre-procedure score of 21 to 25 at 12 ($p<0.001$) and 26.5 at 24 months ($p<0.001$). The reduction in the volume of the lesion after RFA reduced significantly at 12 months (mean vol:144cc, $p<0.001$) and 24 months (mean vol:92cc, $p<0.001$). There were five complications seen out of 109 sessions (4.5%) of RFA.

Conclusion: Radiofrequency ablation is safe and effective in the treatment of recurrent fibromatosis. It reduces the size of the tumor, helps in pain palliation and improves functional outcomes.

P-90

Percutaneous cryoablation: a novel salvage therapy in abdominal recurrences

Van Der Reijdt D¹, Maas M¹, Baetens T¹, Aarts B¹, Lahaye M¹, Graafland N¹, van Trommel N¹, Aalbers A¹, Kok N¹, Beets-Tan R¹, Gomez Muñoz F¹, Klompenhouwer E¹
¹Antoni Van Leeuwenhoek, Amsterdam, Netherlands

Purpose: To assess the primary safety and oncological outcome of percutaneous cryoablation in patients with abdominal recurrences after prior surgery.

Methods: All patients with abdominal recurrences after prior abdominal surgery, and treated with percutaneous cryoablation were retrospectively identified. Patients were included after at least nine months of follow-up. Technical success was achieved if the iceball had a margin of ≥ 5 mm in three dimensions on post-procedural CT. Complications were recorded using the Society of Interventional Radiology (SIR) classification system. Time until disease progression was monitored with follow-up CT and/or MRI. Local control was defined as absence of recurrence at the site of ablation.

Results: Eleven patients underwent cryoablation for 14 tumour localizations (mean diameter 20 ± 9 mm). Primary tumour origin was renal cell ($n=4$), colorectal ($n=3$), granulosa cell ($n=2$), endometrium ($n=1$) and appendix ($n=1$). Treated lesions were localized retroperitoneal ($n=8$), intraperitoneal ($n=2$) or in the abdominal wall ($n=4$). Technical success was achieved during all procedures. After a median follow-up of 27 months (9-36 months) all patients were alive. Local control was observed in 10/14 tumour localizations, and the earliest local progression was detected after ten months. Five patients showed distant progression at a different site than the ablation zone. No major adverse events occurred. One patient suffered a minor asymptomatic adverse event (pseudocyst) without need for further treatment.

Conclusion: This study showed that cryoablation is safe and could be an effective treatment in tumour localizations in the non-visceral abdomen after prior surgery.

P-91**Electrochemotherapy (ECT) use in deep seated tumors****Jocius D¹**, Sileikis A, Poskus E, Strupas K¹*Santaros klinikos (Vilnius University Hospital), Vilnius, Lithuania*

Purpose: Evaluate potential value of ECT with intravenous bleomycin in deep seated tumors of various histology as a focal treatment option in advanced disease stage or as primary therapy in rare disease.

Materials and methods: We present retrospective analysis of 7 ECT procedures applied on deep-seated tumors in 6 patients with different tumor histology during a period of 1 year.

Results: ECT procedures were performed 1 intrahepatic cholangiocarcinoma, 1 pancreatic cancer, 1 pancreatic NET, 2 colorectal lymph-node metastasis and primary anal melanoma (2 procedures). 1 patient died before any follow-up was present. 3 patients had stable disease or partial response after 5 months in treated area. 1 patient had local relapse at follow-up. The last patient with anal melanoma had complete response at 1 month according to MRI but progressed after 2 months clinically and was retreated, however despite first follow-up (MRI) showed complete response, a clinical and MRI progression was present after 2 months again.

Conclusion: In our retrospective review half of the patients achieved partial/complete response after single ECT session – a quite good result in advanced disease setting. Despite potential value treating different advanced diseases prospective trials regarding different tumor types are needed to select optimal candidates for ECT.

P-92**Lymphangiography & thoracic duct interventions: case series study****Kulkarni S**, Shetty N, Gala K, Chandra D, Hota F, Bhatia R, Patel A¹*Tata Memorial Hospital, Mumbai, India*

Purpose: Postoperative chylothorax is a serious complication after transabdominal surgeries or transthoracic esophagectomy, and is associated with major morbidity due to dehydration and malnutrition. Radiologic interventional management is an innovative procedure that has the potential to replace surgery in the treatment algorithm.

Material and methods: 44 patients underwent lymphangiography for suspected chyle leak during the span of last 10 years (January 2012 to December 2021). Male:Female: 28:16(mean Age 50.6 years). Surgical management was performed in 39 patients. Non-surgical management was done in 5 patients. The clinical outcomes were correlated with the imaging findings after the preceding interventional and medical treatments.

Results: Out of the 44 patients who underwent intranodal lymphangiography, 17 patients showed clinical improvement with just lymphangiography.

Rest of the patients underwent successful retrograde thoracic duct cannulation (17) and various other interventions like fluoro guided neck puncture, surgical exposure to thoracic duct & percutaneous approach. Technical failure to cannulate was observed in 4 patients. Clinical failure was noted in 4 patients. No clinical response was seen in 4 patients.

Conclusion: Minimally invasive, safe and viable technique in patients who are poor surgical candidates or whose leaks are not responding to conservative measures.

P-93*withdrawn by authors.***P-94***withdrawn by authors***P-95****Percutaneous transesophageal gastrostomy (PTEG) safety and efficacy: a single cancer center experience****Youssef E¹**, Moussa A¹, Aly A¹, El Hawari M¹, Santos E¹, Gonzalez-Aguirre A¹, Maybody M¹¹*Interventional Radiology Service, Memorial Sloan Kettering Cancer Center, New York, USA*

Purpose: Percutaneous Transabdominal Gastrostomy (PTAG) placement sometimes is not feasible, and often is the only obstacle preventing discharge in terminal cancer patients. We report the safety and efficacy of Percutaneous Transesophageal Gastrostomy (PTEG) as an alternative solution.

Material and methods: IRB waiver of consenting for retrospective review of patients who underwent PTEG placement for either feeding or venting between January 2017 and December 2021 was obtained. Data on the indication for PTEG placement, technical aspects of the procedure, clinical success and complications is reported.

Results: PTEGs were attempted in 16 patients (11 males, median age: 53 years old (31 – 79), all of which were technically successful. The indication for PTEG placement was venting (n=14) and feeding (n=2). 5 patients had minor complications related to the procedure. One had self limited bleeding through the tube with negative angiography. 13 patients had the PTEG placed on the left side of the neck and 3 patients had it placed on the right side. The median time between PTEG placement and death was 30.5 days (range 2 – 438 days). 15 patients were able to be discharged after placement of the PTEG.

Conclusion: PTEG is a safe and effective alternative in patients with malignant bowel obstruction or nutritional deficit with contraindication to PTAG, endoscopy or surgery.

Other organs

P-96

LAMPiCis study: repeated isolated intra-arterial cisplatin of the pancreas (± liver) for patients with pancreatic adenocarcinomas with or without liver metastases

Aigner Ko², Khin N^{1,3}, Aigner Ka², Sampath S¹, Lane R^{1,4,5,6}

¹AllVascular Limited, St Leonards, Australia, ²Medias Klinikum GmbH & Co KG, Burghausen, Germany, ³University of Technology Sydney, Sydney, Australia, ⁴Sydney Adventist Hospital, Wahroonga, Australia, ⁵Royal North Shore Hospital, St Leonards, Australia, ⁶Macquarie University, Australia

This is a prospective, single-arm, open label safety and feasibility study for a new locoregional technique for patients with locally advanced pancreatic adenocarcinoma with or without low volume liver metastases. Study eligibility requires confirmed progressive disease during firstline treatment, adequate haematological, renal, and liver function with a life expectancy greater than 3 months.

The purpose of the study is to establish a safe cisplatin dose for repeated intra-arterial pancreatic isolation cisplatin (PiCis) and to determine the feasibility of the PiCis technique.

Screening will comprise of imaging, haematology, surgical consult, and informed consent. Eligible patients will be surgically implanted with an arterial access system. Patients will return to the hospital for each PiCis treatment via the access system and will receive up to 6 treatments over an 8-week period. The PiCis technique will comprise of temporarily obstructing the arteries supplying the pancreas using multiple compliant balloon catheters then infusing the pancreatic tumour with cisplatin. A 3+3 dose escalation protocol will be used to establish a recommended dose which will be used for the remainder of the patients until n = 20.

The primary endpoints will be safety and feasibility measured through onset or absence of organ complications and the patient's ability to tolerate the treatment. Secondary endpoints include objective response rate, duration of response, progression-free survival, and overall survival.

The PiCis technique is anticipated to be more repeatable compared to other locoregional techniques and will provide insight into the full therapeutic capability of existing hardware in the context of interventional oncology.

P-97

Cognitive and imaging fusion guided prostatic biopsy – are there really any differences when connecting MR and EUS

Chudacek Z¹

¹Hospital of Dr. Mulac, Plzeň, Czech Republic

Purpose: To compare transrectal prostatic biopsy guided with cognitive connection of magnetic resonance (MR) and endosonography (EUS) or with the real imaging fusion of MR and EUS.

Material and methods: The results of prostatic transrectal biopsy in two groups of 40 patients with suspicious MR finding were statistically compared. In the first group we used the cognitive connection of EUS and MR images only while in the second group the Hitachi RVS imaging fusion system was used.

Results: In patients with prostatic volume up to 50 ml we did not find any significant difference in prostatic carcinoma hit rate between the two groups. In bulkier glands the detection rate of carcinoma was higher in fusion group. Using not only the targeted but also schematic biopsy in all patients the additional carcinoma foci were found in 15% of patients compared with MR imaging.

Conclusion: As to our results transrectal biopsy in smaller prostatic gland does not necessarily need MR+EUS imaging fusion to confirm MR finding. Additional schematic biopsy after the targeted one often reveals additional intraglandular carcinoma foci compared with MR findings.

P-98

Indwelling peritoneal catheters: impact of inpatient to daycase service conversion

Daga K¹, Berry T¹, Mullan D¹, Laasch H^{1,2}

¹The Christie NHS Trust, Manchester, United Kingdom, ²Minerva Medical Foundation CIC, Manchester, United Kingdom

Purpose: The insertion of indwelling peritoneal catheters (IPC) for refractory malignant ascites is traditionally conducted as an inpatient procedure. Our institute piloted a daycase service for the insertion of IPCs with the aim to analyze the effects on patient safety, the associated financial implications and burden on resources.

Materials and methods: In this retrospective study we compare our single-centre experience of the insertion of IPCs as inpatient and daycase procedures over four years up to March 2020. The 15.5Fr PleurX™ IPCs (BD, Wokingham, UK) were inserted under local anaesthesia in the interventional radiology suite of a supraregional cancer centre. Patient records, details on cost and the billing procedure were reviewed. An institutional review board review classified this as an "audit", waiving patient consent.

Results: 138 IPC were placed, 63 (46%) as an inpatient procedure and 75 (54%) as a daycase. Complication rates were 15.9% and 16.0% for inpatient and daycase procedures respectively (p=0.98). Mean survival after IPC insertion was 58.5 and 83.8 days for inpatient and daycase procedures respectively (p<0.05). The mean hospital stay was 2.5 bed-days for inpatient procedures and 0.3 bed-days for daycase (p<0.001). Daycase procedures saved 165 bed-days annually. There was an estimated savings of €2191.69 per procedure or €164,376.62 annually.

Conclusions: IPCs can safely be inserted as a daycase procedure. This results in significant economic benefits as well as much greater patient satisfaction, without negative effects on patient safety or efficacy. Daycase IPC insertion has become routine practice in our institution.

P-99

Percutaneous ablation of metastatic lymph nodes: an insight from the comparison of safety and efficacy between radiofrequency ablation and cryoablation

Efthymiou E¹, Georgiadi E¹, Karahaliou A¹, Mazioti A¹, Kelekis A¹, Filippiadis D¹

¹University General Hospital „ATTIKON“, National and Kapodistrian University of Athens. Greece, Athens, Greece

Purpose: To retrospectively compare efficacy and safety of Computed Tomography (CT)-guided percutaneous ablation of metastatic lymph nodes (LN) between cryoablation (CWA) and radiofrequency ablation (RFA).

Materials and methods: Institutional database research identified 28 patients with 40 metastatic LNs who underwent percutaneous CT-guided ablation; RFA group included 18 patients/26 lesions and CWA group included 10 patients/16 lesions. Contrast-enhanced CT or MRI was used for post-ablation follow-up. Patient and tumor characteristics, technical and clinical success on a per tumor and a per patient basis as well as complication rates were recorded, evaluated and compared between the 2 groups.

Results: Both RFA and CWA groups had the same median lesion size (2.00 vs 2.00, $p=0.257$), the same median follow-up time (20.00 vs 20.50, $p=0.923$) and the same median length of stay in the hospital (1.00 vs 1.00, $p=0.283$). The analysis showed that cryotherapy had a higher median procedure time (110.50 vs. 52.00, $p=0.001$). On a per lesion basis, the overall complete response post-ablation according to the mRECIST criteria applied was 88.46% (23/26 lesions) in the RFA and 93.75% (15/16 lesions) in the CWA group; no association was revealed between local tumor control and ablation technique ($p=0.709$). On a per patient basis CWA had a higher median overall survival (28.00 vs. 22.50, $p=0.057$) than RFA, but that was practically non-significant (at the 10% significance level). No complications were recorded in both Groups.

Conclusion: CT-guided RFA and CWA are equally effective on terms of efficacy and safety for the treatment of metastatic lymph nodes.

