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ABSTRACT

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001. Comparative Study Between Mitral Valve Surgery by Minimal Invasive Approach and Traditional Median Sternotomy

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Background: This study compares our experience of early surgical outcome for the mitral valve (MV) after minimal invasive surgery (MIS) and traditional median sternotomy approach. **Aim:** To evaluate early surgical outcome of MIMVS in our experience. **Method:** It is prospective comparative cohort study in adult patients who perform MVS either MI or SMS. From January 2020 to December 2021, early outcome of MVS between [120 patients] MI group through right mini-thoracotomy (RMT) with CPB peripheral cannulation and [120 patients] SMS group are compared. **Result:** Females are more in MIMVS (80%). Blood loss is lesser in MIMVS (250 ± 60.6 ml) than in SMS (550 ± 230 ml). Blood transfusion required (0.1 ± 0.53) in MIMVS and (0.9 ± 0.7) in SMS. Re-exploration for bleeding is required in (4) cases of SMS. Mechanical ventilation time is shorter in MIMVS (6.4 ± 1.3) than in SMS (12.4 ± 6.8). ICU duration and hospital stay are shorter in MIMVS than SMS (2 ± 0.4 vs 3.5 ± 1.3, 7.2 ± 1.3 vs 12 ± 0.5). Wound infections present in (20) cases of SMS. Spirometric studies in MIMVS reveal better postoperative pulmonary functions than SMS group. Pain Visual Analog Score at discharge is better in MIMVS (1.4 ± 0.6) than in SMS (8.5 ± 1.5). **Conclusion** Minimally invasive surgery for the mitral valve showed satisfactory outcome in comparison to sternotomy approach. The need for rising curve of training for all surgeons is mandatory.

ETHICS DECLARATIONS

Conflict of Interest: The authors declare they do not have any conflict of interests.

Ethical Approval: Not applicable.

Consent for Publication: Not applicable.

002. Innovative Techniques Used for Trouble Shootings in Transcatheter Ventricular Septal Defect Device Closure in a 28 days Symptomatic Neonate—New Thoughts

Amjad Mahmood[1], **Anoosh Khan**[1]

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Objectives: This case report is aimed to present various innovative techniques for closure of large mid-muscular ventricular septal defect (VSD) in 28 days neonate failing to thrive. The procedures involved were very unconventional, safe, and very promising in which VSD was closed without arterial puncture under echocardiogram guidance. **Background:**: Large VSD in neonatal age leads to failure to thrive and repeated episodes of severe chest infection. VSD patch closure is very challenging by cardiac surgeon in such small neonates. The other alternative is hybrid approach involving cardiac surgical team and interventional pediatric cardiologist. We used a different technique for transcatheter VSD device closure. Methods: In this case, we placed 5F sheath in right internal jugular vein. Arterial line was not

taken to avoid the risk of arterial thrombosis. We introduced 5F JR catheter through the sheath and with the help of 0.35 Terumo wire tracked down from superior vena cava to right atrium to right ventricle and with gentle torque of Terumo wire could manage to cross VSD from right ventricle to left ventricle (LV) and parked the 5F JR in LV cavity. We introduced 0.35 super stiff exchange wire through JR and parked wire in LV cavity. We selected 7F delivery system and again parked in LV. We selected 12 mm Amplatzer (Abbott Vascular, Santa Clara, California) self-expanding self-centering nitinol double disc device and introduced in delivery sheath through loader. Initially, we released LV end of the device and confirmed position on transthoracic echo, gently pulled the whole system till interventricular septum then released the RV end. We confirmed the device position before releasing on echocardiogram. **Result:** The device was successfully implanted in this neonate with no residual leak, aortic, and tricuspid valves were free from device. There was no arrythmia or pericardial effusion detected during and following the procedure. Peri-procedure the patient remained stable hemodynamically, there was no arrhythmia, pericardial effusion, or desaturation. Post-procedure course remained uneventful. The neonate is being followed up in our outdoor and is thriving well with no device-related complication. Conclusions: Transcatheter device closure of large mid-muscular VSD without arterial puncture is very challenging in neonatal age but using innovative techniques and meticulous presence of mind, the selected cases can be done. The operator should be able to use trouble shootings in unexpected scenarios but backup of surgical team cannot be underestimated.

ETHICS DECLARATIONS

Conflict of Interest: The authors declare they do not have any conflict of interests.

Ethical Approval: Obtained.

Consent for Publication: Obtained

003. Stent in Stent to Rescue an Adolescent with Recoarctation

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Objectives: This case report is aimed to present a novel case of severe long-segment hypoplastic aortic arch with discrete narrowing at a point in 18 years boy. The boy underwent coarctation stenting two years ago but subsequently developed recoarctation leading to resistant hypertension. We restented within the previous stent negotiating the discrete narrowing and tried to minimize the gradient across recoarctation with favourable post-procedure results. **Background:**: Long-segment hypoplastic aortic arch is difficult to be stented unless you have a long stent enabled to dilate the aortic wall without damaging the intimal aortic wall. During post-stenting follow-up, the blood pressure monitoring is mandatory to evaluate the effectiveness of stenting. If there is no response to hypertension following coarct stenting, reevaluation of stent patency by echocardiogram, CT Angio or Cardiac MRI is crucial to identify the cause of resistant hypertension. In this particular case we placed another stent within the previous stent and achieved optimal results. Methods: In this case the boy 18 years of age already had a 12*59 mm BeGraft aortic Covered stent-Bentley InnoMed two years ago for severely hypoplastic descending aorta from isthmus to post-ductal area. During follow-up, there was no reduction in antihypertensive treatment and echocardiogram revealed recoarctation at discrete point with gradient of 60 mmHg across descending aorta. We took the patient to cath lab and did aortogram in LAO 90 degrees. Aortogram with 5F pigtail revealed instent restenosis at a discrete point in upper part of previous stent. Angiographic gradient across descending aorta was 50 mm Hg. We replaced pigtail catheter with 0.035 superstiff wire and parked at aortic root, introduced 14F cooks long sheath above the previous stent. We selected 18*34 mm Covered CP stent over 18*39 mm BIB balloon -Numed, introduced through the sheath after proper crumping with the help of silk suture. After confirming proper position with the help of check angiograms keeping middle of stent at narrowest segment, inflated inner balloon initially followed by outer balloon inflation. After full inflation, both balloons were deflated. **Result:** Final angiogram with pigtail revealed adequate placement of second stent with waist in the middle. Post-restent gradient reduced from 50 to 20 mmHg. Patient was discharged next day uneventfully with dual antiplatelet treatment. Peri-procedure the patient remained stable hemodynamically, there was no arrhythmia, pericardial effusion or desaturation. Conclusions: Restenting of instent restenosis is challenging but in selected cases can be done with optimal results. Accurate assessment of severity of recoarctation and proper selection of hardware is crucial for favourable results.

ETHICS DECLARATIONS

Conflict of Interest: The authors declare they do not have any conflict of interests.

Ethical Approval: Obtained.

Consent for Publication: Consent given

004. Innovative Techniques Used for Trouble Shootings in Transcatheter Ventricular Septal Defect Device Closure—New Thoughts

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Objectives: This case report is aimed to present various innovative techniques employed for transcatheter ventricular septal defect (VSD) device closure. We used many maneuvers not mentioned in literature or interventionists. The Idea is to share thoughts for the future better understanding of interventional colleagues. **Background:**: Normally transcatheter VSD device closure involves conventional steps of LV angiogram, crossing the defect from LV to RV, snaring from pulmonary artery or vena cava to create AV loop, placing the delivery sheath from retrograde side, and delivering of device. But in certain situations, the procedure needs troubleshooting for the situations not mentioned before. There may be assessment issues for device closure, entrapment of device in aortic valve sinus while pulling in to LV from aorta, SD device closure in neonates, and confusion of VSD with aorta to RA fistula. With our experience of wide variety of VSD device closure, this presentation touches some thoughtful varied ideas. Methods: We have included various scenarios involving different steps for transcatheter VSD device closure. In case of peri membranous VSDs which visibly seem close to right coronary cusp (RCC) and not amenable to device closure. Echocardiographic technique is crucial for such type of VSDs. If on transthoracic echo with 5 chamber view VSD is clearly seen and RCC is masked, this VSD can be closed. While if VSD and RCC are seen in the same view, then RCC should be about 5 mm away from upper margin of VSD. Another problem faced during VSD device closure is entanglement of LV end with aortic valve cusps when you open the LV end in ascending aorta or transverse arch. You cannot pull the device down to LV as this step may damage the cusp, sometimes you gently rotate the whole sheath to disengage the device but may not be successful. The best way to overcome this issue is crossing the VSD from RV side and park the wire and sheath in LV. We have devised another step, when you cross VSD try to track down the terumo wire and JR

catheter from RV to RA and IVC, place snare through this catheter and take another JR with terumo wire from femoral vein, now snare the wire from IVC and gently pull the wire into LV with the help of wire, park the wire in LV cavity and proceed, this may be called AMJADs reverse snare technique to avoid aortic valve cusp. In another scenario, we closed large mi muscular VSD in a neonate without arterial puncture from right internal jugular vein. We tracked the 5JR from SVC to RA to RV and maneuvered the terumo wire from RV to LV, exchanged the terumo wire with 0.035 super stiff exchange wire, and introduced 7F long sheath and placed 12 mm muscular VSD through this sheath. The procedure went uneventful and tricuspid and aortic valve were from device entanglement. **Result:** All these procedures went successful and new techniques were encouraging. We look forward to learn more feedback from international colleagues and device new methods for newer interventions. Conclusions: Newer techniques can be useful with meticulous use of hardware and mind. The operator should be well versed with trouble shootings when stuck in Cath lab to bail out the critical scenario.

ETHICS DECLARATIONS

Conflict of Interest: The authors declare they do not have any conflict of interests.

Ethical Approval: Obtained.