P-100

Chemoembolization in palliative treatment of head and neck cancer

Ilchenko S¹, Uzun D¹, Minaev A¹

¹Regional Territorial Medical Association, city Kramatorsk, Cardiovascular dept., Kramatorsk, Ukraine

Head and neck cancer is the 7-th most common cancers worldwide. Almost 50% of all new cases presents with advanced stage. One year survivability in Ukraine in 2019 was only 40%. One of the main reasons of death among this patients – life-threatening tumor bleeding. Our purpose was to identify the role and benefits of TACE among patients with head and neck cancers and high tumor bleeding risk. We treated 16 patients from April 2020 to December 2021 with locally advanced head and neck cancer and high tumor bleeding risk. Tumor localization was oropharynx and hypopharynx. All patients passed through general

examination, tumor biopsy, CT or MRI and endoscopic study. All patients were discussed with onco-team. Patients, depending on their general health status received TACE with systemic chemotherapy or TACE alone. TACE was performed with drug eluting beads loaded with cisplatin. All patients tolerated procedure well. After TACE all patients received otorhinolaryngologist examination on 7,14,21,30 day, regular endoscopic study and CT after 1,5 month. In 1 month after TACE 4 patients showed stabilization of tumor, tumor resorption more than 50% was observed in 5 patients, tumor resorption 20-40% observed in 6 patients, and prolongation was observed in 1 patient. In period of 1,5 year none of the patients had life threatening bleeding. TACE showed itself as an effective procedure with improvement in quality of life among patients with head and neck cancer and high tumor bleeding risk.

P-101

PAE: do morphological changes of the IPP and PUA go hand in hand with LUTS improvements

Kovács A¹, Tüchler M¹, Bischoff P¹, Zhou W¹

¹MediClin Robert Janker Klinik, Bonn, Germany

Purpose: Intravesical Prostatic Protrusion (IPP) and a higher Prostatic Urethral Angle (PUA) are associated with Lower Urinary Tract Symptoms (LUTS). The aim was to correlate the IPP- and PUA-improvement with the treatment outcome after Prostate Artery Embolization (PAE).

Materials and methods: Data from 307 patients treated with PAE from 04/2015 to 02/2020 were retrospectively analyzed regarding changes in IPP, PUA, Quality of Life (QoL) and International Prostate Symptom Score (IPSS) from Baseline up to 6-months (mo) follow-up.

Results: More pronounced IPPs $12.9 \pm 5\text{mm}$ could be reduced to $4 \pm 5.4\text{mm}$ after 6 mo ($p=0.022$) and equally pronounced PUA $81.5 \pm 7.3^\circ$ to $66.5 \pm 8.7^\circ$ ($p=0.002$). After 6 mo, mean IPSS reduced from 23,0 [19,05 – 26,69] to 4,0 (2,82 – 11,18, $p < .001$). Mean QoL improved from 5,0 [4,41 – 4,83] to 0,0 [0,05 – 1,48, $p < .001$]. The proportion of severe IPSS (20.35) was reduced from 73% to 14%, as was the proportion of dissatisfied and very dissatisfied patients from 78% to 0. Reciprocally, the proportion of very satisfied patients increased from 0 to 72%. **Conclusion:** Particularly large IPPs and severely kinked PUAs respond well to PAE, which is reflected in the almost complete conversion of the most severe to mild IPSS, as well as as predominantly dissatisfied patients to predominantly satisfied ones.

P-102**Role of interventional radiology in the management of post pancreatectomy complications**

Shetty N¹, Kulkarni S¹, Narayan D¹, Gala K¹, Bhandare M², Shrikhande S²

¹Tata Memorial Hospital, Interventional Radiology Department, Mumbai, India, ²Tata Memorial Hospital, Surgical Oncology Department, Mumbai, India

Purpose: To evaluate the role of interventional radiology (IR) in the management of post pancreatectomy complications in terms of preventing re-exploration and 90 day mortality rates.

Materials and methods: DESIGN: An audit of prospective maintained electronic medical data.

Duration of study: January 2012 -December 2018. All patients who required image guided interventions for the management of post pancreatectomy complications were identified and reviewed.

Results: Number of patients who underwent pancreatectomy – 758, Number of patients who developed post pancreatectomy complications – 206.

Post Pancreatectomy Haemorrhage (PPH): 46/758(6%), Intervention: 30/758(3.96%), Primary angioembolisation: 13/ 46 (28.3%), 90 day mortality in patients with PPH: 8/46 (17.39%), 90 day mortality in primary angioembolisation group: 5/13 (38.46%), Role IR played in preventing re-exploration: 8/13 (61.5%)

Intra-abdominal fluid collection: Total patients-173/758 (22.8%), Primary IR intervention-147/173(85%), Percutaneous drainage-141/147(95.9%), Aspiration-6/147 (4.1%). 90 day mortality in primary IR group-9/147(6.12%), 90 day mortality in patients with intra-abdominal collection-14/173(8.1%), Role IR played in preventing re-exploration: 146/147 (99.3%)

Biliary complications: 31/758 (4%), Bile leak-28/31(90%), Biliary stricture-3/31(9.7%) PTBD-10/28 (35.7%), PTBD+SEMS -5/28 (17.85%), Primary IR intervention-18/31(58%), 90 day mortality in IR group-5/18 (27.78%), 90 day mortality in patients with biliary complications - 8/31(25.8%), Role IR played in preventing re-exploration -16/18 (88.9%).

Conclusion: IR procedures are safe and effective and the synergistic role of interventional radiologist provides minimally invasive approach in the management of post pancreatectomy complications while reducing the need for re-operation and helps in reducing recovery time and preventing morbidity associated with re-exploration.

P-103**Managing radiation strictures from radical treatment for oesophageal carcinoma: first results from an IR-led multi-disciplinary algorithm**

Laasch H^{1,2}, Dickinson O^{2,3}, Bi Y¹, Borg P¹, Radhakrishna G⁴, Edwards D^{1,2}

¹The Christie NHS Foundation Trust, Dept. of Radiology, Manchester, United Kingdom, ²Minnova Medical Foundation CIC, Wilmslow, United Kingdom, ³Rotherham NHS Foundation Trust, Dept. of Endoscopy, Rotherham, United Kingdom, ⁴The Christie NHS Foundation Trust, Dept. of Clinical Oncology, Manchester, United Kingdom

Purpose: To propose a treatment protocol for iatrogenic strictures after curative chemo-radiotherapy for oesophageal cancer and advance national guidelines.

To review initial results of a new regional service for patients with limiting dysphagia after cancer cure.

Materials and methods: The radiology department of a specialist cancer centre was accepted by the regional multi-disciplinary-team as a central referral point. Procedures were undertaken by endoscopy-trained radiologists, supported by a consultant nurse endoscopists.

Residual/recurrent cancer was excluded with CT and biopsy. Baseline dilatation was done to 9mm for filiform, 12mm for complex and 15mm for simple strictures. Patients received balloon-dilatations every 1-2 weeks increasing by ≤3mm to 20mm. If strictures recurred, steroid injections were added and temporary stenting (metal/biodegradable) suggested. Procedural sedation was given by the IR nurses using EEG-guidance. This 2-year review was IRB approved.

Results: 18 Patients (5 male) with a median dysphagia grade of 3=liquids only (2-4) were referred. Median number of dilatations was 6 (5-23). 4 stents (1 biodegradable) were placed in 2 patients. 1 perforation occurred, which was managed conservatively. 4 patients developed local recurrence, 2 metastatic disease. Two died from unclear causes. 9 disease-free patients improved to dysphagia 1 (1-2). 6 feeding tubes could be removed.

All patients are able to eat in a restaurant, but only 3 are intervention-free at 6 months.

Conclusion: Initial results validate the treatment protocol. Combining the endoscopic and radiologic expertise is crucial in the management of these recalcitrant strictures. The high detection rate for early cancer recurrence justifies the added endoscopic surveillance.

P-104**Comparative analysis of costs and radiation dose using coils versus vascular plugs in ischaemic conditioning of the stomach prior to esophagectomy**

Picado Bermúdez A¹, Farias Lisboa P¹, Lloret Larrea M¹, Boukhoubza A¹, Calatayud Jordán J¹, Solana González J¹, García Marcos R¹

¹Hospital Universitari I Politecnici La Fe, Valencia, Spain

Purpose: To analyze the differences in costs, fluoroscopy time and radiation exposure using coils, vascular plugs and a combination of coils and vascular plugs in gastric ischemic conditioning prior to esophagectomy.

Materials and methods: Retrospective study of gastric ischemic conditioning performed in our center between 2018 and 2020. 67 patients were included and the differences in costs, fluoroscopy time and radiation exposure between different groups were analyzed: only coils (C=54), vascular plugs together with coils (C +T=5) and only vascular plugs (T=8). The comparative analysis between groups was performed using the Welch test.

Results: The mean total cost, fluoroscopy time, PDA (mGy*cm²) and air kerma (mGy) were significantly lower in group T compared to group C: €2,839 versus €4,676; (P= 0.00004274), 22 min versus 11.8 (P=0.00325), 143398 mGy*cm² versus 348270 (P=0.001483) and 614 mGy versus 1470 (P=0.003204), respectively. These differences were also significant for the C+T versus C group: €3320 (P=0.008688), 13.96 min (P=0.00131), 144575 mGy*cm² (P=0.002066), and 911 mGy (P=0.04263).

Conclusion: The use of vascular plugs reduces costs, fluoroscopy time and radiation exposure (PDA and Kerma in air) in gastric ischemic conditioning prior to esophagectomy.

P-105**Robotic high-intensity focused ultrasound of 1370 patients with prostate cancer – single center experience**

Solovov V¹, Tiurin A

¹Samara Oncology center, Samara, Russian Federation

Purpose: To analyze 15 years results of robotic HIFU (rHIFU) treatment of patients with prostate cancer (PC) and with local recurrence after external beam radiotherapy (EBRT) and radical prostatectomy (RPE), stratified by tumor recurrence risk according to D'Amico risk classification.

Material and methods: The current analysis included the results of treatment 1370 patients in the Samara Oncology Center between 2007 – 2022: 389 with low risk progression, 425 with intermediate risk progression, 501 with high risk progression, 55 – after the EBRT and RPE failure. Mean follow-up is 128 months (range 6-176). The mean age of the whole group of patients were 70.1 (52-89) years. The oncology follow-up consisted of the PSA evaluation, the MRI and a transrectal biopsy in the case of rising the PSA.

Results: In group with low risk progression of PC after 15 years of follow-up the progression was observed in 4.8 % of the patients; in intermediate risk group – 7.1 %, in high risk group in 36.8 % of the patients; in group with EBRT and RPE failure in 19.2 %.

Conclusion: rHIFU ablation is a safe, minimally invasive treatment for localized and locally advanced prostate cancer, effective in 86.3 % of cases with mild and transient side effects; rHIFU-therapy can also be successfully performed in patients with local recurrence after RPE and EBRT.

P-106**Procedural steps in lymphangiography and lymphatic interventions: a preclinical in vivo approach for standardization and training**

Tinouh P¹, Pan F³, Do T¹, Schmitt N², Vollherbst D², Brassel F⁶, Schlunz-Hendann M⁶, Pereira P⁴, Richter G⁵, Kauczor H¹, Sommer C^{1,6}

¹Heidelberg University Hospital, Clinic of Diagnostic and Interventional Radiology, Heidelberg, Germany, ²Heidelberg University Hospital, Department of Neuroradiology, Heidelberg, Germany, ³Department of Radiology, Union Hospital, Tongji Medical College, Huazhong University of Science and Technology, Wuhan, China, ⁴Center for Radiology, Minimally-invasive Therapies and Nuclear Medicine, SLK Kliniken Heilbronn GmbH, Heilbronn, Germany, ⁵Clinic of Diagnostic and Interventional Radiology, Stuttgart Clinics, Stuttgart, Germany, ⁶Clinic of Radiology and Neuroradiology, Duisburg Sana Clinics, Duisburg, Germany

Purpose: To introduce a preclinical in vivo approach for standardization and training of different procedural steps in lymphangiography and lymphatic interventions.

Materials and methods: This study was performed in accordance with the rules of scientific working and publishing as well as ethics in medicine (AZ 35-9185.81/G-3/18). Twelve Landrace pigs with a body weight of 33±3 kg were prepared according to standard techniques (e.g. general anesthesia, central venous line, intubation and muscle relaxation). Cut-down of the groin with introduction of vascular sheaths simulated a surgical procedure potentially leading to a lymphatic fistula. A range of lymphangiography and lymphatic intervention techniques should be performed in the same manner as in humans applying different imaging and guiding modalities.

Results: For the visualization of the peripheral and central lymphatic system inclusive of lymphatic pathology, Lipiodol based transpedal and intranodal fluoroscopy/CT lymphangiography as well as Gadolinium based interstitial and intranodal MR lymphangiography were successfully implemented. For the treatment of the lymphatic system, different types of sclerotherapy (e.g. percutaneous ethanol sclerotherapy) and embolization procedures (e.g. interstitial glue embolization or thoracic duct coil embolization) were technically and clinically feasible without complications under visual, ultrasound, fluoroscopy, CT, cone-beam CT and/or MRI guidance.

Conclusion: The presented preclinical in vivo approach is feasible, safe and effective for standardization and training of different procedural steps in lymphangiography and lymphatic interventions. Before such interventions in humans take place, unexperienced radiologists and interventional radiologists such as fellows, residents and interns should collect practical skills in a controlled and realistic environment.

P-107

Treatment of primary breast cancer using thermal ablation: comparative evaluation of microwave ablation and cryoablation

Vogl T¹, Cakmak S¹, Panahi B¹, Gruber-Rouh T¹

¹Universitätsklinikum, Frankfurt am Main, Germany

Purpose: To retrospectively compare feasibility, safety and efficacy of cryo- and microwave ablation (MWA) for the treatment of primary breast cancer.