Consent for Publication: Consent given

005. Percutaneous Treatment of Congenital Heart Diseases in Unusual Situations

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Introduction The number of patients who have been treated by percutaneous intervention has increased due to the increasing experience of interventionists and a large number of available tools. Therefore, there is not specific material for every kind of congenital heart disease; in many cases, off-label treatment is necessary. Objective: The aim is to show a series of cases in which unusual vessel access or off-label material was used with success. Cases: Treated: (1) one premature baby, 980 g severe coarctation of aorta with coronary stent by axillar artery punction; (2) an 8 kg-patient with left isomerism, dextrocardia, absence of IVC and right SVC-ASD, ASD closed by left internal jugular vein; (3) a four-year-old girl with multiple PAVFs closed using coils and glue; (4) one adult patient having undergone PDA close by right subclavian vein due to total obstruction of IVC; (5) a large ASD closure by transhepatic punction in a woman; (6) closing of abnormal artery from descendent aorta to lungs in a neonatal patient using PLUGS; (7) two patients having undergone the closing of an abnormal connection between left subclavian to LA using ADOI; and (8) three cases of ruptured sinus of Valsalva aneurysm treated with ADOI. Results: All patients were treated successfully, with no mortality, and reached the previous treatment objective. **Discussion and conclusion:** There are not specific materials for every type of CHD that can be treated by percutaneous methods, and in several situations, alternative vessels should be used, due to the impossibility of using the usual one, or because the usual access makes the procedure more difficult. The variety of materials available and the increase of the experience among interventionists, in conjunction with the possibility of working together with experts from other areas, have enabled the treatment of rare congenital heart disease, using off-label material or alternative vessel access.

ETHICS DECLARATIONS

Conflict of Interest: The authors declare they do not have any conflict of interests.

Ethical Approval: Not applicable.

Consent for Publication: Not applicable.

006. Complete Heart Block (CHB) After Percutaneous Closure of Atrial Septal Defect (ASD).

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Introduction Percutaneous closure of ASD has proven to be safe even in small children and for closing larges defects with low complication rates. Among the possible complications, there is the possibility of complete heart block (CHB), which is rare and there are few cases reported with different approaches. Objective: The aim is to show our experience with this rare complication and discuss the literature review. Cases: pt.1: 4 years old, 15 kg; Occlutech device 21; CHB, device replaced for 18 without result; device removed recovering SR. The patient was referred for surgery one year later. Pt2: 3 years old;12 kg; ASO 17 implanted; CHB 4 yours after the procedure; corticoid; SR within 24 h. Pt.3::4 years old; 14 kg, implanted a 21 Occlutech device, CHB five minutes after releasing; corticoid with no result; surgery in the 80 day, SR in the 80 day after surgery. Pt.4: 2 years old; 8 kg; ASO 15; CHB after releasing; conversion to SR after atropine iv; discharge home the next day. **Discussion and conclusion:** CHB after percutaneous closure of ASD is a rare complication, with few cases published, without a uniform strategy to be followed. Luckily many of these complications happen during the hospitalization period, making it safer to take care of these patients. Small patients with big devices are at a higher risk to develop CHD even if rare. Report on this complication should be encouraged to be published to improve our understanding and to facilitate making a uniform plan to treat these patients.

ETHICS DECLARATIONS

Conflict of Interest: The authors declare they do not have any conflict of interests.

Ethical Approval: Not applicable.

Consent for Publication: Not applicable.

007. Endovascular Treatment of Critical Coarctation of the Aorta (CoA) in Newborns and Infants

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Background: Newborns and infants with CoA combined with hypoplasia of the aorta, CHD, and Ductus-dependent flow (DDF) referred to critical heart defects. Objective: To present in-hospital and mid-term results of endovascular interventions in newborns and infants with CoA. Material: 30 patients with CoA underwent intervention, of them: 19(63.3%)—surgery; 11 (36%)—balloon dilatation.

Age of patients = 1 to 360 days (98.9 ± 10.8). In 16 (53.3%) patients, the diagnosis was prenatal. In patients with DDF, prostaglandin E1 used after prior to the intervention. In 14 (46.6%) patients, CoA combined with other CHD. Pressure gradient in the CoA site during hospitalization was 58 ± 1.7 mm Hg. LVEF (51 ± 12%). Mean pressure gradient in endovascular group before dilatation was 59 ± 18 mm Hg. LVEF 41 ± 9%. Patients with hypoplasia of the aorta and concomitant CHD referred surgery. In the presence of low pulmonary flow, and absence or hypoplasia of the aorta, dilatation performed urgently. After angioplasty, pressure gradient decreased to 19 ± 7 mm Hg; LVEF increased to 63 ± 7%. Group with endovascular treatment made an uneventful recovery. 13 (43.3%) patients need surgery for re-CoA on 3–6 months after dilation. **Conclusion** In critic patients, endovascular intervention should be preferred with good immediate results. Feasibility of angioplasty of CoA in newborns and infants with CoA remains controversial through a high rate of re-coarctation and re-interventions.

ETHICS DECLARATIONS

Conflict of Interest: The authors declare they do not have any conflict of interests.

Ethical Approval: Not applicable.

Consent for Publication: Not applicable.

008. Combined Percutaneous Transcatheter Interventions in the Same Session for Patients with Multiple Congenital Cardiovascular Defects

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Background: **Aim:** To investigate the methods of combined percutaneous transcatheter interventions for congenital heart disease with multiple defects and to evaluate its efficacy in children. Patients and methods: 15 cases (8 boys, 7 girls, ages 3 days-16 years, body weight 3.4-35 kg) that underwent multiple transcatheter interventions for congenital heart disease with multiple defects were retrospectively analyzed and presented. The sequence of the interventions was planned according to the nature and localization of the defects. Results: Additional PDA closure (5) was performed following VSD closure (1), ASD closure (1), coarctation angioplasty (2), and pulmonary balloon valvuloplasty (1); coarctation angioplasty (5) was performed following aortic valvuloplasty (3), VSD closure (1), and balloon atrial septostomy (1) for transposition of great arteries. Ductal stent implantation was the combined procedure in 2 patients after pulmonary valve perforation and/or pulmonary balloon valvuloplasty with hypoplastic right ventricles. Other combined procedures were ASD closure after pulmonary balloon valvuloplasty (1); pulmonary balloon valvuloplasty after aortic balloon valvuloplasty (1); coil embolization of a pulmonary lobar sequestration after coarctation angioplasty (1); and palliative pulmonary balloon valvuloplasty after recanalization and angioplasty of the systemic-pulmonary shunt in tetralogy of Fallot (1). There was no mortality or major morbidity. **Conclusion** For the treatment of combined congenital cardiovascular defects, multiple transcatheter interventions in the same session are feasible, safe and effective with satisfactory good results. Second intervention may be performed as complementary or substantive to the first procedure.

ETHICS DECLARATIONS

Conflict of Interest: The authors declare they do not have any conflict of interests.

Ethical Approval: Not applicable.

Consent for Publication: Not applicable.

009. Transcatheter Congenital Coronary Artery Fistula Closure in a 1-Day-old

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Introduction Congenital coronary artery fistula is a rare communication originating from the coronary artery to a right-sided chamber, left-sided chamber, or the pulmonary artery. Transcatheter closure is an alternative to surgical repair of this lesion. Successful transcatheter closure of congenital coronary artery fistula closure in the neonatal period has been reported; however, there is no current literature describing successful transcatheter closure in a 1-day-old neonate. Case Description: A full-term female with concern for total anomalous pulmonary venous return on prenatal echocardiogram was found to have normal pulmonary venous connections on postnatal echocardiogram. However, there was a large left coronary artery fistula connecting to the right atrium. The patient was tachypneic. She underwent transcatheter coronary artery fistula occlusion on day of life one. The proximal aneurysmal area of the left coronary artery measured 4.9 mm in diameter and 8.6 mm in length on angiography. An arteriovenous loop was established, and an Amplatzer Piccolo 5-mm-by-4-mm device (Abbott Medical, Plymouth, MN) was used for fistula closure. Postoperative echocardiogram showed complete occlusion of the fistula. Discussion: The transcatheter approach to congenital artery fistula closure is a safe alternative to surgical intervention. However, transcatheter closure in neonates is technically challenging with complications such as embolization of device, thrombosis, and death. Despite this, early intervention on this lesion is recommended due to the risk of developing congestive heart failure over time. This case is the first reported case of a symptomatic patient as young as one-day-old undergoing closure of a coronary artery fistula with an Amplatzer Piccolo device. On follow-up, the patient had no symptoms of congestive heart failure and echocardiogram demonstrated appropriate device position. This case demonstrates the safety of transcatheter closure of congenital coronary artery fistula in the early neonatal period. **Conclusion** Transcatheter closure of a coronary artery fistula can be successfully performed in children as young as 1 day old.

ETHICS DECLARATIONS

Conflict of Interest: The authors declare they do not have any conflict of interests.

Ethical Approval: Not applicable.

Consent for Publication: Not applicable.

010. Provocative Testing During Cardiac Catheterization in Platypnea-Orthodeoxia Syndrome: A Case Report

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Background: Platypnea-orthodeoxia syndrome (POS) is characterized by hypoxemia and dyspnea in the sitting position that resolves with lying supine. It is typically associated with an interatrial

communication such as a patent foramen ovale (PFO) or atrial septal defect (ASD). We present a case of a 60-year-old patient who presented with new onset POS causing a several month history of repeated hospitalizations, persistent oxygen requirement, and severe functional limitation (NYHA class III). Baseline oxygen saturations while supine were 100% but quickly decreased to the low 80 s while sitting upright with associated dyspnea. Work-up was largely negative except for a strongly positive agitated contrast bubble study indicating a prominent right to left shunt. To evaluate for pulmonary arteriovenous malformations, a chest CT was performed and revealed a sinus venosus ASD with partial anomalous pulmonary veins as well as a dilated ascending aorta in the setting of a bicuspid aortic valve. Given the rarity of POS in the setting of a sinus venosus defect with PAPVR, we sought to better understand the physiologic mechanism for the patient's symptoms; therefore, we performed a cardiac catheterization with invasive hemodynamics obtained both in the supine and upright positions. CASE: With the patient on the catheterization table, we first determined what semi-supine position would result in desaturation and symptoms. To allow the patient to participate in the catheterization (sit upright and express symptoms), no sedation was given. Access was obtained in the femoral vein (with a kink resistant sheath) and internal jugular (IJ) vein. The IJ approach was utilized for right heart hemodynamics and the femoral venous approach for left heart hemodynamics across the sinus venosus defect. Initial hemodynamics while supine (Fig. 1) were notable for a Qp:Qs near 1:1.

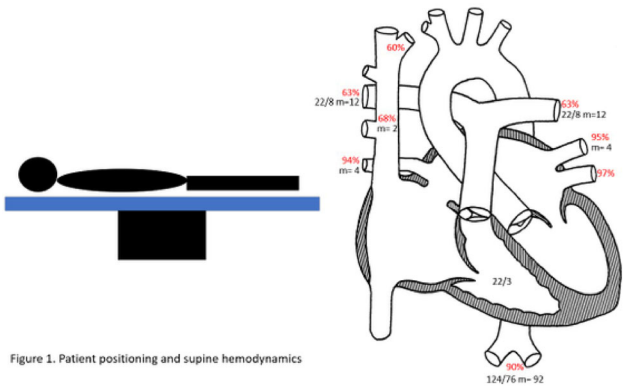

Figure 1. Patient positioning and supine hemodynamics

Agitated saline bubble study in each branch pulmonary artery confirmed the absence of pulmonary arteriovenous malformations. The patient was then placed in a semi-supine position (Fig. 2, reverse Trendelenburg and wedge behind back to simulate sitting upright at 45 degrees) causing a drastic decrease in systemic oxygen saturations and worsening of his dyspnea consistent with his usual symptomatology. Repeat assessment of Qp:Qs was 0.6:1.

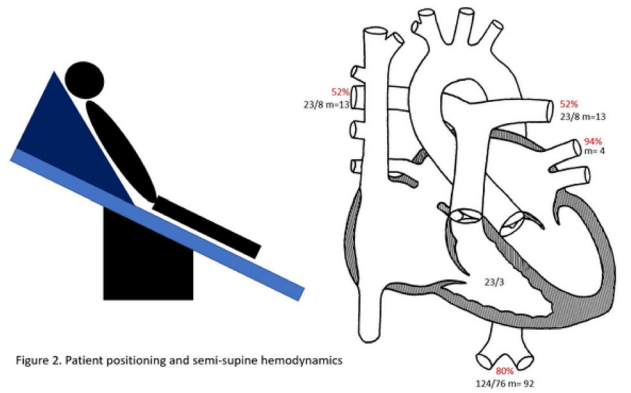

Figure 2. Patient positioning and semi-supine hemodynamics

Given these findings, the patient underwent surgical ASD closure with baffling of the anomalous pulmonary venous return using a Gortex patch as well as replacement of the aortic valve, aortic root, and ascending aorta with a 25-mm On-X valved conduit with coronary re-implantation (Bentall procedure). This resulted in complete and immediate resolution of his symptoms of POS. DISCUSSION: Despite uncommon, a sinus venosus ASD can present with POS. In this patient, the presence of aortic root dilation likely altered the intracardiac geometry leading to right to left shunting of SVC blood across the ASD while sitting upright. A diagnostic cardiac catheterization using evocative maneuvers like body position changes can be successfully utilized to assess for changes in intra-cardiac shunting and was helpful to confirm that operative correction of the patient's cardiac lesion would result in the intended physiologic outcome.

ETHICS DECLARATIONS

Conflict of Interest: The authors declare they do not have any conflict of interests.

Ethical Approval: IRB exempt.

Consent for Publication: Yes

011. Same Day Discharge of Patients After Persistent Foramen Ovale (PFO) Closure with GORE®CARDIOFORM Septal Occluder (GSO)

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Background: Transcatheter closure of a patent foramen ovale (PFO) has been demonstrated to reduce the risk of recurrent stroke. Closure of the vascular access site with different devices has been shown to be safe and effective in preventing bleeding complications (BC). Patients who underwent transcatheter device implantation have traditionally been discharged the day after intervention. **Objectives**: We aimed to investigate the feasibility of same day discharge (SDD) of patients on the day of PFO closure with GSO devices. Femoral vein access closure was performed in 63.3% of patients with the suture-mediated closure device Perclose ProGlide™ system (Abbott Vascular, CA, USA). Methods: 262 patients (164 men and 98 women) were included in this retrospective study between march 2017 and June 2020. All patients had a history of cryptogenic stroke, and echocardiographically confirmed PFO. All patients were discussed interdisciplinary with cardiologist and neurologist prior to intervention. 261 Gore Septal Occluder devices were implanted in local anesthesia under intracardiac echocardiographic guidance (ICE) with a 9 French catheter with femoral vein as access site. 166 patients underwent closure of the femoral access vein with 2 Perclose ProGlide systems. Results: The primary efficacy outcome of our study was the number of patients who were successfully discharged on the day of the intervention and this was achieved in 93.9%. Patients were kept on bed rest for 2 h and discharged 4-6 h post-catheter intervention after echocardiographic control of device position and pericardial effusion. Reasons for no discharge on the same day: Three due to bleeding, four due to late procedure start/finish that would have led to late discharge time, two due to pain in the groin, one due to chest pain, two due to pericardial effusion and tamponade, one due to atrial fibrillation, one due to desaturation and pulmonary complications/problems, and one without obvious reason. Common reason for readmissions (and ER visits) was atrial fibrillation and fever. 166/262 (63.3%) patients were treated with the Perclose ProGlide system. 5 out of 166 had minor bleeding, 3 ceased with manual compression within 5 min, one patient was treated with a z-suture and one with a

Teleflex MANTA® Device. No patient had to be readmitted to hospital due to bleeding complications. P values obtained from logistic regression comparison between Proglide and non-Proglide patients. The estimated differences (i.e. similarities) of SDD and BC (respectively) between the Proglide and the non-Proglide groups are not significantly affected by age, sex, or cardiovascular comorbidities. Conclusions: In this retrospective single-center study, same day discharge appears to be safe and cost effective, with a low rate of bleedings complications and very low rate of early readmission. Shorter length of hospital stay can improve throughput and is advantageous for both caregivers and patients. Larger randomized studies are needed to further investigate the feasibility and safety of same day discharge.

ETHICS DECLARATIONS

Conflict of Interest: The authors declare they do not have any conflict of interests.

Ethical Approval: Not applicable.

Consent for Publication: Not applicable.

012. Catheter Closure of Patent Foramen Ovale Using the Cocoon Occluder: A Multicenter retrospective Study

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Aims: To present initial experience and 12–48-month follow-up with catheter closure of patent foramen ovale (PFO) using the Cocoon PFO occluder (CPFOO). This new double-disk Nitinol device has some distinctive structural modifications aimed to reduce the risk of major complications of catheter PFO closure. Methods and Results: This retrospective non-randomized study included 253 patients (mean age 45 years) with cryptogenic stroke who underwent attempted catheter closure of PFO in 6 European centers. When compared to Amplatzer and the other PFO occluders, the most important structural characteristics of Cocoon device are its Nanoplatinum coating that prevents nickel leaching into the blood and the removal of Nitinol oxide from the wire net which makes the CPFOO a quite soft device. The occluder was permanently implanted in all (100%) patients. Transesophageal echocardiography with bubble test at 6 months showed complete occlusion of PFO in 250/253 (98,8%) patients. Three patients had a trivial residual shunt. Thrombus formation on the device which successfully treated with rtPA infusion was observed in one patient. No other complications occurred. During a median follow-up period of 28 months, 3 patients (1.2%) developed recurrent new atrial fibrillation that was treated successfully with amiodarone. No neurologic events, cardiac erosions, allergic reactions to nickel, or thrombus formation occurred. Conclusions: The Cocoon PFO occluder is an effective and safe device that adds to our armamentarium for catheter closure of PFO.

ETHICS DECLARATIONS

Conflict of Interest: The authors declare they do not have any conflict of interests.

Ethical Approval: Not applicable.

Consent for Publication: Not applicable.

013. Use of Abiomed Impella for Hemodynamic Support in MIS-C Associated with COVID-19

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Background: Multisystem Inflammatory Syndrome in Children (MIS-C) is a known complication of COVID-19 infection and can result in hemodynamic collapse. This report describes use of an Abiomed Impella 5.0 assist device in circulatory support in a patient with mixed distributive and cardiogenic shock at a tertiary center without ECMO support. **Case Report:** A 17-year-old male with morbid obesity (155 kg) and prediabetes was transferred from an outside facility and admitted to the pediatric ICU with nearly one week of headache, dyspnea, and loss of taste. Outside laboratory assessment demonstrated acute renal failure with creatinine 7.4 mg/dL, lactate 4 mmol/L, troponin 0.34 ng/mL, and with chest CT demonstrating dependent ground glass opacities. PCR testing was positive for COVID-19. Shortly after arrival, he was initiated on corticosteroids and aspirin therapy with delay of IVIG administration given hemodynamic lability. He was subsequently noted to become progressively delirious with echocardiogram demonstrated LVEF 25-30%. He was escalated from high flow nasal cannula to BiPap and norepinephrine, epinephrine, and vasopressin therapies with continued worsening hemodynamics and metabolic acidosis by arterial line sampling. Without full ECMO capability in a pediatric patient, he was emergently brought to the cardiac catheterization laboratory. Lactate at time of presentation to the catheterization laboratory was 10 mmol/L. An Abiomed Impella 5.0 catheter was then successfully placed and in the right femoral artery. Motor current of 3.4-3.5 was obtained (estimating equivalent LPM) and the catheter secured into place. The patient demonstrated a new-onset left bundle-branch block, though they did not have any acute hemodynamic sequelae in the presence of the Impella catheter. Lactate subsequently decreased to 4 mmol/L prior to transfer. The patient was then successfully transferred to a quaternary center for further cares. He was successfully separated from Impella support on post-implant day 6. He was transferred back to Albany Medical Center 25 days following catheter placement, with discharge from the hospital 8 days thereafter. At one-year follow-up, he appears to have demonstrated full cardiovascular recovery with resolution of renal injury and bundle branch block. **Conclusion:** The Abiomed Impella Heart Pump can successfully be used for circulatory support in the setting of MIS-C with hemodynamic collapse.