Material and Methods: 33 female patients (55±12 years, range:35-85) with primary breast cancer (43 lesions) were treated with either cryoablation or MWA between 01/12 and 02/21. CT-guided cryoablation was performed in 25 patients (mean:55±12 years; range:36-85) with 31 lesions (mean tumor volume ± SD, 3.53 cm³±6.22; range:0.65 cmx0.45 cm to 4.18x3.13 cm) from 05/19 to 01/21, CT-guided MWA in 8 patients (mean:56±10 years; range:35-68) with 12 lesions (mean tumor volume + SD, 2.77 cm³±3.57; range:0.28 cmx0.36 cm to 4.9 cmx2.61 cm) from 02/12 to 03/19. Radiological outcome was evaluated at 3-month intervals with a mean follow-up of 6 months (range, 1-36 months).

Results: Adverse events post MWA included minor complications like local pain, slight regional reddening, edematous swelling or discrete focal bleeding zones occurring in 3 cases (25%), post cryoablation slight swelling, edematization of the breast parenchyma in 3 cases (9,7%). Technical success was 100% with no major complications in both groups. Three months post ablation complete regression was documented in MWA in 75% and in cryoablation in 96%. No local recurrence of primary tumors was observed during follow-up. Mean necrosis volume for cryoablation one day and three months post treatment was 16.977 cm³ and 14.28 cm³, for MWA 8.92 cm³ and 7.84 cm³.

Conclusion: MWA and cryoablation are well tolerated, feasible, and effective treatment options for primary breast cancer patients with a better risk-benefit profile for cryoablation.

P-108

A primer on interventional and oncological applications and translational barriers for selective venous sampling: a review of literature

Dunne O¹, Umair M²

¹Pritzker School of Molecular Engineering, University of Chicago, Chicago, United States of America, ²Northwestern University Feinberg School of Medicine, Chicago, United States

Selective venous sampling employs catheter-directed venous aspiration from the tumor's microenvironment, an alternative to image-guided tissue biopsies (percutaneous biopsies) - the current standard for cancer diagnostics. The applications of selective venous sampling, also referred to as liquid biopsy in common literature, include oncological diagnostics and therapeutics with identification of tumor markers, monitoring progression of preexisting tumors by following these biomarkers, treatment response, and screening for high-risk patients. Selective venous sampling offers a less invasive alternative with decreased risks of complications compared

to many percutaneous biopsies, including lesser risks of parenchymal bleeding. In cases of patients with high risk for bleeding and transplanted organs, selective venous sampling can be a safer option for tissue sampling. Additionally, in cases when image-guided percutaneous biopsies are challenging due to either the small size of lesions or the inaccessibility of location, selective venous sampling from the tumor microenvironment may facilitate early diagnosis. On the other hand, percutaneous biopsies can lead to more definitive histopathological diagnoses with demonstration of tumor cytoarchitecture. The primary barrier to the clinical translation of selective venous sampling technology is mainly not procedural, but rather lies in the limitations of current microfluidics and biomarker detection, including lab-on-a-chip technologies, in addition to our limited database of known tumor biomarkers. In conclusion, although not the standard of care for tissue sampling, selective venous sampling can be a safer option for certain high-risk populations and can lead to early detection for some small or inaccessible lesions on images.

P-109

Tips and tricks for a safe and effective image-guided percutaneous thyroid nodule ablation.

Gasparrini F, Mauri G, Rossi D, Camisassi N, Maiettini D, Varano G, Della Vigna P, Bonomo G, Orsi F

¹Istituto Europeo di Oncologia, Milano, Italia

Learning Objectives: To offer an overview of the most frequently used ablative techniques, the best image guidance setting and of the most important protective maneuvers that can be applied to image-guided thermal ablation of thyroid nodules.

Background: Some factors can limit the feasibility and safety of thyroid ablation. In particular, the proximity of sensitive structures to the nodule, an inadequate operating room settings and wrong patient management can limit the application of image-guided ablations.

Clinical Finding: The availability of the most advanced imaging techniques may enhance the correct targeting of the nodule and maximize the technical outcome. Furthermore, different ablative techniques might be used, each one with its own specific characteristics, that should be considered in order to minimize the risk of complications. Moreover, the application of some protective maneuvers, such as hydro-dissection, are useful to overcome these limitations. Emphasis is placed on the clinical management of the patient and the provided correct information regarding the goals, limitations and possible complications of the procedure. A good knowledge of differences among ablative techniques, optimal room setting and image guidance, and of possible protective maneuvers is of paramount importance for a safe and effective application of image guided ablation of thyroid nodules.

Conclusion: Interventional radiologists who perform thyroid thermal ablation should have a fully equipped operating room, with an experienced nursing team and they should be familiar with neck anatomy, all the ablative techniques and protective maneuvers that can be applied to maximize the result by reducing the complications.

P-110

Possible complications of radiologically inserted gastrostomy and strategies how to avoid them and treat them

Jarzabek M¹, Parthipun A¹, Monzon L

¹Guy's and St. Thomas Hospital NHS Foundation Trust, London, United Kingdom

The main learning objective of the presentation is to be aware of the range of possible complications during and after gastrostomy insertion. Also, to be familiarised with the severity of more serious complications and to be aware how to avoid them and deal with them.

Gastrostomy insertion is an established method of treatment in patients with malnutrition. Radiologically inserted gastrostomy is considered to be a high risk, compared to other interventional radiology procedures in terms of morbidity and mortality rates. 30-day mortality rate reaches 6% with morbidity rate around 10%. In most clinical centres the procedure is limited to patients with head, neck and oesophageal malignancy or failed attempt of endoscopic insertion. The possibility of cone beam CT significantly reduces the risks of bowel, liver or vessel injury, and makes the procedure safer.

We present case scenarios where procedure can go unexpectedly wrong and how to deal with any potential complication. The case scenarios were collected from our institution and from review of the published literature. We conclude, that having adequate resources and experienced team, being involved in patients selection and organised after care protocols significantly minimises the risks and mortality rates after the procedure.

P-111

Percutaneous cryoablation of extra-abdominal desmoid-type fibromatosis

Quek L¹, Pua U¹

¹Tan Tock Seng Hospital, Singapore, Singapore

Learning objectives: Understand the role of cryoablation in the treatment of extra-abdominal desmoid-type fibromatosis.

Background: Desmoid tumours (DT) are dense tumors that do not metastasize. They are also known as aggressive fibromatosis or desmoid type fibromatosis. These tumours are aggressive, grow along musculoaponeurotic structures, and often recur after treatment. Hence they are treated like cancer. Often, these tumours lead to pain and disability. European Society for Medical Oncology (ESMO) guidelines recommend frontline watchful waiting and medical treatment in progressing tumours. And National Comprehensive Cancer Network (NCCN) 2021 guidelines recommends active therapy for progressive, morbid, or symptomatic disease. Cryoablation is an interventional radiology technique that is suitable for DT patients on the basis of repeated cycles of freezing, leading to cell death.

Clinical findings/procedure details: A review of DT cases in author's institution demonstrating the imaging findings, procedural techniques to approach of the DT, as well as the challenges encountered in the follow-up and further staged treatment of these patients referenced to the relevant guidelines.

Conclusion:

DT are rare and often challenging non-malignant but locally aggressive disease of which local ablative tools, primarily cryoablation, can benefit patient in terms of disease control, pain and quality of life compared to conventional treatment such as surgery, chemotherapy and radiation therapy.

P-112

The eye sees what the mind knows

Agarwal U¹, Kulkarni S¹, Shetty N¹, Gala K¹, Chandra D¹

¹Department of Radio diagnosis and Interventional Radiology, Tata Memorial Hospital, Mumbai, India

Clinical history/Pre-treatment imaging: 51 year old female case of carcinoma bilateral breast underwent bilateral modified radical mastectomy in 2018 followed by chemotherapy. On follow up she complained of partial closure of the left eye for 2 months along with pain in the retro orbital region. MRI orbit revealed bulky and oedematous left intraorbital muscles with near complete replacement of retro orbital fat by ill-defined altered signal intensity showing homogenous post contrast enhancement. Likely radiological differentials were metastasis over orbital pseudotumor. PET-CT was done FDG avid soft tissue deposit involving left extra ocular muscles. CT guided biopsy of the orbital lesion was done using lateral approach. No post procedural complication was there.

Treatment options/Results: Biopsy revealed orbital metastasis in a known case of carcinoma breast and the patient was declared metastatic. Palliative radiotherapy was planned for left orbital metastasis.

Discussion: Breast carcinoma is the most common primary cancer to cause metastases to the orbits with noted incidence of 8% to 10%. The frequency of breast carcinoma among patients with orbital metastases varies from 29% to 51%. The average time between the primary diagnosis and orbital metastases varies from 4.5 to 6.5 years. Patients usually present with diplopia, proptosis, and decreased vision. Possible differential diagnosis are orbital pseudotumor, lymphoma and IGG4 related orbitopathy and pathological diagnosis is needed as it would completely change the management. Take-home points: Imaging guided biopsies of orbit is feasible, safe, accurate and free from long-term complications and also provides immunohistochemical analysis of the specimen.

P-113

Head and neck vascular malformation: what to do

Agarwal U¹, Kulkarni S¹, Shetty N¹, Gala K¹, Chandra D¹

¹Department of Radio diagnosis and Interventional Radiology, Tata Memorial Hospital, Mumbai, India

Clinical history/Pre-treatment imaging: 1 year old child developed progressive swelling in submandibular region with recent increase in size and breathing difficulty and fever. Patient underwent excision of the mass and patient had stridor with difficult intubation. MRI revealed diffuse infiltrative multiloculated non-enhancing T2 hyperintense cystic mass extending along bilateral masseteric, submandibular, parapharyngeal, parotid and carotid spaces, and involving the tongue, floor of mouth and oropharynx. Findings were suggestive of lymphatic malformation. Percutaneous sclerotherapy with bleomycin and sodium tetradecyl sulphate was chosen instead of surgical treatment. First session was targeted to relieve the laryngeal component and stridor. Further sessions of sclerotherapy at a interval of 2 months was done to treat rest components. Recent MRI post six sessions shows further decrease in size and extent of lesion and significant clinical improvement and easy intubation.

Treatment options/Results: Many therapeutic options for head and neck lymphatic malformation have been reported in the literature, including surgical excision and sclerotherapy.

Discussion: Sclerotherapy is simple and safe to apply, economical, and easily available, as well as does not require specific equipment and allows for partial or total lesion reduction without bleeding and scarring. Few drawbacks are postoperative discomfort and burning, the risk of allergic reaction, tissue necrosis, and airway impairment. Amount and the number of applications required are determined by the size and location of the lesion.

Take-home points: Sclerotherapy should be considered the major treatment option, because it is a very effective, low-cost, and simple-to-apply treatment technique.

P-114

Needle track metastasis after RFA. Misdiagnosis or unexpected complication

Balaka S¹, Hrechikhin H, Olkhovskiy D, Vieriemiei D

¹SO «Grigoriev Institute for Medical Radiology and Oncology of the National Academy of Medical Sciences of Ukraine», Kharkov, Ukraine

Medical history: Woman 35-years-old was presented with complaints of right-side lower back pain. The blood tests were normal, patient did not have fever, there were no injuries in this area. Six months earlier a biopsy and RFA for the RCC of the right kidney were performed. Two months earlier, there were no pathologic findings in this area on CT and MRI. Psychogenic stress occurred before symptoms appeared.

Treatment options: CT and MRI scans showed metastasis in the quadratus lumbal muscle and retroperitoneal space with a maximum size of 42 mm. Core-needle biopsy and RFA were performed. Histological findings: fragments of skeletal muscle with chronic active inflammation

Discussion: The appearance of tumor in the area near the ablation zone make us to think about the metastatic genesis of the focus. We have assumed that this tumor was a needle track seeding through a previous biopsy channel. To avoid re-seeding we performed next core-needle biopsy and RFA simultaneously.

Take-home points: It is possible that the histological examination was inaccurate or that we took material from a site of necrotic tissue.

Should we perform biopsy before RFA despite the risk of contamination of the needle track

Should we trust the diagnosis by CT or MRI in all cases.

P-115

Feasibility and efficacy of cryoablation as an eyeball salvage therapy for radiation-resistant orbital/uveal metastases

Ponti A¹, Saltiel S, Holderbaum Do Amaral R, Villard N, Tsoumakidou G, Mederos N, Denys A, Duran R

¹Centre Hospitalier Universitaire Vaudois, Lausanne, Switzerland

Clinical history: We report two patients treated by cryoablation for orbital and choroidal metastases. The first one is a 67-year-old woman with lung adenocarcinoma who lost right eye vision due to an intraorbital extraocular metastasis. Debulking by cryoablation was proposed after persistent growth despite stereotaxic radiotherapy (figure1). The second one is a 31-year-old man with lung NUT carcinoma who lost left eye vision due to a choroidal metastasis. The lesion demonstrated persistent growth despite stereotaxic radiotherapy. Cryoablation was attempted in order to prevent enucleation (figure2).

Results: Both interventions were performed under general anesthesia. Cryoablation needles (Boston Scientific) were positioned in the orbit under sonographic and CT guidance. Two freeze-thaw cycles were performed with close monitoring of ice ball extension. Radiological response was mixed in the first patient, probably due to our limited aggressiveness, and favorable in the second patient. Follow-up imaging showed extensive necrosis of the orbital metastasis with some tumor growth of untreated areas that were stabilized by subsequent immunotherapy. A complete response was obtained in the choroidal metastasis.