ETHICS DECLARATIONS

Conflict of Interest: The authors declare they do not have any conflict of interests.

Ethical Approval: Not applicable.

Consent for Publication: Received.

014. Cardiac Catheterization for Right Ventricular Outflow Tract Obstruction Following Neonatal Arterial Switch Operation

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Background: The arterial switch operation (ASO) for d-transposition of the great arteries (d-TGA) achieves anatomic repair but creates the potential for right ventricular outflow tract obstruction (RVOTO) or branch pulmonary artery (PA) stenosis as a result of the LeCompte maneuver. While the resultant right ventricle (RV) hypertension is

generally well tolerated, in cases where RV pressures exceed 2/3 systemic levels, patients are frequently referred for cardiac catheterization investigation. The outcomes of interventional catheterizations for RVOTO following the ASO with the LeCompte maneuver have not been well described. **Objectives**: To describe the degree and nature of RVOTO among patients referred for cardiac catheterization in a large, single-center cohort of patients after their ASO. We also sought to assess the safety and efficacy of any intervention undertaken in the cardiac catheterization lab. Methods: A retrospective single-center study of patients who had a LeCompte maneuver and subsequent cardiac catheterization for suspected right ventricular hypertension. We reviewed patient and procedural characteristics for all consecutive patients who had both an ASO and right-sided cardiac catheterization at our institution over a 16 year period (2004–2020). We excluded patients who had coronary studies, biopsies, or left-sided interventions. Descriptive statistics were reported, and paired sample t tests were used for analysis. **Results:** In the study period, 544 children had an ASO and 111 children (20%) had a cardiac catheterization after their ASO. Following exclusions, 59 children (86 catheterizations) were included in the study. The mean age was 3.0 ± 3.9 years. 10 catheterizations (12%) were solely diagnostic and 76 catheterizations (88%) included intervention in the right ventricular outflow tract with either a balloon or stent. The RV to systemic pressure ratio in all right-sided catheterizations was 0.66 ± 0.21. The RV-to-systemic pressure ratio in solely diagnostic studies was 0.52 ± 0.16. The RV-to-systemic pressure ratio in interventional studies was 0.68 ± 0.21 which was significantly more than solely diagnostic catheterizations ($p < 0.01$). In the intervention group, the pre-procedure RV to systemic pressure ratio was 0.68 ± 0.20 and was significantly reduced to 0.56 ± 0.17 ($p < 0.01$) after RVOTO intervention (balloon and/or stent). Complications were seen in 13% of cases, and none were considered serious. Conclusions: Patients undergoing right-sided cardiac catheterization after ASO had RV pressures that were 2/3 systemic. Among these patients, higher RV to systemic pressure ratios were associated with RVOT interventions, either balloon or stent. Approximately 10% of patient did not have intervention at time of catheterization. Both balloons and stents were effective in reducing the RV to systemic pressure ratio, but only to levels close to half-systemic. Complications were rare and not serious.

ETHICS DECLARATIONS

Conflict of Interest: The authors declare they do not have any conflict of interests.

Ethical Approval: Not applicable.

Consent for Publication: Not applicable.

015. Early Preclinical Experience of a Mixed Reality Ultrasound System with Active GUIDance for NEedle-Based Interventions: The GUIDE Study

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Introduction Use of ultrasound (U/S) to facilitate vascular access has increased compared to landmark-based procedures despite ergonomic challenges and need for extrapolation of 2-dimensional images to understand needle position. The MantUS^{TM} system (Sentiar, Inc, St Louis, MO) uses a mixed reality (MxR) interface to display US images and integrate real-time needle tracking. This prospective preclinical study aims to evaluate feasibility and usability of MantUS^{TM} in a simulated environment. We hypothesized that 1) MantUS^{TM} would improve accuracy and efficiency for central vascular access (CVA) for all comers (as measured by time to access, number of access attempts, and number of needle repositions), 2) MantUS^{TM} may provide increased benefit for difficult access, and 3) the MantUS^{TM} prototype would be usable. Methods: Participants were recruited from pediatric cardiology and critical care. Access was obtained in two vascular access training models, a femoral access model and head and neck model for a total of 4 vascular access sites under two conditions: conventional U/S and MantUS^{TM}. Participants were randomized for order of completion. Videos were obtained, and quality of access including time required, repositions, number of attempts and angle of approach were quantified. Results. Use of MantUS^{TM} resulted in an overall reduction in number of needle repositions ($p = 0.03$), and improvement in quality of access as measured by distance ($p < 0.0001$) and angle of elevation ($p = 0.006$). These findings were even more evident in the RFV access site, which was a simulated anatomic variant with a deeper more oblique vascular course. Here, use of MantUS^{TM} resulted in faster time to access ($p = 0.04$), fewer number of both access attempts ($p = 0.02$), and number of needle repositions ($p < 0.0001$) compared to conventional U/S. Post-participant survey showed high levels of usability (87%) and a belief that MantUS^{TM} may decrease adverse outcomes (73%) and failed access attempts (83%). **Conclusion** Use of MantUS^{TM} improved vascular access among all comers, including the quality of access. This improvement was even more notable in the vascular variant (RFV). MantUS^{TM} readily benefited users by providing improved spatial understanding. Further development of MantUS^{TM} will focus on improving user interface and experience, with larger clinical usage and in-human studies.

ETHICS DECLARATIONS

Conflict of Interest: The authors declare they do not have any conflict of interests.

Ethical Approval: Not applicable.

Consent for Publication: Not applicable.

016. Safety and Acute Outcomes for Small Infants Undergoing Device Closure of Patent Ductus Arteriosus

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Objectives: The aim of this study was to evaluate acute procedural outcomes and safety for infants < 4 kg who underwent catheterization with intended patent ductus arteriosus (PDA) device closure in a multi-center registry. **Background**: Transcatheter PDA closure in premature infants has been an area of significant growth and innovation in the past decade. Procedural outcome and safety data have not been evaluated in a multi-center registry. **Methods**: A multi-center retrospective review was performed using data from the Congenital Cardiac Catheterization Project on Outcomes (C3PO) registry. Data were collected for all intended cases of PDA closure in infants < 4 kg from April 2019 through December 2020 at 13 participating sites. Successful device closure was defined as device placement at the conclusion of the catheterization. Procedural outcomes and adverse events (AE) were described, and associations between patient characteristics, procedural outcomes and AEs were analyzed. **Results**: During the study period, 379 cases were performed with a median weight of 1.3 kg (range 0.7-3.9). Successful device closure was achieved in 98.4% of cases with a 2.6% incidence of level 4/5 AEs, including one procedure-related mortality. Neither failed device placement nor adverse events were significantly associated with patient age, size, or institutional volume. Higher incidence of adverse events associated with patients who had non-cardiac problems (p = 0.03) and cases with multiple devices attempted (p = 0.003). Procedural outcomes and safety were similar for patients < 2.5 kg. Conclusions: Transcatheter PDA closure in small infants can be performed with excellent acute outcomes and safety across institutions of variable case volume.

ETHICS DECLARATIONS

Conflict of Interest: The authors declare they do not have any conflict of interests.

Ethical Approval: Approval was obtained from the IRB at the coordinating center (Boston Children's Hospital) and, when necessary, at participating sites. Other sites did not require IRB approval as this registry data is de-identified and for quality improvement projects.

Consent for Publication: Consent to participate in this research study was not necessary and waived, as these data were collected for quality improvement purposes.

017. Evaluating Procedural Performance: A Novel Outcome Metric for Aortic and Pulmonary Balloon Valvuloplasty in Congenital Cardiac Catheterization Laboratories

Oliver Barry[1], Babar Hasan[2], Fatima Ali[2], Aimee Armstrong[3], Sarosh Batlivala[4], Matthew Crystal[1], Abhay Divekar[5], Todd Gudausky[6], Ralf Holzer[7], Jacqueline Kreutzer[8], George Nicholson[9], Michael O'Byrne[10], Brian Quinn[11], Brian Boe[3]

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Objectives: The aim of this study was to develop a procedural performance metric for simple aortic and pulmonary valvuloplasty using a composite of procedural safety and technical success. This may help identify areas of further investigation and quality improvement. **Background:** Safety events and technical success have been previously reported for these procedures, but a composite performance metric as a novel, patient-centered strategy has not been studied before. **Methods:** A multi-center review was performed using data from the Congenital Cardiac Catheterization Project on Outcomes (C3PO) registry. Data were collected for all cases of isolated balloon aortic and pulmonary valvuloplasty from 2014 through 2017. Patients were excluded if they were less than one month of age, an inpatient at the time of the procedure, or had significant co-morbidities, such as Williams or Noonan syndrome. Criteria for technical success were developed and categorized by multi-center expert consensus into 3 classes (class I to III). Adverse Events (AEs) were categorized by severity (level 1-5) using established criteria. Level 3-5 severity AEs were considered high severity adverse events (HSAEs). Procedural performance was categorized using composite criteria of technical success and severity of AEs also into three classes (I to III) (Table). Factors associated with class III (unsatisfactory) procedural performance were analyzed. **Results:** There were 169 cases of aortic valvuloplasty and 270 cases of pulmonary valvuloplasty were included in the respective cohorts. Aortic valvuloplasty had a class I or II technical success in 91% of cases. HSAEs occurred in 7% of cases. Class III procedural performance occurred in 14% of cases, mostly due to HSAE. No significant associations between patient or case characteristics and procedural performance were demonstrated. Pulmonary valvuloplasty had 91% of cases with class I or II technical success and no HSAE. Class III procedural performance occurred in 9% of cases, predominantly due to residual valve gradient, and was associated with younger age (p = 0.06), and lower weight (p = 0.02). **Conclusions:** Procedural performance is a metric designed to identify a composite outcome consisting of technical success and safety. Simple balloon aortic and pulmonary valvuloplasty have demonstrated excellent procedural performance. Incorporating both technical success and AEs may better reflect patient outcome rather than each outcome measured separately. It may also help identify areas for further investigation and quality improvement.