Discussion: Metastases to the eye and orbit are rare, difficult to diagnose and generally discovered in patients with disseminated disease. Treatment is palliative and local options are limited consisting mainly of radiation therapy. Cryoablation is a feasible and efficient therapeutic option with the advantage of eye preservation after failed radiation therapy.

Take-home points: Cryoablation in the orbit for intra- and extraocular metastases is feasible, minimally invasive and safe with the advantage of eye preservation. Further clinical follow-up is needed.

P-116**A rendezvous with a jejunal twist: combined percutaneous and endoscopic enteric stent insertion for malignant gastrojejunostomy obstruction****Elsakka M¹**, Zamir M¹¹West Hertfordshire NHs Trust, Watford, United Kingdom

Clinical history: A 78-year-old male patient presents with obstructive jaundice one year after Whipple's procedure for a T4N0M0 pancreatic head carcinoma.

Treatment options/Results: Imaging investigations demonstrated obstruction of the biliary loop as a result of peritoneal metastases [see Fig.1]. Surgical, endoscopic and transhepatic intervention were considered unfeasible and a percutaneous biliary loop puncture was undertaken with traversal of a guidewire into the stomach. However, a stent could not be deployed percutaneously and a stent was deployed orally following endoscopic snaring of the percutaneously inserted guidewire [see Fig.2]. The patient made a rapid uneventful recovery with normalisation of liver function and managed by the outpatient palliative team.

Discussion: Advances in oncological treatments have extended the life expectancy of patients with advanced cancers resulting in a proportional increase of previously rare disease complications. Malignant obstruction at the level of the gastrojejunostomy has been infrequently reported in literature with multi-disciplinary team discussion playing a pivotal role in its management. Anatomic alteration post-Whipple's procedure poses a challenge for any single treatment modality. An endoscopic-percutaneous rendezvous procedure allows for the stent to be deployed orally obviating the need for a large percutaneous/jejunal puncture minimising the risk of complications.

Take-home message: The current advances in medical imaging and minimally invasive procedures will strengthen interventional oncology's status as the fourth pillar of oncological treatment. A modified rendezvous allows for an unconventional treatment option for these unique clinical conundrums. The site and direction of the percutaneous biliary loop puncture must be carefully planned to allow for technical success.

P-117**Taking piece of mind – a peculiar case of USG guided brain biopsy****Gupta A**, Shetty N, Kulkarni S, Gala K, Chandra D, Atkuri P
¹Tata Memorial Hospital, Mumbai, India

Clinical history/Pre-treatment imaging: A 29year old young lady, underwent left sided decompressive craniectomy for nodular frontoparietal cortical based lesion which was thought to be a meningioma. On Follow up scan after one year, patient presented with bulging flap, headache and right sided weakness with power of 2/5 in right upper limb. MRI revealed two solid nodular component along the tumor bed and bulge area (Fig 1). No spine/ metastatic disease appreciable. Biopsy review at our institution revealed Anaplastic Ependymoma (WHO grade III), GFAP+ve; L1CAM + (s/o RELA- fusion). However, DOTA PET-showed peripheral SSTR uptake in ring enhancing lesion noted at left parafalcine region SUVmax 7.22. No significant tracer uptake noted in another ring enhancing parafalcine lesion posterior to aforementioned lesion.

Treatment options/Results: The treatment plan and prognostication for ependymoma and meningioma is entirely different. Hence repeat biopsy was indicated. However, neurosurgical brain biopsy was deemed risky in view of flap bulge and risk of brain herniation. Hence, the patient underwent USG guided brain biopsy as the lesions were superficial and craniectomy flap provided adequate window. USG guided brain biopsy was performed via semiautomatic coaxial 18 G, 9cm length cook needle from suspicious lesion adjacent to left high parietal lobe lesion (Figure 2). Patient was stable post procedure with no neurologic deficits. Final Histopathology was in favor of Ependymoma

Discussion: USG guided procedures can be performed for post superficial craniectomy with safe and effective yield

Take-home points: USG guided biopsy can be performed for superficial brain lesions after craniectomy.

P-118**An amazing story of sinonasal spindle cell hemangioma**

Abdullah M¹, **Mohamad N¹**, Nadarajan C¹, Seu Kean T¹

¹*Department of Radiology, School of Medical Sciences, Universiti Sains Malaysia, Kota Bharu, Malaysia*

Spindle cell haemangioma is a benign vascular lesion which was previously known as spindle cell haemangioendothelioma (1). It is usually found in distal extremities. Its occurrence in the head and neck regions are rare (2). We illustrate a confirmed case of spindle cell haemangioma, successfully treated with embolisation and surgery.

A 26-year-old male was presented to the Otorhinolaryngology clinic in October 2020 with persistent left-side nasal blockage for a week which caused patient to have insomnia. He also experienced anosmia, intermittent left-sided throbbing headache, and gum pain. The left eye vision became blurred associated with left eye watery discharge and floaters. In addition, he experienced intermittent unprovoked left-sided epistaxis for one month – otherwise, no history of trauma. Computed tomography (CT) and Magnetic Resonance Imaging (MRI) of the brain revealed an aggressive, highly vascular left sinonasal mass. Biopsy of the mass was complicated with massive bleeding (2 litres blood loss). Histopathological examination revealed sinonasal spindle cell haemangioma. The sinonasal mass doubled in size within three months, resulting in almost total blindness. The patient underwent embolization thrice before surgery. Marked reduction of mass was achieved after the second embolisation. The left eye vision turns to normal. Surgery was also uneventful. This case underwent a series of multidisciplinary discussions on the approach for treatment. Based on the previous history of massive bleeding during biopsy as well as deterioration of patient's condition, we opted for preoperative embolisation. The embolization of the mass helped to reduce the size of the mass. Therefore, we would like to share our endovascular approach in treating patients with sinonasal spindle cell haemangioma.

References

1. Weiss SW, Enzinger FM. Spindle cell hemangioendothelioma. A low-grade angiosarcoma resembling a cavernous hemangioma and Kaposi's sarcoma. *Am J Surg Pathol.* 1986; 10(8):521-30.
2. Perkins P, Weiss SW. Spindle cell hemangioendothelioma. An analysis of 78 cases with reassessment of its pathogenesis and biologic behavior. *Am J Surg Pathol.* 1996; 20(10):1196-204.

P-119**Percutaneous single probe cryoablation with liquid nitrogen in oral tumor recurrences**

Kammoun T¹, **Touimi Benjelloun G¹**, Ortman S¹, Dabli D¹, de Forges H¹, Frandon J¹, Beregi J¹

¹*CHU Nîmes, Nîmes, France*

Clinical history/Pre-treatment imaging: 70 years old man, mandibular cystic adenoid carcinoma treated by surgery with palatal flap and external radiotherapy. MRI control: Tumor recurrence in the right mandibular branch and on the palatal flap.

Surgical treatment refused because of radiotherapy.

Treatment options/Results: percutaneous cryoablation of both sites of tumor recurrence. Single probe cryoablation with liquid nitrogen under CT and US guidance.

Freezing duration was 20 minutes in both sites. Placement of a chiba needle to plan the ablation path and then mounting the co-axial (12G) of cryotherapy cryoprobe on the chiba.

No complication. MRI check at 6 months:

No tumor recurrence in the right mandibular branch.

Small tumor residue on the flap: new cryoablation.

Discussion: Percutaneous single probe cryoablation is an excellent therapeutic option on ENT tumor recurrence after radiation therapy. It produces ablation zones of around 3 cm in 20 minutes of freezing. It can be conducted under local anesthesia with sedation if general anesthesia is contraindicated. Path planning with a chiba needle provides additional safety.

Take home messages: Single probe liquid nitrogen percutaneous cryoablation can be used for treatment of tumors in various organs including ENT tumors. It is safe and reproducible with good local disease control.

Pre-clinical & experimental

P-120

Predictability of response to transarterial chemoembolization with degradable starch microspheres (DSM-TACE) of liver metastases: the role of radiomics

Badia S¹, Rengo M, Cianni R, Morucci M, Agresti P, Giuliani S, Bellini D, Trillò G, Capodanno A, Pampana E, Fabiano S, Carbone I, Laghi A

¹*La Sapienza" University of Rome, I.C.O.T. Hospital / Diagnostic imaging Unit, Latina, Italy*

Purpose/Objective: To investigate the effectiveness and predictability of success of DSM-TACE in patients affected by inoperable liver metastases with CT texture analysis (CTTA).

Materials and methods: A retrospective single-center study design was performed on 12 patients (8 men and 4 women; median 58 years, range 48–71) affected by liver metastases (19 lesions). A suspension of 75 mg of doxorubicin and 7.5 ml of a degradable starch microsphere (Embocept®S) was administered intra-arterially up to 2 times with a 3 weeks-interval. Baseline and follow-up contrast enhanced computed tomography (CECT) was assessed at 1 month after "complete treatment" measuring the density of each lesion according to CHOI criteria. Measures of heterogeneity were obtained in post-processing by placing a VOI (Volume of interest) on the entire lesion and CTTA parameters were correlated with density using machine learning algorithms (WEKA®).

Results: According to CHOI criteria, imaging follow-up revealed a partial response in 16 lesions, stable disease in 2 and progression in 1 lesion. In CTTA, machine learning analysis with a decision tree classifier revealed higher performances for detecting responsive metastases (95% of lesions correctly identified; ROC area = 0.964) with sensitivity and specificity of 83% and 100% respectively.

Conclusion: DSM-TACE is well tolerated and provides a valid treatment; CTTA with machine learning offers a high evaluation of predictability of response to treatment of liver metastases.

P-121

From micro to nano: optimization and characterization of multi-scale drug and device combinations via a thermally-reporting immuno-ablation phantom and activateable carriers

Rivera J¹, Christou A, Negussie A, Wood B

¹*Center for Interventional Oncology, Bethesda, United States,*

²*University of Oxford, Oxford, United Kingdom*

Purpose: To define methods and models to study and clarify the complex interactions between drug and image guided device, with goals of cell death, targeted drug delivery, or immunomodulation. To review activate-able drug delivery systems across a variety of scales in IO.

Methods: A thermochromic and biomimetic in vitro phantom was developed. Immunogenic cell death (ICD) biomarkers were studied with corresponding dynamic thermal profiles over space and time. Spatial compartments were divided according to highest temperature achieved (unheated, sub-lethally heated and heated to cell death). HMGB1 and calreticulin were quantified in each compartment as biomarkers of ICD. Other approaches such as activateable carriers were also reviewed. Drug may be added to image guided devices with a variety of approaches to target image-guided local drug delivery or systemic immunomodulation across a variety of scales (from micro to nano). Image guided devices include ablation probes, ultrasound, or drug eluting microspheres.

Results: "Thermal reporting" biomimetic immuno-ablation phantoms had the most ICD markers at the sublethal ablation margin, followed by the necrotic center, and least in the remote unheated zone. Image-able local drug delivery carriers were reviewed across scales to include nano (IV heat-deployed liposomes delivering chemotherapy and MRI contrast), micro (drug eluting microspheres), and multi-scale approaches (ultrasound-activated IV microbubbles, nanodroplets, or nano-cups).

Conclusion: Immunoablation phantom models and a better understanding of bioeffects and scales of activate-able drug carriers may help elucidate complex drug plus device interactions in interventional oncology.

P-122**A new planning software for the definition of optimal overlapping ablation zones (optoAZs): a geometrical approach with Ulm-Heidelberg-Uncertainty-principles (UHU)**

Sommer C¹, Meinke M¹, Pereira P², Tinoush P¹, Pan F³, Do T¹, Richter G⁴, Kauczor H¹, Mittmann B⁵, Kannberg T⁵, Franz AM⁵
¹Clinic of Radiology, Heidelberg University Hospital, Heidelberg, Germany, ²Center for Radiology, Minimally-invasive Therapies and Nuclear Medicine, SLK Kliniken Heilbronn GmbH, Heilbronn, Germany, ³Department of Radiology, Union Hospital, Tongji Medical College, Huazhong University of Science and Technology, Wuhan, China, ⁴Clinic of Diagnostic and Interventional Radiology, Stuttgart Clinics, Stuttgart, Germany, ⁵Institute for Computer Science, Ulm University of Applied Sciences, Ulm, Germany

Introduction: The new version of our experimental planning software for percutaneous thermal ablation (<https://osf.io/r7f5d/>; 2021.12-preAlpha) is used to propose number, size and position of optimal overlapping ablation zones (optoAZs).

Materials and methods: Software characteristics can be obtained from publications (<https://www.youtube.com/watch?v=AssunPnxgio>). In brief, a model based on automatic selection from a large number of randomized geometrical arrangements was selected to define spherical ablation zones of different size within/around the tumor. Because a solution considering exclusively geometrical aspects seems inappropriate (e.g. ablated and non-ablated tissues have influence on pending ablation zones), Ulm-Heidelberg-Uncertainty-principles (UHUs) were implemented: UHU-1 "tolerance-non-ablated-tumor" and UHU-2 "shrinkage-ablation-zone". Safety margin, ablation zone radii and iterations defined further presets. >5.0cm RCCs underwent analysis applying 36 preset combinations (n=5 times each): UHU-1 of 0/1/3/5/10/20% and UHU-2 of 0/5/10/20/30/40% (with 5mm safety margin, 5-20mm range of ablation zone radii and n=100 iterations).

Results: The algorithm was robust and the results were reproducible, plausible and consistent and depended on the preset combinations. Exemplary for a 5.1cm RCC, number of optoAZs and ablation zone radii were 2.0-19.8 and 15.0-19.0mm, respectively (UHU-1=20%/UHU-2=40% [non-ablated tumor: 19.0%] versus UHU-1=0%/UHU-2=0% [non-ablated tumor: 0.0%]). A less extreme preset combination (UHU-1=1%/UHU-2=25%) resulted in 5.8 optoAZs with ablation zone radii of 15.0-19.8mm (non-ablated tumor: 0.71%).