Criteria for Procedural Performance

Procedure	Class I*	Class II#	Class III#
BAVP			
Technical Success (TS)	• Residual PSG <35 mmHg • No worsening AR	• PSG 35-50 mmHg • Worsening of AR by 1 level compared to baseline	• PSG ≥ 50 mmHg • Worsening AR by ≥2 levels compared to baseline, or severe AR
Procedural Performance (+TS)	• AE s 1-2 • Elective home discharge	• AEs 3	• AEs 4-5
BPVP			
Technical Success	• Residual valvar PSG <20 mmHg • No worsening PR	• Residual valvar PSG 20-40 mmHg • Worsening of PR by 1 level compared to baseline •	• Residual valvar PSG ≥ 40 mmHg • Worsening PR by ≥2 levels compared to baseline, or severe PR
Procedural Performance (+TS)	• AEs 1-2 • Elective home discharge	• AEs 3	• AEs 4-5

* All criteria need to be met.

A single criterion in the highest class determines classification.

AR= aortic regurgitation, BAVP: balloon aortic valvuloplasty, BPVP: balloon pulmonay valvuloplasty, PR: pulmonary regurgitation, PSG: peak systolic gradient.

ETHICS DECLARATIONS

Conflict of Interest: The authors declare they do not have any conflict of interests.

Ethical Approval: Approval was obtained from the IRB at the coordinating center (Boston Children's Hospital) and, when necessary, at participating sites. Other sites did not require IRB approval as

this registry data is de-identified and for quality improvement projects.

Consent for Publication: Consent to participate in this research study was not necessary and waived, as this data was collected for quality improvement purposes.

018. Evaluating Procedural Performance: A Novel Outcome Metric for ASD and PDA Device Closure in Congenital Cardiac Catheterization Laboratories

Oliver Barry[1], Babar Hasan[2], Nadeem Aslam[3], Sarosh Batlivala[4], Matthew Crystal[1], Todd Gudausky[5], Ralf Holzer[6], Jacqueline Kreutzer[7], George Nicholson[8], Michael O'Byrne[9], Brian Quinn[10], Suren Reddy[11], Arash Salavitabar[12], Brian Boe[12]

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Objectives: The aim of this study was to develop a procedural performance metric for simple atrial septal defect (ASD) and patent ductus arteriosus (PDA) device closure using a composite of procedural safety and technical success. This may help identify areas of further investigation and quality improvement. **Background:** Safety events and technical success have been previously reported for these procedures, but a composite performance metric as a novel, patient-centered strategy has not been studied before. **Methods:** A multi-center review was performed using data from the Congenital Cardiac Catheterization Project on Outcomes (C3PO) registry. Data were collected for all cases of isolated ASD or PDA closure from 2014 through 2017. Cases with complex congenital heart disease (CHD) and/or significant co-morbidities were excluded from both cohorts. In the ASD cohort, patients with multiple defects or ≥ 2 deficient rims were excluded. In the PDA cohort, patients < 6 kg or with pulmonary hypertension were excluded. Criteria for technical success were developed and categorized by multi-center expert consensus into 3 classes (class I to III). Adverse events (AEs) were categorized by severity levels (1-5) using established criteria, and level 3-5 were considered high severity adverse events (HSAEs). Procedural performance was categorized using composite criteria of technical success and AE also into three classes (class I to III) (Table). Factors associated with class III (unsatisfactory) procedural performance were analyzed. **Results**: A total of 542 ASD and 688 PDA closure cases were included in the respective cohorts. ASD cases had 91% with class I or II technical success and 1% risk of HSAEs. Class III procedural performance occurred in 10% of cases, mostly due to new mitral valve insufficiency, and was associated with a deficient rim ($p = 0.03$). PDA cases had 98% with class I or II technical success and HSAE in $< 1\%$. Class III procedural performance occurred in 2% of cases, predominantly due to new arch obstruction, and was associated with younger age ($p < 0.001$) and lower weight ($p = 0.001$). **Conclusions:** Procedural performance metrics are designed to provide a composite outcome encapsulating both technical success and safety. Simple ASD and PDA closure have demonstrated high procedural performance. Incorporating both technical success and AEs may better reflect patient outcome rather than each outcome measured separately. It may also help identify areas for further investigation and quality improvement.

Definitions of Procedural Performance

Procedure	Class I*	Class II#	Class III#
ASD Closure			
Technical Success (TS)	• No residual flow • No new MR	• Residual flow <3 mm (mild or moderate) • No new MR	• Residual flow ≥ 3 mm (severe) • New MR
Procedural Performance (+TS)	• AEs 1-2 • Elective home discharge	• AEs 3 (including successful retrieval of embolized device if no new valvar regurgitation and subsequent ASD closure)	• AEs 4-5 (including embolized device that could not be retrieved, lead to new valvar regurgitation)
PDA Closure			
Technical Success	• No residual flow • No new LPA or Aortic flow acceleration (Peak gradient <16 mmHg/Echo Peak Velocity <2 m/sec) (no stenosis)	• Mild residual shunt through the device without requiring device removal during subsequent catheterization or operation • Mild new LPA/Aortic flow acceleration (Peak gradient 16-36 mmHg/Echo Peak Velocity 2-3 m/sec)	• Moderate or worse residual shunt through/around device or residual flow requiring device removal during subsequent catheterization or operation • New LPA/Aortic stenosis with peak gradient >36 mmHg/Echo Peak Velocity >3 m/sec)
Procedural Performance (+TS)	• AEs 1-2 • Elective home discharge	• AEs 3 (including successful retrieval of embolized device if no new valvar regurgitation and subsequent PDA closure)	• AEs 4-5 (including embolized device that could not be retrieved, lead to new valvar regurgitation)

* All criteria need to be met.

A single criterion in the highest class determines classification.

LPA= left pulmonary artery, MR= mitral regurgitation.

ETHICS DECLARATIONS

Conflict of Interest: The authors declare they do not have any conflict of interests.

Ethical Approval: Approval was obtained from the IRB at the coordinating center (Boston Children's Hospital) and, when necessary, at participating sites. Other sites did not require IRB approval as this registry data is de-identified and for quality improvement projects.

Consent for Publication: Consent to participate in this research study was not necessary and waived, as this data was collected for quality improvement purposes.

019. Major Adverse Outcome After Congenital Cardiac Catheterization Complicated by Vascular or Cardiac Trauma, or Technical Adverse Events

Ralf Holzer[1], Sarosh Batlivala[2], Brian Boe[3], Bryan Goldstein[4], Todd Gudausky[5], Babar Hassan[6], Michael O'Byrne[7], Brian Quinn[8], Shyam Sathanadam[9], Shabana Shahanavaz[10], Sara Trucco[4], Jeffrey Zampi[11], Lisa Bergersen[8]

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Background: Data on the frequency and outcome of surgical interventions as a result of adverse events (AE) encountered in the pediatric and congenital cardiac catheterization laboratory are limited. This study analyzes the outcomes of specific types of AE that are most likely to require immediate surgical intervention. Methods: Data from the C3PO registry were analyzed to identify specific types of

significant vascular/cardiac trauma or technical adverse events (stent/device/coil embolization/migration). The relationship between these AE and an "adverse outcome" (defined as either surgery, ECMO, or death) was analyzed. Results: Between 01/2014 and 12/2017, 25,731 cases were entered into the C3PO registry. Vascular or cardiac trauma was observed in 92 cases (0.36% cases in C3PO), and technical adverse events were observed in 176 cases (0.68% cases in C3PO). The two highest PREDIC3T risk categories accounted for 61% of the cases in the cardiac/vascular trauma cohort, and 34% in the technical AE cohort. For vascular/cardiac trauma, 24 (26%) had an adverse outcome, with ECMO in 8 (9%), surgery in 19 (20%), and death in 9 (10%). For technical AE 25 (14%) had an adverse outcome, with ECMO in 3 (2%), surgery in 23 (13%), and death in 3 (2%). Survival after cardiac surgery secondary to an AE was 68% for cardiac/vascular trauma, and 96% for technical adverse events. RF perforation of the pulmonary valve was the procedure most likely to result in cardiac/vascular trauma (10%), with 57% of those having an adverse outcome. Atrial septal interventions accounted for 29% of all adverse outcomes in the cardiac/vascular trauma cohort. Non-elective or emergent cases were associated with a significantly higher incidence of an adverse outcome for both, cardiac/vascular trauma (OR 7.1) and technical adverse events (OR 2.7). Surgery within the last 30 days was associated with a significantly higher incidence of an adverse outcome for cardiac/vascular trauma only (OR 4.2). Conclusions: Significant cardiac/vascular trauma or stent/device/coil embolization/migration is rare, but high consequence AE. With appropriate surgical and ECMO backup, survival is high. The potential need for and impact of immediate surgical backup seem to be higher for cardiac/vascular trauma (in particular after specific case types), than for device/coil migration/embolization, and as such case-specific backup arrangements are required.

ETHICS DECLARATIONS

Conflict of Interest: The authors declare they do not have any conflict of interests.

Ethical Approval: Not applicable.

Consent for Publication: Not applicable.