Conclusion: This new version of our experimental planning software for percutaneous thermal ablation is promising. In a next step, the results need to be correlated with real-world data to assess which preset combinations are most realistic and if the concept as a whole is clinically feasible.

P-123**Prediction ablation volume software in interventional radiology: preliminary results**

Arrichiello A¹, Ierardi A², Di Meglio L², Wood B¹, Carrafiello G²
¹Center for Interventional Oncology, National Institutes of Health, Bethesda, United States, ²Operative Unit of Radiology, Fondazione IRCCS Ca' Granda Ospedale Maggiore Policlinico, Milan, Italy

Purpose: Evaluate the clinical feasibility of an ablation treatment flowchart provided by a "Prediction Ablation Volume Software" and its potential ability in improving outcomes.

Material and Methods: This is a single-center prospective study. From April 2021 to July 2021, consecutive patients who underwent liver ablation were enrolled in this study. Each patient was discussed by a MDT. Patient who underwent combined therapies were excluded. The total of the patients selected was 5. After the procedure a 1 month Follow Up CT or MR is planned for all the patients.

Results: Technical Success was of 100%. Mean time of the procedure was 60min. In 3 cases after the prediction of the ablation volume, the antenna was repositioned (60%). There was no Residual tumor at the CT-FU in all the patients. Technical Efficacy was of 100%. Only one case of minor complication occurred (self-limiting hemoperitoneum).

Discussion: In our study, all the lesion were treated following the protocol, which means it could be potentially proposed as a routine protocol. Thanks to the high Technical Efficacy, the use of the Software present in our treatment protocol may help reducing the incidence of Residual Unablated Tumor. Local Recurrence rate will be evaluated in the next imaging follow up.

Conclusion: The implementation of a Prediction Ablation Volume Software in the treatment of liver malignancies in a small population was safe and had a high Technical Success and Efficacy. More studies are needed to confirm these preliminary results.

P-124**CT guided navigation with a compact IMU-based medical device**

Dénes H¹, Somogyi D², Gyulay K², Szántó P³
¹Semmelweis University, Department of Interventional Radiology, Budapest, Hungary, ²Semmelweis University, Department of Radiology, Budapest, Hungary, ³Semmelweis University, Department of Nuclear Imaging, Hungary

Purpose: Navigation systems opened a new era in CT guided interventions. In this study we evaluated a novel, compact IMU-based navigation device and compared its accuracy with the standard freehand technique in a phantom experimental setup.

Material and methods: The device is based on a small sensor attached to the extracorporeal end of a needle. To define default accuracy, the needle was fixed in 100 different random positions and angles were calculated between the vector defined by sensor data and the centerline of the actual needle trajectory. In order to assess needle placement accuracy, one hundred "single-shot" punctures were performed on a phantom (Model 071B; CIRS Inc.) using both the standard freehanded technique and the new navigation device. Four predefined entry points were used. The average depth was 11 cm and target size was between 5-12 mm. Accuracy was assessed on control CT images by measuring the perpendicular distance between the target and the needle axis (lateral target point error).

Results: The angular error in the fixed position experiment was $1.7 \pm 0.92^\circ$. The lateral target point error in the freehand group was 18.9 ± 10.85 mm, while the navigated group showed 4.8 ± 3 mm, which is significantly less.

Conclusion: Our study showed improved accuracy with an IMU-based navigation system compared to the standard freehand technique. For this reason, this navigation device could be beneficial in out-of-plane needle insertions. Moreover, since our navigation system is simple and compact, it could be easily adopted in the everyday CT workflow.

P-125

3D conformal laser ablation guided by real-time volumetric MR-thermometry

Desclides M^{1,2,3}, Machinet G⁴, Pierre C⁴, Ozenne V^{2,3,5,6}, Chemouny S¹, Quesson B^{2,3}

¹Certis Therapeutics, Pessac, France, ²UMR⁵⁵³⁶ CRMSB, Université de Bordeaux, Bordeaux, France, ³IHU Liryc, Electrophysiology and Heart Modeling Institute, Hopital Xavier Arnoz, Pessac, France, ⁴ALPhANOV, Talence, France, ⁵Centre de Recherche Cardio-Thoracique de Bordeaux, U1045, University of Bordeaux, Bordeaux, France, ⁶INSERM, Centre de Recherche Cardio-Thoracique de Bordeaux, U1045, Bordeaux, France

Purpose: The purpose of this work is to present a new Laser Interstitial Thermal Therapy (LITT) device integrating a multi-probe laser unit, allowing the creation of thermal ablations of various shapes under real-time 2D multislice MR-thermometry.

Materials and methods: Laser device (Alphanov, France): A 6-multimode-fiber bundle (200 μ m core diameter) was shaped to ensure radial propagation of each laser beam in different directions (60° each, distributed over 360°). The bundle (2 mm diameter) was illuminated by a 6-laser-diodes module (976 nm) with adjustable power.

Real-time MRI thermometry pipeline: The laser probe was inserted into a gelatin gel. 10 slices of a single shot EPI sequence positioned perpendicular to the laser tip were acquired every 2 seconds on a 1.5 T clinical scanner (Avanto, Siemens Healthcare): TE=18 ms, FOV=180x180 mm², 3 mm slice thickness, FA=60°, GRAPPA acceleration=2, bandwidth/pixel = 1446 Hz. Images were processed online to visualize 3D temperature images (Certis Therapeutics, France).

Results: Three heating patterns were successfully created and visualized on temperature maps: a triangle (2W applied during 60s on fibers #2, #4 and #6), an ellipse (1.5W applied during 25 s on fibers #3 and #6) and a half sphere (1.5W applied during 30s on fibers #1, #2, #3 and #6).

Conclusion: The proposed LITT device is MR-compatible and allows creating various heating shapes that can be visualized in real-time by rapid volumetric MR-thermometry, opening interesting perspectives for conformational tumor treatment.

P-126

Computed tomography-guided microwave ablation of malignant liver lesions located in the hepatic dome; safety and efficacy of percutaneous navigation under local anesthesia

Efthymiou E¹, Georgiadi E¹, Palialexis K¹, Grigoriadis S¹, Spiliopoulos S¹, Kelekis A¹, Filippiadis D¹

¹University General Hospital „ATTIKON“, National and Kapodistrian University of Athens, Greece, Athens, Greece

Purpose: to report safety and efficacy of percutaneous navigation under local anesthesia for computed tomography (CT)-guided microwave ablation (MWA) of malignant liver lesions located in the hepatic dome.

Materials and methods: Patients with primary and secondary malignant liver lesions located in the hepatic dome who underwent percutaneous CT- guided MWA using a computer-assisted navigation system under local anesthesia were prospectively evaluated. Primary objective was technical success (defined as successful completion of the planned microwave ablation of each target lesion). Secondary objectives included evaluation of complications.

Results: Sample consisted by 10 participants (16 lesions) with a mean age of 60.60 years (SD=9.25 years) and a mean size of 20.37 ± 7.29 cm; mean follow up time was 3.4 months (SD =1.41) months. Neoplastic substrate included: hepatocellular carcinoma [2/10 (20%)], colorectal carcinoma [4/10 (40%)], gastrointestinal stromal tumor [2/10 (20%)] and myeloid carcinoma of the thyroid gland [2/10 (20%)]. Primary technical success was 93.75%; tumor remnant was noticed at one month follow up in a single metastatic lesion which was re-treated with an ablation session and no tumor remnant was depicted in the subsequent imaging follow-up (secondary technical success 100%). Grade I self-limited complications (according to the CIRSE classification system) included small pleural effusion (n=1) and minor bleeding post antenna removal (n=1) requiring nothing but observation.

Conclusion: Findings of the present study indicate that of percutaneous navigation under local anesthesia is a safe and efficacious approach for computed tomography-guided microwave ablation of malignant liver lesions located in the hepatic dome.

P-127**Adaptation and development of IR services in response to the COVID-19 pandemic: preliminary results of a focused survey**

Gomez Muñoz F¹, Reimer P², Pereira P³, Bent C⁴, Cazzato R⁵, Das M⁶, Diamantopoulos A⁷, Zeka B⁸, Nathalie K⁸, Makris G⁹
¹Interventional Radiology, Hospital Clinic de Barcelona, Barcelona, Spain, ²Diagnostic and Interventional Radiology, Klinikum Karlsruhe, Karlsruhe, Germany, ³Radiology, Minimally Invasive Therapies and Nuclearmedicine, SLK-Clinics GmbH Heilbronn, Ruprecht-Karls-University Heidelberg, Heilbronn, Germany, ⁴Interventional Radiology, University Hospitals Dorset, Bournemouth, United Kingdom, ⁵Interventional Radiology, University Hospital of Strasbourg, Strasbourg, France, ⁶Department of Diagnostic and Interventional Radiology, Helios Klinikum Duisburg, Duisburg, Germany, ⁷Department of Interventional Radiology, Guy's and St. Thomas' NHS Foundation Trust, London, United Kingdom, ⁸Clinical Research Department, Cardiovascular and Interventional Radiological Society of Europe, Vienna, Austria, ⁹School of Biomedical Engineering & Imaging Sciences, Faculty of Life Sciences & Medicine, Kings College London, London, United Kingdom

Purpose: The cyclic nature of active and recovery phases of the COVID-19 pandemic, has demanded fast adaptations and preparation for health care workers world-wide. We aimed to assess how interventional radiologists are handling the pandemic during active and recovery phases with regard to work and team structures, as well as mental health and how the pandemic could have increased the awareness of minimally-invasive therapies as alternatives to postponements of non-urgent procedures.

Material and methods: 7125 CIRSE members were invited to participate. For this interim report, responses were collected between 23 November 2021 and 17 December 2021.

Results: 114 responses were obtained for this preliminary report, of which 102 were complete. 94% (n=99) of respondents were interventional radiology specialists. Most respondents reported having established a routine to handle different waves of the pandemic (89.5%; n=102). Compared to active phases, fewer respondents indicated at least one pandemic-associated measure in their department during recovery phases (46%-71% vs 13%). 56% reported an increase in ambulatory care patients either during active and/or recovery phases. 54% reported more referrals during active and/or recovery phases.

25% reported increased hours at the hospital during recovery phases, 52% indicated increased sick leave, care leave, quarantine, and burn-out of team members and only 39% reported to get enough time to rest during recovery phases.

Conclusion: While the COVID-19 pandemic is continuing to burden IR departments and the mental health of IRs, more than half of respondents reported an increase in referrals for minimally-invasive therapies and ambulatory care.

P-128**Digital air leak quantification during pneumothorax drainage**

Izaaryene J¹, Piana G¹
¹Institut Paoli Calmettes, Marseille, France

Purpose: To evaluate the safety and efficacy of digital drainage of pneumothorax in interventional radiology. Material and methods: All patients requiring chest drainage for pneumothorax between March 2020 and March 2021 were retrospectively included. In the first phase, digital drainage was maintained for a period of at least 24 hours, and then the drain was removed if the air leak was under 20 mL/min for at least 6 hours. In the second phase, the drains were removed as soon as this threshold was reached. The primary endpoint was the recurrence of pneumothorax during the month following the procedure.

Results: During the first phase, forty-seven patients were included (median age, 66 [52; 73], 35 women); one patient developed pneumothorax recurrence few days after drain removal. The median effective drainage time was 23 hours [20; 44], the median theoretical required drainage time was 7 hours [6; 15] (p<.001), the median additional drainage time was 16 hours [10; 116]. Two airflow cessation patterns were determined. Twenty-nine patients (62%) presented a fast air leak cessation pattern (≤7hours), and eighteen (38%) presented a prolonged air leak cessation pattern. During the second phase, ten patients were included (median age, 67 [56.2; 72.8], 7 women). The chest drains could be removed on the same day for five patients (50%) and on the following day for four patients (40%).

Conclusion: Digital drainage might provide a better understanding of air leak resolution and might allow an optimization of the current practice in particular by considering an earlier drain removal.

P-129**The Access Cube: evaluation of a novel, patient-mounted system for CT-guided punctures – a phantom study**

Krammer L¹, Kadrijaj V³, Hostettler R^{2,4}, Wetzel S^{2,3}
¹University of Basel, Basel, Switzerland, ²Medical Templates AG, Egg, Switzerland, ³Department of Neuroradiology, Hirslanden Clinic Zurich, Zurich, Switzerland, ⁴Robotics and Embedded Systems, Technical University Munich, Munich, Germany

Purpose: To evaluate the accuracy and efficiency of the Access Cube (AC), a new instrument guide for the Cube Navigation System (CNS), for CT-guided percutaneous interventions in comparison to the free-hand method (FHM).

Material and methods: The CNS consists of self-adhesive cubes attached to the patient with an upper and lower template plate with through holes, and software that recognizes the cube in the planning scan.

The target in the image dataset is connected by a line, here “virtual needle” which passes through the cube. For any chosen path of the virtual needle, the entry points for the needle into the cube are displayed by the software for both templates on-the-fly. The AC is a new instrument guide for the CNS designed for instruments with a diameter of 16 to 10G with removable template plates. On two phantoms 59 punctures were performed with the FHM and the AC.