020. Three-Dimensional Cardiac Imaging Vital to Pre-procedural Planning of Complex ACHD Interventions: A Case Series

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Three-dimensional (3D) cardiac imaging is a rapidly advancing technology that facilitates procedural planning for intervention of complex congenital cardiac anatomies. With reduced radiation and contrast burdens for computed tomography (CT), it has become a mainstay of cardiac imaging given the tissue resolution, definition of extracardiac structures, and functional data with ECG gating. The ability to accurately measure and assess anatomy in the pre-procedural setting informs planning to ensure success during catheter interventions with complex underlying anatomy. Herein, we describe two cases in which pre-procedure 3D CT imaging was vital to the success of complex adult congenital heart disease (ACHD) interventions. The first case is a 21-year-old female with congenitally corrected transposition of the great arteries (S,L,L), double-outlet right ventricle and ventricular septal defect (VSD) who had previously undergone an arterial switch operation with Lecompte, Senning atrial baffle and Rastelli VSD closure procedure with subsequent 26 mm pulmonary homograft replacement and bilateral branch pulmonary artery stenosis requiring stent angioplasty. She developed progress exercise intolerance coincident with severe pulmonary insufficiency and RV chamber dilation. Initial attempt at trans-catheter pulmonary valve replacement was unsuccessful due to the tortuous catheter course causing unstable hemodynamics when tracking large bore sheaths. A CT was performed with 3D printing of cardiac and skeletal anatomy. With unique ventricular orientation, a heart-rib cage model informed hybrid per-ventricular access at the 5th intercostal space along the mid-axillary line. A 24Fr Gore Dryseal sheath was advanced readily into the conduit and a 26 mm Sapien S3 valve was placed without incident. There was no residual regurgitation or paravalvular leak and the patient has had sustained improvement in symptoms two years from intervention. The second case is a 47-year-old male with double-outlet right ventricle with D-malposed great vessels, pulmonary atresia, and VSD s/p Rastelli repair and multiple subsequent pulmonary homograft revisions and VSD patch revisions for recurrent dehiscence. He developed advanced heart failure symptoms and need for positive airway pressure in the setting of RV dysfunction and pulmonary over-circulation. He was not deemed a surgical candidate given the severity of his clinical status and history of recurrent surgical interventions without durable result, therefore, underwent CT with 3D printing to determine feasibility of a trans-catheter intervention. Given the concern for surgical patch instability and favorable location of the residual VSD, an RVOT-covered stent was favored over device closure. The patient was brought to the catheterization lab and cannulated to ECMO after an arrest following sheath placement. Three 4.5- and 5-cm 10-zig covered CP stents were placed in succession across the RVOT with significant reduction in his residual shunt. Next, a 22 mm Melody valve was placed using the Ensemble system without incident and no residual pulmonary insufficiency. He was able to decannulate from ECMO and one year from intervention requires nasal cannula at night only. Three-dimensional CT imaging can inform pre-procedural planning in complex ACHD cases, thus, improving the likelihood of successful interventions.

ETHICS DECLARATIONS

Conflict of Interest: The authors declare they do not have any conflict of interests.

Ethical Approval: Not applicable.

Consent for Publication: Not applicable.

021. Off-label Use of Muscular VSD Device for Closure of a Rare Porto-Systemic Shunt

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Background: Congenital porto-systemic shunt (CPSS), also known as Abernethy malformation, is a rare vascular malformation in which the portal blood drains towards the systemic circulation eluding the liver. CPSS incidence persisting after the neonatal period ranges from 1:30,000 to 1:50,000 live births. In extrahepatic shunts, the porto-mesenteric blood drains into a systemic vein through a complete or partial shunt in the absence or presence of the portal vein, respectively. The presence of vasoactive substances in the intestinal circulation bypass the liver without being metabolized lead to PAH. A 6-year-old patient was brought for evaluation due to dyspnea on exertion. By Echocardiography, there was significant right atrial and ventricular dilatation and hypertrophy with estimated systolic pulmonary arterial pressure of 75 mmHg, no obvious left to right shunt lesions, or any underlying cardiac abnormalities. Before we conclude the diagnosis of idiopathic pulmonary hypertension, a multi-slice CT

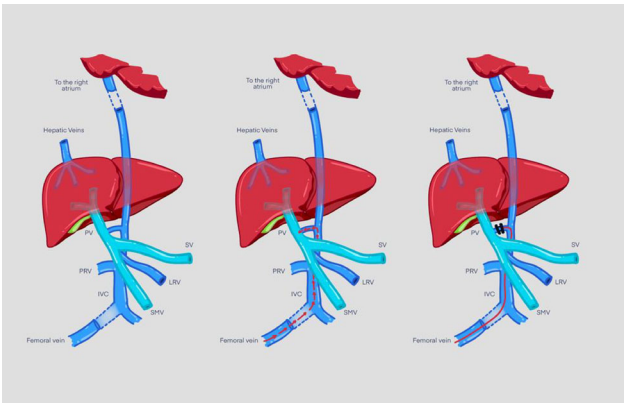
angiography was requested revealing the presence of a CPSS. Attempt for transcatheter closure of this porto-systemic shunt was decided due to the presence of PAH. For this purpose, a 6 Fr femoral vein and 5 Fr Internal jugular vein access as well as a 5Fr femoral arterial access was prepared. IVC injection revealed the presence of the previously identified fistulous malformation between it and the portal vein, conical in shape with its largest diameter from IVC side around 8 mm. First attempt was done by using ADOI (8/6) device for closure of the shunt, but unfortunately, it was unstable in position and slipped into IVC. A decision was made to close it using a Lifetech muscular device size 8 mm. A 4F JR catheter under terumo wire guidance in the IVC was used to cross the fistula to the portal vein. The terumo wire was replaced by a stiff wire 0.035 × 260 cm to secure its position in the portal vein and to support the delivery system of the muscular device. The device was loaded on a 7 Fr Lifetech delivery system, and the whole system was advanced and once reached the portal vein adjacent to the fistula, the device was released progressively to seal the CPSS. Repeated injections revealed adequate closure of the fistula. No short-term complications were observed. Three months later after the procedure, gradual decline of pulmonary artery pressure from 75 to 50 mmHg was evident by echocardiography. Learning Points: In pediatric patients, if the cause of PAH is unknown, all possible causes of secondary PAH should be considered, including the most uncommon ones. CPSS is rare and should be ruled out when facing this type of patient and the damage caused by PAH may be reversed by transcatheter closure of the shunt.

ETHICS DECLARATIONS

Conflict of Interest: The authors declare they do not have any conflict of interests.

Ethical Approval: Not applicable.

Consent for Publication: Not applicable.



022. Optimizing Blood Product Utilization in the Cardiac Catheterization Laboratory

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Background: Packed red blood cells (PRBC) are often ordered for pediatric cardiac catheterizations (PCC) with no current appropriate use guidelines, resulting in increased utilization. A quality improvement (QI) project was created to focus on optimizing ordering of PRBC for PCC. The primary aim was to increase adherence to new guidelines to > 97%, with a global aim to decrease patient cost. Methods: Retrospective chart review was performed to collect baseline data. For PDSA cycle 1, we updated our own PRBC ordering guidelines by risk stratifying procedures. The PCC report was updated to include documentation of PRBC ordering or transfusion. PDSA cycle 2 included further refinement of the guidelines, and improved awareness amongst those placing the pre-PCC orders. Process measures included ensuring the need for PRBC stated during every pre-PCC time-out, and consistent documentation in the PCC report. Balancing measures included monitoring the rate of PRBC transfusion within 24 h post-PCC, and incidence of emergency release of PRBCs. Results: For 3 months of baseline data, 112/403 of CCPs (27.8%) had PRBC ordered, 87.5% (98/112) of which followed the prior protocol, with 13/403 (3.2%) receiving PRBC transfusion during CCP. With our revised guidelines, there could be > 20% reduction in PRBC ordering, with estimated > $20,000 cost savings based on 1 crossmatch ($173) and 1 unit PRBC ($730) prepared. For PDSA cycle 1, 27/81 (33%) of PCC had PRBC ordered, with 92% adherence to the updated guidelines, and 100% documentation compliance. For PDSA cycle 2, 13/47 (27.6%) had PRBC ordered with 100% adherence to ordering guidelines. During both cycles, 3 patients had PRBC transfusions within 24 h of their procedure for other medical reasons not related to bleeding. During continued evaluation, 19/75 (25.3%) had PRBC ordered, while 6 (24%) which would have had PRBC ordered previous prior to implementing new guidelines did not. No cases required emergency release of PRBC. There was a statistically significant process change from a median of 86% to 100% adherence ($p = 0.01$) since implementation of the updated guidelines. **Conclusion** With revised guidelines and improved adherence, hospital resources and charges were decreased in low-risk cardiac catheterization procedures without an increase in adverse events. This model can be utilized in other systems to similarly reduce resource utilization and costs.

ETHICS DECLARATIONS

Conflict of Interest: The authors declare they do not have any conflict of interests.

Ethical Approval: Not applicable.

Consent for Publication: Not applicable.

023. The First Experience of Percutaneous Tricuspid Valve-in-Valve Implantation using New Self-Expandable PULSTA Valve in a High-Risk Patient

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Percutaneous tricuspid valve implantation (PTVI) has emerged as an attractive alternative option to surgery for high-risk patients with recurrent symptomatic severe tricuspid regurgitation that occurs after tricuspid bioprosthetic valve replacement or surgical ring repair with good long-term outcomes. Similar interventions have been performed with balloon-expandable valves of the Edward SAPIEN valve, SAPIEN XT valve, and SAPIEN 3 valves in tricuspid position. Recently, a feasibility study using the PULSTA valve (Tae Woong Medical Co, Gyeonggi-do, South Korea) for native RVOTs was reported; the diameter of the PULSTA valve ranges from 18 to 32 mm and the lengths of valve were 33 mm and 38 mm each. Herein, we present a first case of PTVI with new self-expandable PULSTA valve which overcomes that limitation as large size of TV in the tricuspid position in a high-surgical-risk patient with one-and-a-half ventricle repair without complications.

ETHICS DECLARATIONS

Conflict of Interest: The authors declare they do not have any conflict of interests.

Ethical Approval: Not applicable.

Consent for Publication: Not applicable.

024. Simultaneous Percutaneous Tricuspid and Pulmonary Valve Implantation via Right Internal Jugular Vein Approach Using Reverse Loading Technique in Patient who Underwent One-and-a-half Ventricle Repair

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Percutaneous tricuspid valve implantation (PTVI) and percutaneous pulmonary valve implantation (PPVI) has emerged as a good alternative option to surgery for high-surgical-risk patients with good long-term outcomes. Similar interventions have been performed with balloon-expandable valves of the Edward SAPIEN valve, SAPIEN XT valve, and SAPIEN 3 valves in tricuspid position and various types of pulmonary valve available, namely the Edward SAPIEN XT valve (Edwards Lifesciences, Irvine, CA, USA), Harmony valve (Medtronic, Inc., Minneapolis, MN, USA), Venous P valve (Venus Medtech, Shanghai, China), Alterra Adaptive Prestent (Edwards Lifesciences), and PULTA valve (Tae Woong Medical Co, Gyeonggi-do, South Korea) in pulmonic position in the world recently. Herein, We described a first challenging experience of simultaneous percutaneous tricuspid valve in valve implantation with self-expandable PULST valve which overcome that limitation as large size of TV and pulmonary valve implantation with balloon-expandable Melody valve via right internal jugular vein approach using reverse device-loading technique without temporal pacing in patient who underwent one-and-a-half ventricle repair with severely enlarged right atrium and right ventricle successfully.