Results: Using the AC, accuracy was significantly increased ($3.8\text{mm} \pm 1.3\text{mm}$ vs. FHM $6.7\text{mm} \pm 4.5\text{mm}$, $p = 0.004$) and procedure time was significantly reduced ($263.1\text{s} \pm 84.4\text{s}$ vs. FHM $411.2\text{s} \pm 141.0\text{s}$, $p < 0.001$). The number of CT control scans was significantly lower using the AC (1.4 ± 0.6 vs. FHM 2.8 ± 0.4 , $p < 0.001$). Accuracy did not decrease significantly on punctures with a non-rigid phantom (non-rigid $4.6\text{mm} \pm 2.6\text{mm}$ vs. rigid $3.8\text{mm} \pm 1.3\text{mm}$, $p = 0.48$).

Conclusion: The AC is a potentially valuable extension of the CNS for larger needles increasing accuracy and decreasing procedure time of interventions in comparison to the FHM.

P-130

Possible use of digital variance angiography in liver transarterial chemoembolization: a retrospective observational study

Lucatelli P¹, Teodoli L¹, Argirò R², Guiu B³, Ciaglia S¹, Saba L⁴, Vallati G⁵, Gyano M^{6,7}, Gog I^{6,8}, Osvath S^{6,9}, Szigeti K^{6,9}, Kiss J⁶, Catalano C¹

¹Sapienza University of Rome, Roma, Italy, ²Interventional Radiology Unit, Department of Biomedicine and Prevention, University of Tor Vergata, Rome, Italy, ³Saint-Éloi University Hospital, Department of Radiology, Montpellier, France, ⁴Department of Radiology, University of Cagliari, Cagliari, Italy, ⁵Department of Radiology, IRCCS-Regina Elena National Cancer Institute, Rome, Italy, ⁶Kinepict Health Ltd, Budapest, Hungary, ⁷Department of Interventional Radiology, Heart and Vascular Center, Semmelweis University, Budapest, Hungary, ⁸Department of Vascular Surgery, Hungarian Defence Forces Medical Centre, Budapest, Hungary, ⁹Department of Biophysics and Radiation Biology, Semmelweis University, Budapest, Hungary

Purpose: Digital variance angiography (DVA), a recently developed image processing technology provided higher contrast-to-noise ratio (CNR) and better image quality (IQ) in lower limb interventions compared to digital subtraction angiography (DSA). Our aim was to investigate whether this quality reserve can be observed also in liver transarterial chemoembolization (TACE).

Materials and methods: We have retrospectively compared the CNR and IQ parameters of DSA and DVA images from 25 patients (mean \pm SD age: 67.5 ± 11.2) underwent liver TACE intervention at our institution. CNR was calculated using 728 regions-of-interest on 50 images. IQ of the same image set was evaluated by 5 experts using a 4-grade Likert scale. The diagnostic value was evaluated by the possibility to identify lesions and feeding arteries.

Results: DVA provided significantly higher CNR than DSA (the mean CNRDVA/CNRDSA was 1.33). DVA images received significantly higher Likert score than DSA images (mean \pm SEM

3.34 ± 0.08 vs. 2.89 ± 0.11 , Wilcoxon signed-rank $p < 0.001$). DSA could not detect lesion and feeding artery in 30% and 36% of cases, and allowed clear detection only in 20% and 14%, respectively. In contrast, DVA failed only in 8% and 18% and clearly revealed lesions and feeding arteries in 30% and 26%, respectively.

Conclusion: DVA provides higher quality images and better diagnostic insight than DSA, therefore it might be a useful tool in liver TACE interventions. The observed quality reserve might be used for dose management (reduction of applied radiation dose and/or contrast media), but the validation of these claims requires further clinical investigations.

P-131

EEG (BIS) monitoring improves accuracy and safety of procedural sedation

Oh A¹, Karim N², Pitt A², Hodgetts S², Royle G², Maxfield L², Laasch H³

¹Maidstone and Tunbridge Wells NHS Trust, Maidstone, United Kingdom, ²Department of Radiology, The Christie NHS Foundation Trust, Manchester, United Kingdom, ³Minnova Medical Foundation CIC, Wilmslow, United Kingdom

Purpose: To demonstrate the validity of EEG Bispectral-Index-Sensor (BIS, Medtronic) guidance as a tool to optimise procedural sedation and prevent oversedation. To assess the level of adherence to an updated sedation protocol in a supraregional cancer centre.

Materials and methods: Consecutive cancer procedures requiring sedation between April and December 2021 underwent review to ensure adequate documentation and to analyze the sedation parameters.

After pre-oxygenization midazolam and fentanyl were titrated to drop BIS to a target range of 80-85. Further doses were given throughout the procedure to maintain that level. $\text{SpO}_2 \leq 94\%$ was to prompt active intervention, incl. the use of reversal agents. IRB and anesthetic review required this study to validate the protocol.

Results: 150 cases (30-86 years) were collected. The three commonest procedures were gastrostomy (22%), oesophageal stent (19.3%) and oesophageal dilatation (18.7%).

In 39 cases BIS was not used or recorded. One of these recorded five SpO_2 readings $\leq 94\%$ without use of a reversal agent. 141 cases applied BIS correctly. Baseline BIS was $89.8 (\pm 9.9)$ which dropped to a mean intra-procedure BIS of $81.3 (\pm 9.1)$. One case recorded a single SpO_2 reading of 94%, not requiring reversal.

Conclusion: BIS-guidance readily achieves optimum sedation levels, avoiding over- as well as undersedation and respiratory depression. BIS offers real-time assessment of the depth of sedation and increases patient safety. In contrast to capnography it allows prediction of the safety of further drug administration. BIS-guided sedation remains routine practice in our institution. Some minor clerical issues are being addressed.

P-132

Iterative image reconstruction (IIR) in single-energy and dual-energy CT-guided RFA and CRYO for optimization of image quality

Slatosch-Petz F¹, Pereira P², Färber M¹, Heim J¹, Melzig C¹, Schmitt N³, Vollherbst D³, Möhlenbruch M³, Kauczor H¹, Do T¹, Sommer C^{1,4}

¹Clinic of Diagnostic and Interventional Radiology, Heidelberg University Hospital, Heidelberg, Germany, ²Clinic for Radiology, Minimally-invasive Therapies and Nuclear Medicine, SLK Kliniken Heilbronn GmbH, Heilbronn, Germany, ³Department of Neuroradiology, Heidelberg University Hospital, Heidelberg, ⁴Clinic of Radiology and Neuroradiology, Sana Clinics Duisburg, Duisburg, Germany

Purpose: To analyze the value of iterative image reconstruction (IIR) in single-energy and dual-energy CT-guided RFA and CRYO for optimization of image quality.

Materials and methods: 17G-RFA-needles or 13G-CRYO-needles were inserted into livers of 10 pigs under CT-guidance. Raw image data were acquired using two scanning techniques (single-energy or dual-energy) and seven dose settings (CTDI-vol ranging from 13.5mGy to 3.3mGy). Images were reconstructed with different algorithms (filtered-back-projection [FBP] or IIR). Quantitative and qualitative image analyses were performed by two independent observers.

Results: Image noise and signal-to-noise-ratio were better with IIR than with FBP in single-energy and dual-energy CT-guided RFA and CRYO. The density of 17G-RFA-needle/13G-CRYO-needle tips was comparable between IIR and FBP in single-energy and dual-energy CT-guidance (with markedly higher Hounsfield Units [HUs] for 13G-CRYO-needles compared with 17G-RFA-needles). Quantitatively, artifacts in the liver parenchyma in direct extension to the needles were comparable between IIR and FBP, however showed markedly lower HUs in dual-energy CT-guidance compared with single-energy CT-guidance (e.g., CRYO [8.4mGy]: -234.8±105.7HUs [FBP-single-energy]; -237.7±104.9HUs [IIR-single-energy]; -129.1±51.8HUs [FBP-dual-energy]; -134.0±48.9HUs [IIR-dual-energy]). The quantitative results were supported by different qualitative image analyses (e.g., RFA [5.0mGy], overall image quality [5-point Likert scale; 1-excellent overall image quality]: 3.0 [FBP-single-energy]; 2.0 [IIR-single-energy]; 2.5 [FBP-dual-energy]; 2.0 [IIR-dual-energy]).

Conclusion: In single-energy and dual-energy CT-guided RFA and CRYO, overall image quality is optimized with IIR. With respect to specific image artifacts caused by the needles, IIR shows no additional value. Interestingly, dual-energy CT-guidance appears to result in a reduction of specific image artifacts when compared with single-energy CT-guidance.

P-133

Percutaneous liquid nitrogen cryoablation for metastatic lesions: a 5-year experience

Rossi D¹, Mauri G², Bonomo G², Camisassi N², Della Vigna P², Maiettini D², Varano G², Gasparrini F², Orsi F²

¹Postgraduate School of Radiodiagnostics, University of Milan, Milan, Italy, ²Division of Interventional Radiology, IEO, European Institute of Oncology IRCCS, Milan, Italy

Purpose: To assess the safety and efficacy of cryoablation using a liquid nitrogen-based cryogenic system in cancer patients with metastatic lesions.

Material and methods: Between April 2017 and December 2021, 61 patients (34 females, 27 males, median age 61, range 31-82) underwent 74 cryoablations for metastatic lesions, localized in bone structures (22/74; 30%), soft tissues (30/74; 41%) and parenchymal organs (22/74; 29%). Histological diagnosis included 8/74 (11%) breast carcinoma, 10/74 (14%) colorectal cancer, 8/74 (11%) lung carcinoma, 8/74 (11%) melanoma, 18/74 (24%) renal cell carcinomas, 12/74 (16%) sarcoma and 10/74 (14%) others.

The inclusion criteria consisted of symptomatic metastatic patients with either contraindication to other treatments or to delay them in oligometastatic patients.

All treatments were performed in a dedicated angiography room setting in patients under general anesthesia or sedation, using a liquid-nitrogen based Prosense Cryosurgical system under CT or US guidance.

Results: Technical success and efficacy were reached in 68/74 (92%) and 64/74 cases (86%), respectively. An average of 1.9 cryoablation cycles was performed with a median procedure time of 33 minutes (range 10-136 min). Minor adverse events (AEs) were reported in 7/74 lesions (9%). No major or severe AEs were reported. At a mean follow up of 9 months, local tumor progression occurred in 26/74 lesions (35%), requiring further systemic treatments.

Conclusion: Image-guided cryoablation is a safe and effective treatment option for metastatic patients and can be used to delay systemic therapies, maintaining disease control and life quality. A longer follow-up is needed for stronger survival outcomes.

P-134

Efficacy and safety of balloon occluded hepatic radioembolization with Yttrium-90 in patients with unresectable hepatocellular carcinoma (HCC)

Teodoli L¹, Vallati G¹, Trobiani C¹, Cappelli F¹, Lucatelli P², Ungania S¹, Sciuto R¹, Vidiri A¹, Catalano C²

¹Istituto Nazionale Tumori Regina Elena – IRCCS IFO, Roma, Italy,

²Sapienza University of Rome, Rome, Italy

Purpose: This cohort, retrospective, single center study purpose was to quantify in vivo the micro-balloon role by comparing transarterial hepatic radioembolization (TARE) with Yttrium-90 procedures performed with and without balloon-microcatheter for unresectable Hepatocellular Carcinoma (HCC).

Material and methods: We treated 63 patients with unresectable hepatocellular carcinoma (HCC) using trans-arterial locoregional therapy. 39/63 patients were treated with TARE and 24/63 b-TARE.

Impact of balloon micro-catheter on trans-arterial locoregional treatment was analyzed using 2D and 3D dosimetry in SPECT-CT after TARE and b-TARE. Dosimetry was evaluate using a dedicated software for image analysis both in 2D and 3D SPECT-CT scans acquired after the procedures.

Results: Both 2D and 3D SPECT-CT analysis demonstrated a better dosimetry profile in b-TARE group. Concerning 2D evaluation, the activity intensity peak was significantly higher in the b-TARE group compared with SIRT group. Regarding 3D dose analysis, the mean dose administered to the treated lesions was significantly higher in b-TARE group than TARE. With regards to safety evaluation in b-TARE group there was not increase of the mean dose delivered to the normal liver and no increase in complication related to radioembolization.

Conclusions: The results of the present study quantify in vivo, the ameliorative embolization profile (measured as higher signal at SPECT-CT post b-TARE and higher lesion absorbed dose post b-TARE) of oncological interventions performed with balloon-micro catheter, thanks to the use of 2D and 3D SPECT-CT dose evaluation with dedicated image analysis software.

P-135

Percutaneous tumour ablation guided by electromagnetic navigation system: a retrospective study

Ventura Díaz S¹, Olavarría Delgado A¹, Cobos Alonso J¹, Romera Sánchez R¹, Urbano García J¹

¹Hospital Universitario Ramón Y Cajal, Madrid, Spain

Purpose: To assess the applicability of an electromagnetic navigation system (EMNS) as an auxiliary tool for abdominal tumours ablation.

Material and methods: This study retrospectively collected patients with kidney and liver tumours treated with ablation from January 2020 to April 2021. Ablation modality was decided depending on the tumour characteristics. Subfrenic and subcapsular lesions or tumours located less than 1 cm away from the bowel or gall bladder were categorized as high-risk. Major and minor complications were recorded. Median follow-up was 9 months after treatment.

Results: 97 lesions were treated in 67 patients, being the mean size 18,9 mm (range 5-40). The majority (77,6%) were male, with a mean age of 66,5 years (range 20-88). 67,2%(45) were hepatocarcinomas, 20,9%(14) liver metastases from colonic cancer, and 11,9 %(8) renal carcinomas. In total, 89 liver lesions were treated and 42%(38) of them were in high-risk locations. 91%(41) of hepatocarcinomas were treated with radiofrequency, all liver metastases with microwave and all kidney lesions with cryotherapy. 94% had a complete response within the first month, and 98% after a second ablation. Four major complications (2 active bleedings, 1 hepatic abscess and a pneumothorax) and 10 minor complications (8 autolimited bleedings and 2 autolimited pneumothorax) were recorded.

Conclusion: EMNS (Imactis-CT®) helps radiologists reach those lesions non-visible in non-contrast studies and/or with high risk locations. This reduces the number of complications regardless of radiologist experience and allows ablation as a valuable therapeutic option to many more patients.

P-136

Percutaneous biliary tract biopsy with dual cholangioscopic and cholangiographic guidance

Stranieri G¹, Basile D, Gola G, Molinaro M, Gallesio I, Veltri A, Pacielli A, Barbero S

¹AO Alessandria, Alessandria, Italy

LO: Use of dual cholangioscopic and cholangiographic guidance in mucosal biliary biopsy procedures

B: In interventional radiology, percutaneous approach biliary biopsy has a very wide range of diagnostic accuracy. Cholangiographically-guided biopsy is safe, technically simple approach that can be achieved through multiple (8-12) samplings performed with classic dedicated biopsy forceps. Cholangioscopic biopsy with transoral approach is procedure with many limitations due to site of lesion and technical difficulties to reach biliary tract in patients operated or with complex anatomy. Endoscopic biopsy by transoral approach is a non-sterile procedure that involves introduction of 12 F catheters and for which anesthesia sedation is required. Performing biliary biopsy by introducing a percutaneous cholangioscope and using dual endoscopic and cholangiographic guidance can be an added value to obtain target biopsy by reducing number of samples and risks associated with hemobilia and increasing diagnostic accuracy. **CF/PD:** Use of a microendoscope (7F) through a long armed introducer 7F-22 cm allows direct observation of changes in biliary tract and ability to select precise location to perform multiple bioptic sampling under cholangioscopic and cholangiographic guidance. Procedure is safe and obtainable in sterile environment without anesthesia sedation and does not require increased time or radiation exposure.

Conclusion: Dual cholangioscopic and cholangiographic guidance for target biopsy of biliary tract lesions can increase diagnostic accuracy of procedure without risks of infection, hemobilia, or use of large catheters. Knowledge of endoscopic reports and familiarity with use of newly available angiographic materials can overcome limitations of using microendoscope in percutaneous biliary bioptic procedures.

P-137**Use of the triple coaxial (triaxial) microcatheter system in superselective arterial embolisation for complex interventional cases: an initial experience with the system****Tan Z¹**, Tashi S¹, Gogna A¹¹*Department of Vascular and Interventional Radiology, Singapore, Singapore*

Learning objective: To share our experience in utilizing the triple coaxial (triaxial) system in super-selective cannulation of arteries for complex embolisation procedures.

Background: Percutaneous transcatheter selective embolisation is a widely performed for a myriad of oncologic (e.g. trans-arterial chemo- or radio-embolization) and non-oncologic (e.g. to embolization of bleeding and benign conditions such as uterine fibroid and benign prostate hyperplasia) conditions. The cornerstone of such embolisation procedures is to achieve super-selective cannulation of the arterial supply to the tumour/organ preventing the complication of non-target embolisation. However, the presence of tortuous and complex vascular anatomy can pose a major challenge for achieving this goal.

Clinical findings/procedural details: The triaxial system utilizes 2 smaller microcatheter telescoped through each other and over a microwire within an angiographic catheter. We have adopted the use of the triaxial system for cases which superselective cannulation is challenging due to its perceived superior torquability and trackability compared to the conventional coaxial system. The triaxial system is also favourable in situations which the inner microcatheter needs to “sacrificed” after administering embolics (e.g. after administering radionuclides in radioembolization, N-butyl cyanoacrylate (NBCA) glue or dimethyl-sulfoxide (DMSO)). Through a case series with procedural details such as fluoroscopic time, contrast administered etc, we hope to illustrate the utility and efficacy of the triaxial system as well as present pitfalls in its usage.

Conclusion: The triaxial system is safe for use in embolization procedures and can confer advantages over conventional co-axial system for specific situations.

A

Aalbers, A P-90
 Aarts, B P-90
 Abdullah, M P-118
 Agarwal, U P-112, P-113
 Aggarwal, M P-76
 Agresti, P P-120
 Aigner, Ka P-96
 Aigner, Ko P-96
 Aktas, A P-19
 Alcorn, D 1801.3
 Aldrighetti, L P-30
 Alrashidi, I P-20, P-21
 Altomare, C P-56, P-74, P-84
 Aly, A P-95
 Amodio, F P-49, P-50, P-69
 Andresciani, F P-56, P-74, P-84
 Angileri, A P-26
 Anselmo, A P-23
 Ardisson, V P-33
 Argirò, R P-22, P-23, P-130
 Armstrong, T P-64
 Arndt-Webster, L 902.2
 Arnò, M P-60
 Arntz, M P-44
 Arrichiello, A P-123
 Asif, A P-1
 Assouline, J P-2
 Atkuri, P P-88, P-117
 Auer, T P-18
 Augello, L P-29
 Azrumelashvili, T P-42, P-77, P-93, P-94

B

Badia, S P-120
 Baetens, T P-90
 Baijal, S P-68
 Balaka, S P-114
 Barabino, E P-57, P-60
 Barbero, S P-136
 Bargellini, I P-40
 Barone, R P-66
 Basile, D P-75, P-136
 Batra, A P-68
 Bäumler, W P-65
 Beermann, M P-15
 Beets-Tan, R P-90
 Bellini, D P-120
 Bellissant, E P-33
 Bello, P P-32
 Belloch, V P-32
 Bent, C P-127
 Benz, R P-87
 Bercu, Z 902.2, 1801.8
 Beregi, J P-119
 Berry, T P-98
 Bertini, R P-16
 Bevilacqua, M P-26
 Beydoun, N P-52

Bhandare, M P-102
 Bhatia, R P-92
 Bhatia, S P-62
 Bhattacharai, S P-1, P-8
 Bi, Y P-103
 Bianchi, F P-40
 Bilhim, T P-61
 Biondetti, P P-3, P-26
 Bischoff, P P-36, P-101
 Bisyrri, K P-41
 Bohrer, P 1801.1
 Boni, G P-40
 Bonomo, G P-59, P-109, P-133
 Boolbol, S 1801.7
 Borg, P P-103
 Borzelli, A P-45, P-49, P-50, P-69
 Boukhoubza, A P-85, P-104
 Bour, P P-24
 Bouvry, C P-33
 Bozzi, E P-40
 Bradbury, D 1801.10
 Brandon, D 902.2
 Braren, R 1801.1
 Brassel, F P-106
 Breen, D 1801.3
 Briley, K P-62
 Brönnimann, M P-87
 Brountzos, E P-12
 Bruners, P P-54
 Bruno, A P-74
 Buckley, B P-5
 Burgio, V P-30
 Busch, F P-25

C

Caetano, A P-61
 Cahalane, A P-79
 Cakmak, S P-107
 Calandri, M P-75
 Calatayud Jordán, J P-104
 Camisassi, N P-59, P-109, P-133
 Campillo-Gimenez, B P-33
 Can, E P-18
 Cangiano, G P-49, P-50, P-69
 Capitanio, U P-16
 Capodanno, A P-120
 Cappelli, F P-134
 Carbone, I P-120
 Carnevale, A P-3
 Carrafiello, G P-3, P-26, P-123
 Carrero, E 902.4
 Carriero, S P-26
 Cartledge, J P-1, P-8
 Caruso, S P-66
 Casadei-Gardini, A P-30
 Casanovas, G 902.4
 Catalano, C P-130, P-134
 Cavaglià, E P-49, P-50, P-69
 Cazzato, R P-127

Cea, L P-74
 Ceriani, C P-47
 Cervelli, R P-40
 Chan, V 1801.3, P-1, P-8
 Chandra, D P-82, P-88, P-89, P-92, P-112, P-113, P-117
 Chao, S P-55
 Chatterjee, A P-76
 Chavan, A P-82
 Chemouny, S P-24, P-125
 Chen, B 902.2
 Chen, J 1801.2, 1801.5, P-27
 Chen, N P-54
 Choi, J 902.1
 Chopinet, S P-53
 Christou, A P-48, P-121
 Chudacek, Z P-97
 Ciaglia, S P-130
 Ciampi-Dopazo, J P-58
 Cianni, R P-120
 Ciccarese, G P-23
 Cicek Ozdol, N P-19
 Cioni, R P-40
 Cipriani, F P-30
 Cobos Alonso, J P-135
 Coda, C P-49, P-50, P-69
 Coimbra, É P-61
 COLLISION Trial Group 902.5
 Comito, T P-47
 Conde Vasco, I P-61
 Corvino, F P-49, P-50, P-69
 Costa, N P-61
 Coupe, V 902.5
 Cristecu, M 1801.8
 Cristescu, M 902.2
 Crocetti, L P-40
 Crociati, S P-22

D

Dabbous, H 1801.8
 Dabli, D P-119
 Daga, K P-98
 Damascelli, A P-16
 Das, M P-127
 Dassa, M P-46
 De Baere, T P-28
 De Cobelli, F P-16, P-30, P-29
 de Forges, H P-119
 de Kerviler, E 1801.3, P-2
 De Lorenzis, E P-3
 de Magistris, G P-49, P-50, P-69
 de Vries, J 902.5
 Della Corte, A P-29, P-30
 Della Vigna, P P-59, P-109, P-133
 Dénes, H P-124
 Denys, A P-31, P-81, P-115
 Desai, S P-80

Desclides, M P-125
 Desgrandchamps, F P-2
 Devaraj, A P-80
 Di Meglio, L P-123
 Diamantopoulos, A P-127
 Dickinson, O P-103
 Dietrich, O P-24
 Dijkstra, M 902.5
 Do Amaral, R P-31
 Do, T P-14, P-106
 Do, T P-122, P-132
 Dromain, C P-31
 Duffaud, F P-78
 Dungevski, G P-34
 Dunne, O P-108
 Duran, R P-31, P-81, P-115

E

Eatz, T P-62
 Edeline, J P-33
 Edwards, D P-103
 Efthymiou, E P-99, P-126
 Eigl, B P-15, P-51, P-67, P-70
 Einspieler, I P-65
 El Hawari, M P-95
 El-Haddad, G 902.1, P-35
 Elsakka, M P-116
 Elsayed, M 902.2
 Errani, C P-83

F

Fabiano, S P-120
 Fabritius, M P-43
 Facchini, G P-83
 Faller, T P-24
 Färber, M P-132
 Farias Lisboa, P P-32, P-85, P-104
 Fehrenbach, U P-18
 Filippiadis, D P-12, P-99, P-126
 Fine, R 1801.7
 Fintelmann, F P-79
 Flacke, S 1801.10
 Flamen, P P-55
 Floris, R P-22
 Folco, G P-3
 Formica, V P-22, P-23
 Fouladirad, S P-4
 Frakes, J 902.1
 Frandon, J P-119
 Franz, AM P-122
 Franzese, C P-47
 Fütterer, J P-44

G

Gala, K P-82, P-88, P-89, P-92, P-102, P-112, P-113, P-117

Galanis, S P-9
 Galbiati, A P-45
 Gallesio, I P-136
 Galt, J 902.2
 Gandhi, R P-7
 García Marcos, R P-104
 Garcia, C P-48
 García, R P-85
 Garin, E P-33
 Garnon, J 1801.3
 Gasparrini, F P-22, P-23, P-109, P-133

Gaubert, J P-78
 Gazzo, P P-57, P-60
 Gebauer, B P-18, P-25
 Gehmert, S P-87
 Geninatti, C P-75
 Georgiadi, E P-99, P-126
 Georgiadou, M P-13
 Giankoulof, C P-9
 Gibson, T 1801.6
 Giganti, M P-3
 Girardet, R P-31
 Giuliani, S P-120
 Giurazza, F P-49, P-50, P-69
 Gjoreski, A P-34
 Gog, I P-130
 Gogna, A P-137
 Gola, G P-136
 Goldberg, SN 1801.10
 Gomez Muñoz, F 902.4, P-90, P-127
 Gong, A P-86
 Gonzalez-Aguirre, A P-95
 Gotsiridze, E P-42
 Graafland, N P-90
 Grasso, R P-56, P-74, P-84
 Graumann, O 1801.3
 Gregory, W P-8
 Grigoriadis, S P-12, P-126
 Grozdanovska Angelovska, B P-34

Grubbs, G 1801.10
 Gruber-Rouh, T P-107
 Guazzarotti, G P-16, P-29
 Guerrab, A P-52
 Guirola-Ortiz, J P-58
 Guiu, B P-28, P-130
 Gupta, A P-88, P-117
 Gupta, B P-76
 Gupta, S 1801.6
 Gusmini, S P-29, P-30
 Guzzardi, G P-45
 Gyano, M P-130
 Gyulay, K P-124

H

Habert, P P-78
 Habib, N P-42, P-93, P-94
 Haddad, H P-36
 Haimerl, M P-65

Hamm, B P-18
 Hamm, C P-25
 Hammerich, L P-18
 Hanameel, F P-52
 Harder, D P-87
 Harder, F 1801.1
 Hatiboglu, G P-14
 Hazen, L P-48
 He, Y P-25
 Heers, H P-6
 Heim, J P-132
 Helmberger, T 902.3
 Herpe, G P-52
 Hicks, R 1801.7
 Hodgetts, S P-131
 Hoffe, S 902.1
 Holden, A P-5
 Holderbaum Do Amaral, R P-115
 Homayoon, B P-4
 Ho-Shon, K P-63
 Hostettler, R P-129
 Hota, F P-92
 Hrechikhin, H P-114