ETHICS DECLARATIONS

Conflict of Interest: The authors declare they do not have any conflict of interests.

Ethical Approval: Not applicable.

Consent for Publication: Not applicable.

025. Transcatheter Patent Ductus Arteriosus Closure in Premature Infants on High Frequency Ventilation

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Background: Patent ductus arteriosus (PDA) is common in extremely low birth weight infants, and is associated with increased risk of morbidity and mortality in this patient population. Approved for clinical use in the United States in 2019, the Amplatzer Piccolo Occluder (APO) has been posed as a solution to the unmet need for a safe, effective, and minimally invasive alternative for PDA closure in these small infants; however, ventilator stability and thermoregulation while traveling out of the intensive care unit remain ongoing concerns, especially for those requiring high frequency ventilation (HFV). Following implementation of ventilator guidelines and catheterization laboratory protocols, we sought to describe our early clinical experience with infants undergoing transcatheter PDA closure with the APO while requiring HFV. METHODS: We performed a single-center, retrospective cohort study from February 2021 to February 2022. Patients were included if they underwent transcatheter PDA closure with an APO while requiring HFV. Procedural and respiratory outcomes were observed. Procedural outcomes included successful implantation of APO, presence of residual ductal shunt, device embolization, and presence of either aortic arch or left pulmonary artery obstruction. Temperature upon return to the intensive care unit was also recorded. Respiratory outcomes included change in respiratory severity score (RSS) immediately post-procedure, time to return to pre-procedure RSS, time to RSS $\leq$ 1, and eventual diagnosis of grade 3 bronchopulmonary dysplasia (BPD). RESULTS: Nine patients met inclusion criteria. With an average gestational age of approximately 26 weeks, average procedure age and weight were 42 days and 1178 g, respectively. The majority of the cohort was female (78%). APOs were successfully implanted in all patients with no occurrences of residual ductal shunt, device embolization, aortic arch or left pulmonary artery obstruction. Upon return from the catheterization laboratory, all patients were normothermic, and all but 3 had an improved RSS from prior to the procedure. All patients were successfully extubated with a median time to extubation of 20 days (interquartile range: 7-56 days), and a median time to RSS $\leq$ 1 of 46 days (interquartile range: 24-76 days). Two patients (22%) were eventually diagnosed with grade 3 BPD. **Conclusion** Using a well-strategized, multidisciplinary team approach, transcatheter PDA closure can be feasible, effective, and safe in small, premature infants requiring HFV. To our knowledge, this is the only study to date examining procedural and respiratory outcomes following transcatheter PDA closure in premature infants specifically requiring HFV.

ETHICS DECLARATIONS

Conflict of Interest: The authors declare they do not have any conflict of interests.

Ethical Approval: Not applicable.

Consent for Publication: Yes.

026. Closure of Iatrogenic Ruptured Sinus of Valsalva and Residual Ventricular Septal Defect in a 31 year-Old Female Post-Ventricular Septal Defect Surgical Closure Using Konar: MF VSD occlude devices

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Introduction: Sinus Valsalva aneurysms are usually congenital defects.1 The cause of their appearance is an incomplete fusion of the distal bulbar septum that divides the pulmonary artery and the aorta and attaches to the annulus fibrosus of the aortic valve. There is also thinning of the aortic media observed in affected sinus which can progressively dilate over time, especially in cases of arterial hypertension.1 Although Valsalva aneurysms may involve all 3 sinuses, more frequently the right and noncoronary are involved. During rupture, they open most frequently to the right ventricle or right atrium. The left sinus is not derived embryologically from bulbar septum and therefore is rarely affected. This anomaly can be unrecognized for many years. Percutaneous closure of ruptured sinus Valsalva aneurysm (RSVA) was first attempted by Cullen et al6 in 1994 using a Rashkind umbrella. Since then, a few reports have been published with the use of different available closure devices.2-5. We would like to share our experience in transcatheter closure of a case of RSVA in a female patient. Case presentation: Our patient is 31-year-old female patient, presenting with progressive exertional dyspnea

grade II and palpitations over the past 3 years. The patient has a history of congenital VSD that was surgical closed at the age of 15 years. On admission, her functional class was New York Heart Association class II. On examination tachycardic (heart rate: 100/min), and normotensive (BP: 110/60 mmHg). Precordium was hyperdynamic with a prominent continuous murmur. S1 and S2 were diminished. She did not have any symptoms or signs of connective tissue disorder. Patient was not on any medications on time of presentation. Electrocardiogram showed normal sinus rhythm with infrequent premature ventricular contractions. Transthoracic echocardiography was performed and showed a slightly dilated right ventricle in the presence of a left-to-right shunt from the aorta into the right ventricle, small sub-aortic residua VSD measuring about 7 mm and mild aortic regurgitation. Transthoracic echocardiography (TTE) revealed a ruptured aneurysm of the right coronary sinus of Valsalva causing a large left-to-right shunt into the right ventricle, diagnosed by color Doppler. **Method:** The procedure was attempted under general anesthesia with fluoroscopic and transthoracic echocardiographic guidance. Percutaneous access to right femoral vein and bilateral femoral arteries was obtained by Seldinger technique, and hemostatic sheaths were inserted. Unfractionated heparin 80 U/kg and antibiotic prophylaxis were given intravenously. 6F short sheaths were secured in right femoral vein and right femoral artery. Aortic root angiogram (Fig. 1) was done which showed sinus of Valsalva aneurysm from right coronary sinus with contrast spilling into RVOT from the ruptured site. Transesophageal echo was used to detect and quantify flow across the sinus of Valsalva (Fig. 2) Arterio-venous loop was created (Fig. 3) by passing through the defect from the aortic side using an angled tip 0.035″ glide wire (Terumo) in 6F Judkins right coronary catheter. Glide wire was exchanged with a 260 cm, 0.035″ stiff guide wire over which a 7F long sheath was tracked from the venous side and parked in ascending aorta. We attempted to close the sinus of Valsalva using retrograde approach from the venous side but failed due to bad coaptation of KONAR-MF^{TM} VSD Occluder device (10/8) across the defect. AV loop was abandoned and antegrade approach was adapted. Though the right short femoral artery sheath, A JR catheter was used to introduce the glide wire which was secured in left pulmonary artery. The JR catheter was then exchanged with long sheath. The device was loaded over the cable, passed through the long sheath and deployed across the defect (Fig. 4). Angiogram confirmed optimum position and absence of residual shunt. TTE revealed no impingement of device on aortic leaflets and resolution of the aortic regurgitation, the device was released (Fig. 5). Through the left femoral artery short sheath, a JR catheter was used a long which a glide wire was used to cross the VSD and wire was then advanced and secured in the right pulmonary artery (Fig. 6). The JR catheter was then exchanged with a long sheath along which KONAR-MF^{TM} VSD Occluder device (6/4) was properly positioned and deployed (Fig. 7) with no residual flow detected by TEE (Fig. 8) or Angiography. Patient complained of palpitations after the intervention. ECG was done and showed frequent PVCs. She was given bisoprolol 2.5 mg OD which terminated the PVCs. Patient was then discharged on additional dual antiplatelet therapy and a short oral antibiotic course.

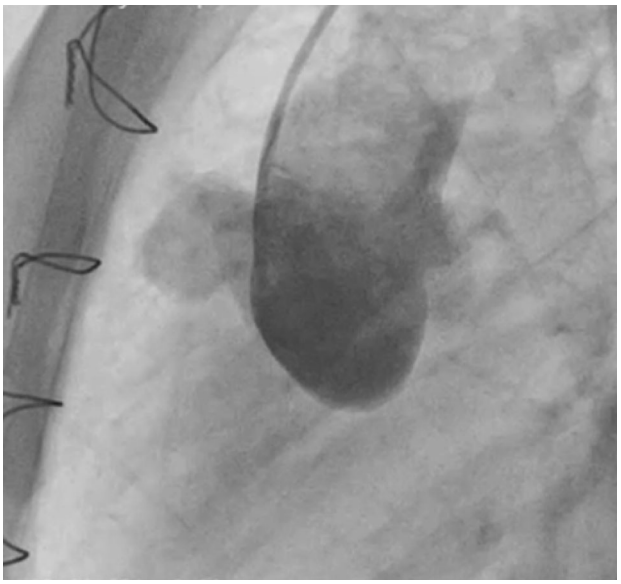

Fig. 1 Aortogram showing contrast spilling from the aorta to RVOT through sinus of Valsalva

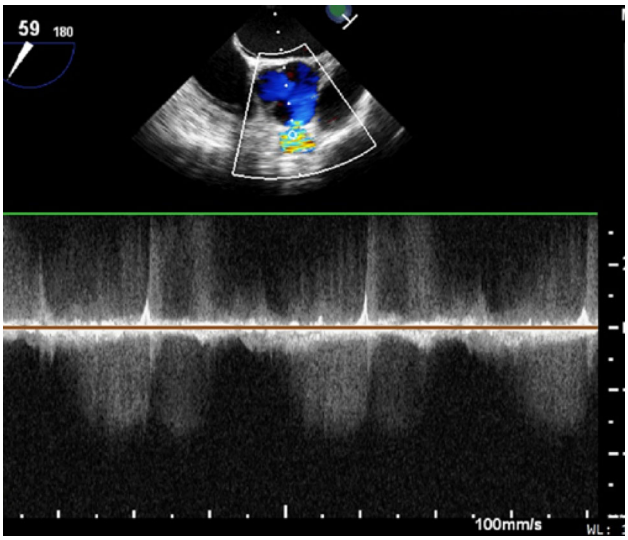

Fig. 2 Transesophageal echo Short axis showing both systolic and diastolic flow across the rupture sinus of Valsalva