I

Ierardi, A P-3, P-26, P-123
 Iezzi, R 902.3
 Ilchenko, S P-100
 Ingrand, P P-52
 Isfort, P P-54
 Ivaldi, D P-57
 Izaaryene, J P-46, P-128

J

Jagdev, S P-1, P-8
 Janu, A P-82
 Jarzabek, M P-110
 Jehanzeb, Q P-10
 Jenniskens, S P-44
 Jha, S P-68
 Jin, Z 1801.2, 1801.5, P-27
 Jocius, D P-91
 Johnson, W P-35
 Jones, J P-5
 Jovanoska, I P-34

K

Kadrijaj, V P-129
 Kammoun, T P-119
 Kannberg, T P-122
 Kappadath, S 902.2
 Karahaliou, A P-99
 Karanian, J P-48
 Karim, N P-131
 Karkhanis, S P-10
 Karst, U 1801.1

Karydis, I 1801.6
 Kassin, M P-48
 Kauczor, H P-106, P-122
 Kauczor, H P-132
 Kauczor, H P-14
 Kaufmann, N 902.3
 Kazemier, G 902.5
 Keeley, Jr, F 1801.3
 Kelekis, A P-12, P-99, P-126
 Khandelwal, A P-68
 Kheiri, M P-78
 Khin, N P-63, P-96
 Kiakidis, T P-41
 Kiladze, M P-93
 Kim, J P-20, P-21
 Kimuli, M P-1, P-8
 King, A 1801.3
 Kis, B 902.1, P-35
 Kiss, J P-130
 Klompenhouwer, E P-90
 Kocharyan, H 1801.8
 Koe, J P-1
 Kok, N P-90
 Kokabi, N 902.2, 1801.8
 König, A P-6
 Kovács, A P-36, P-101
 Krammer, L P-129
 Krasniqi, F P-87
 Krauss, M P-5
 Krieg, AH P-87
 Kriegsmann, K P-14
 Kriegsmann, M P-14
 Krishnamurthy Rajendra, K P-17
 Kronenberg, K 1801.1
 Kuhl, C P-54
 Kulkarni, S P-82, P-88, P-89, P-92, P-102, P-112, P-113, P-117

L

Laasch, HU P-98, P-103, P-131
 Laffont, S P-33
 Lagervald, B 1801.3
 Laghi, A P-120
 Lahaye, M P-90
 Lane, R P-63, P-96
 Lanza, C P-26
 Lanza, E P-47
 Larcher, A P-16
 Le Sourd, S P-33
 Lee, F 1801.4
 Lee, K P-48
 Lentini, S P-24
 Lenton, J P-1, P-8
 Lepareur, N P-33
 Leppelmann, K P-79
 Lešnik Zupan, L P-72
 Levillain, H P-55
 Levin, A P-86

Levy, E P-48
 Li, J P-37, P-38, P-39
 Liarakos, A P-41
 Lilly, M 1801.8
 Lim, W P-18
 Lindeberg, J P-15
 Lingegowds, D P-76
 Lissenberg-Witte, B 902.5
 Lloret Larrea, M P-104
 Lohöfer, F 1801.1
 Long, J P-64
 Lorenzoni, G P-40
 Louis, G P-53
 Lourenco, P P-4
 Loya, M 1801.8
 Lucatelli, P 902.3, P-22, P-23, P-130, P-134
 Luerken, L P-65
 Lughezzani, G 1801.3
 Lyons, G P-86

M

Maas, M P-90
 Machinet, G P-125
 Mahay, U P-10
 Mahendra, A P-7
 Mahnken, A P-6
 Maiettini, D P-59, P-109, P-133
 Majdalany, B 1801.8
 Makris, G P-127
 Malagari, K P-41
 Malfertheiner, P 1801.9, P-43
 Martinez, J P-32
 Martinez, J P-85
 Maruzzelli, L P-66
 Masson Lecomte, A P-2
 Mauri, G P-59, P-109, P-133
 Maxfield, L P-131
 Maybody, M P-95
 Mazioti, A P-99
 McCafferty, I P-10
 Mederos, N P-115
 Meijerink, M 902.5
 Meinke, M P-122
 Melzig, C P-132
 Mercaldo, N P-79
 Mhaskar, R 902.1, P-35
 Miceli, M P-83
 Mikhail, A P-48
 Minaev, A P-100
 Miraglia, R P-66
 Mitreski, N P-34
 Mittmann, B P-122
 Modi, S 1801.6, P-64
 Modica, F P-66
 Mohamad, N P-118
 Möhlenbruch, M P-132
 Mohr, R P-18
 Molinaro, M P-136
 Monfardini, L P-30

Montanari, E P-3
 Montorsi, F P-16
 Monzon, L P-110
 Morelli, C P-22
 Morosetti, D P-22, P-23
 Morucci, M P-120
 Moschouris, I P-41
 Moussa, A P-95
 Mullan, D P-98

N

Nadarajan, C P-118
 Narayan, D P-102
 Narayanan, G P-7
 Nathalie, K P-127
 Navarro-Vergara, P P-58
 Negussie, A P-48, P-121
 Nezzo, M P-23
 Ng, A P-1
 Niekamp, A P-7
 Nielsen, T 1801.3
 Nieuwenhuizen, S 902.5
 Nikolaou, V P-13
 Niola, R P-49, P-50, P-69
 Nivolli, A P-57
 Noorani, S P-67
 Nyarangi-Dix, J P-14

O

Öcal, O 1801.9, P-24, P-43
 Oh, A P-131
 O'Hara, R P-5
 Olavarria Delgado, A P-135
 Olivas, C P-32
 Olkhovskiy, D P-114
 Orsi, F P-59, P-109, P-133
 Ortmans, S P-119
 Osman, F P-1, P-8
 Osvath, S P-130
 Overduin, C P-44
 Ozdogan, M P-19
 Ozenne, V P-125
 Ozenne, V P-24

P

Pacella, G P-56, P-74, P-84
 Pachamano, D P-79
 Pachev, A P-2
 Pacielli, A P-136
 Padley, S P-80
 Pérez-Carpio, A 902.4
 Paladini, A P-45, P-49, P-50, P-69
 Palaniswamy, M P-17
 Palard, X P-33
 Palialexis, K P-12, P-126
 Palumbo, D P-16, P-29
 Pampana, E P-120

Pan, F P-14, P-106, P-122
 Panahi, B P-107
 Pane, F P-45, P-50, P-69
 Papalexis, N P-83
 Paprottka, P 1801.1
 Paquier, Z P-55
 Pardo, G P-18
 Pardo-Moreno, P P-58
 Parikh, N P-35
 Parisi, S P-29
 Park, C P-20
 Parthipun, A P-110
 Patel, A P-92
 Patel, S 1801.6, P-64
 Pedersoli, F P-54
 Pedicini, V P-47
 Pena, C P-7
 Pennella, R P-30
 Pereira, P 902.3, P-14, P-106, P-122, P-127, P-132
 Perez Enguix, D P-32
 Peta, G P-83
 Petsatodis, E P-9
 Phillips, C P-5
 Piana, G P-46, P-128
 Picado Bermúdez, A P-104
 Picado, A P-85
 Pierre, C P-125
 Pinkawa, M P-36
 Pitt, A P-131
 Pittaluga, G P-60
 Pöhlmann, A P-25
 Policarpov, A P-11
 Ponti, A P-81, P-115
 Popovič, P P-72
 Poretti, D P-47
 Poskus, E P-91
 Pritchard, W P-48
 Pua, U P-111
 Puijk, R 902.5

Q

Quek, L P-111
 Quesson, B P-24, P-125
 Qureshi, A P-10

R

Radhakrishna, G P-103
 Ralph, C P-1, P-8
 Ram, H P-68
 Ratti, F P-30
 Reimer, P P-127
 Rengo, M P-120
 Richter, G P-106
 Richter, G P-122
 Richter, G P-14
 Ricke, J 1801.9, P-24, P-43
 Ridge, C P-80

Risteski, F P-34
 Rivera, J P-48, P-121
 Roderburg, C P-18
 Rodriguez-Fernández, A P-58
 Rogan, C P-63
 Rolland, Y P-33
 Romera Sánchez, R P-135
 Roselli, M P-22
 Rossi, D P-59, P-109, P-133
 Royle, G P-131
 Ruarus, A 902.5
 Ruffino, A P-26
 Ruiz-Villaverde, G P-58

S

Saad, W P-48
 Saba, L P-130
 Salim, H P-54
 Sallemi, C P-30
 Salonia, A P-16
 Saltiel, S P-81, P-115
 Sampath, S P-96
 Sánchez, M 902.4
 Sánchez-Ballestín, M P-58
 Sangro, B 1801.9, P-43
 Santangelo, D P-30
 Santos, E P-95
 Sassone, M P-45, P-49, P-50, P-69
 Sat Bozcuk, H P-19
 Savic, L P-18, P-25
 Schaefer, N P-31
 Scheffer, H 902.5
 Schiro, B P-7
 Schlitt, A P-65
 Schlunz-Hendann, M P-106
 Schmidt, R P-18, P-25
 Schmitt, N P-14, P-106
 Schmitt, N P-132
 Schouten, E 902.5
 Schroeder, C P-87
 Schuster, D 902.2
 Schütte, K 1801.9
 Sciuto, R P-134
 Scorsetti, M P-47
 Seidensticker, M 1801.9, P-24, P-43
 Sertorio, A P-56, P-84
 Sethi, I 902.2
 Seu Kean, T P-118
 Sevrukov, A 1801.7
 Shaida, N P-51, P-70
 Sharma, A P-79
 Shetty, N P-82, P-88, P-89, P-92, P-102, P-112, P-113, P-117
 Shewarega, A P-25
 Shochat, M 1801.10
 Shridhar, R 902.1

Shrikhande, S P-102
 Shyn, P P-79
 Sileikis, A P-91
 Silvain, C P-52
 Silverman, S P-79
 Silvestre, M P-49
 Singhal, S P-68
 Slatosch-Petz, F P-132
 Smith, J P-1, P-8
 Solana Gonzále, J P-104
 Solovov, V P-105
 Sommer, C P-14, P-106, P-122, P-132
 Somogyi, D P-124
 Spanomanolis, N P-41
 Spiliopoulos, S P-12, P-126
 Spinetta, M P-45
 Stedman, B 1801.6, P-64
 Steiger, K 1801.1
 Stellato, E P-3
 Stiffi, M P-56, P-84
 Stommel, M P-44
 Stranieri, G P-75, P-136
 Stroosma, O P-54
 Stroszczyński, C P-65
 Strupas, K P-91
 Suslu, H P-19
 Swijnenburg, R 902.5
 Szántó, P P-124
 Szigeti, K P-130

T

Tacke, F P-18
 Taieb, J 902.3
 Taïeb, S P-2
 Tan, Z P-137
 Tashi, S P-137
 Tasu, JP P-52
 Teng, G 1801.2, 1801.5, P-27
 Teodoli, L P-130, P-134
 Tercero, J 902.4
 Thiery, L P-46
 Tinoush, P P-14, P-106, P-122
 Tiurin, A P-105
 Tjwa, E P-44
 Tomenko, K P-11
 Tomkovich, K 1801.7
 Torres, D P-61
 Torres, I P-32
 Torres, M 902.4
 Torsello, G P-18
 Touimi Benjelloun, G P-119
 Tradi, F P-53, P-71, P-78
 Traino, C P-40
 Trillò, G P-120
 Trobiani, C P-134
 Tsoumakidou, G P-31, P-81, P-115
 Tüchler, M P-101

U

Umair, M P-108
 Ungania, S P-134
 Urbano García, J P-135
 Urushadze, O P-77, P-94
 Uzomah, U P-7
 Uzun, D P-100

V

Valero, R 902.4
 Vallati, G P-130, P-134
 van den Boezem, P P-44
 Van Den Bosch, V P-54
 van den Tol, P 902.5
 Van Der Reijd, D P-90
 van Strijen, M 1801.3
 van Trommel, N P-90
 Varano, G P-59, P-109, P-133
 Vasudev, N P-1, P-8
 Velasco, S P-52
 Veloso Gomes, F P-61
 Veltri, A P-75, P-136
 Venkat, S P-62
 Ventura Díaz, S P-135
 Versteeg, K 902.5
 Vidal, V P-53, P-71, P-78

Vidiri, A P-134
 Vieriemiei, D P-114
 Vietti-Violli, N P-31
 Vigneswaran, G 1801.6
 Vihtelić, P P-72
 Villalobos, A 1801.8
 Villard, N P-31, P-81, P-115
 Vlasselaer, M P-55
 Vogl, T P-107
 Vollherbst, D P-14, P-106, P-132
 Vollmer, I 902.4
 Vouche, M P-55
 Vroomen, L 902.5

W

Wah, T 1801.3, P-1, P-8
 Walkden, M 1801.3
 Watte, G P-31
 Weekley, A P-35
 Werner, J 1801.1
 Wessendorf, J P-6
 Wetzel, S P-129
 Wheeler, M 1801.6
 Witkowska, A 1801.10
 Wood, B P-48, P-121, P-123
 Wrobel, M P-79

X

Xu, H P-25
 Xu, S P-48
 Xu, Y P-80

Y

Yildiz, A P-19
 Youssef, E P-95

Z

Zamir, M P-116
 Zech, C P-43
 Zeka, B 902.3, P-127
 Zhang, X P-73
 Zhong, B 1801.2, 1801.5
 Zhou, W P-36, P-101
 Zhou, X P-73
 Zhu, H 1801.2, 1801.5
 ZHU, H P-27
 Zikria, J P-62
 Zlika, S P-9
 Zonderhuis, B 902.5
 Zondervan, P 1801.3