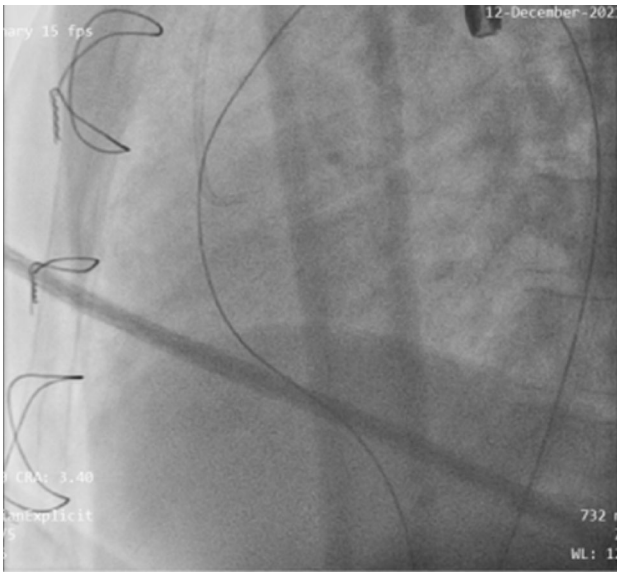

Fig. 3 Arteriovenous loop created

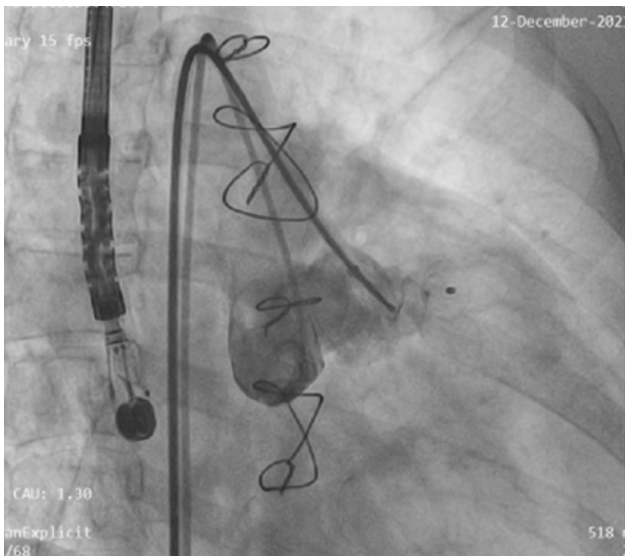

Fig. 4 Well-seated device across the sinus of Valsalva with no flow across

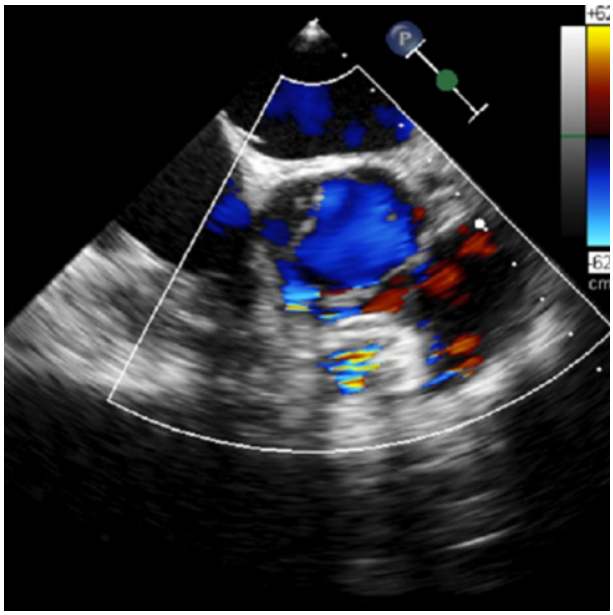

Fig. 5 TEE showing closure of the rupture sinus of vulsuva with no residual flow

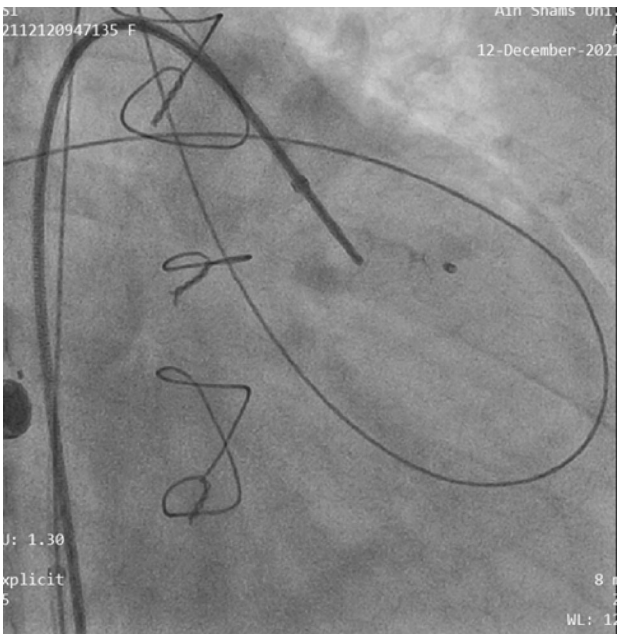

Fig. 6 Wire crossed across VSD and secured in the RPA

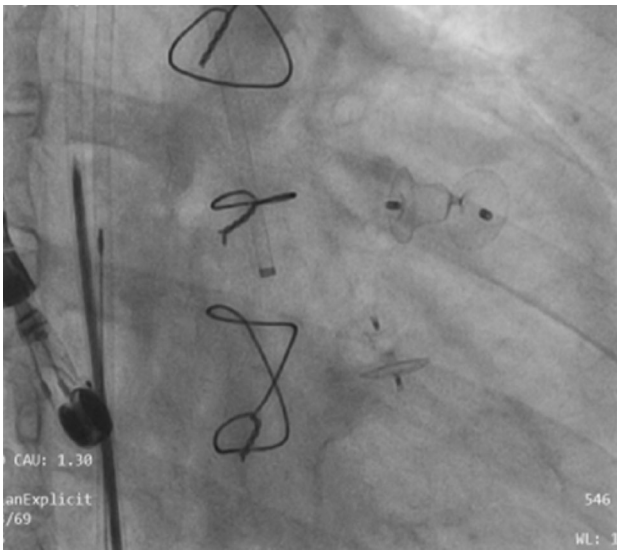

Fig. 7 Deployed devices in place

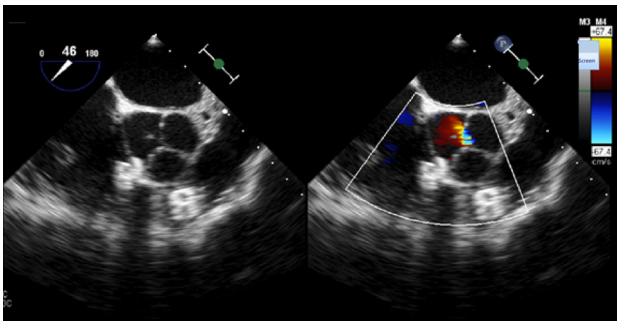

Fig. 8 TEE showing well seated devices (left) with no flow across the devices by color doppler (right)

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ETHICS DECLARATIONS

Conflict of Interest: The authors declare they do not have any conflict of interests.

Ethical Approval: Presented within the ethical guideline.

Consent for Publication: Not applicable.

027. The Last Resort for Severe Pulmonary Hypertension in Critically Ill Patient with Complete Atrioventricular Defect and Cor-Triatriatum

Asmaa Ahmed[1], Maiy Elsayed[1], Mohamed Rashad Awad[1]

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Introduction Cor-triatriatum is one of the rare congenital heart defects that is usually associated with poor outcome. Inadequate communication in these cases affects the hemodynamics by leading to pulmonary venous hypertension, low systemic cardiac output, and providing inadequate inter-circulatory mixing. Cor-triatriatum membrane stenting is considered a palliative method ensuring a reliable and predictable interatrial communication, relieving the left atrial hypertension and hence, improving the circulation. Materials and methods: We present a case of a14 year-old female with Down syndrome and complex congenital heart disease in form of complete endocardial cushion defect and Cor-triatriatum. She was referred to us with a very poor general condition; she was shocked and mechanically ventilated. 2D Echocardiography showed complete endocardial cushion defect with a small communication between the upper chamber of the left atrium and right atrium, the Cor-triatritum membrane precludes the drainage of the pulmonary venous drainage into the Left ventricle so the pulmonary venous flow drains only through this small communication into the right atrium, a large inlet VSD shunting bidirectional and well-functioning ventricles. 3D transesophageal echocardiography confirmed the diagnosis. The patient was transferred directly to the catheterization lab. The procedure was done under general anesthesia with fluoroscopy and 3D TEE guidance. After penetrating the Cor-triatriatium membrane (Fig. 1) and introducing a wire, balloon dilatation was done (Fig. 2). During deployment of a BMS, we encountered a complication; the stent was loose and not securely mounted on the membrane as shown by 3D TEE reconstruction (Fig. 3), causing stent displacement to the right atrium. The stent was pulled over the balloon to the femoral vein and was crushed against its wall. A larger stent was properly positioned across the membrane followed by post-stent balloon dilatation of its proximal and distal parts (Figs. 4, 5) for proper alignment of the stent across the membrane confirmed by 3D TEE reconstruction (Figs. 6, 7). IV heparin was used during the procedure. Results: Free flow across the stent was confirmed by color Doppler and deployed properly positioned stent was confirmed by 3D TEE. Immediately after the procedure, The LA pressure dropped to 12/8 mmHg the blood pressure improved from 60/40 to 90/60, and the oxygen saturation improved to 85%. The patient was clinically improving; she was weaned from the ventilator on the fourth day and was discharged on Aspirin later on. **Conclusion** Cor-triatriatum membrane stenting is a palliative and effective lifesaving procedure while waiting for surgical repair in this case with severe pulmonary hypertension secondary to unrepaired complex congenital heart disease.

ETHICS DECLARATIONS

Conflict of Interest: Self-funded by authors.

Ethical Approval: Not applicable.

Consent for Publication: Obtained

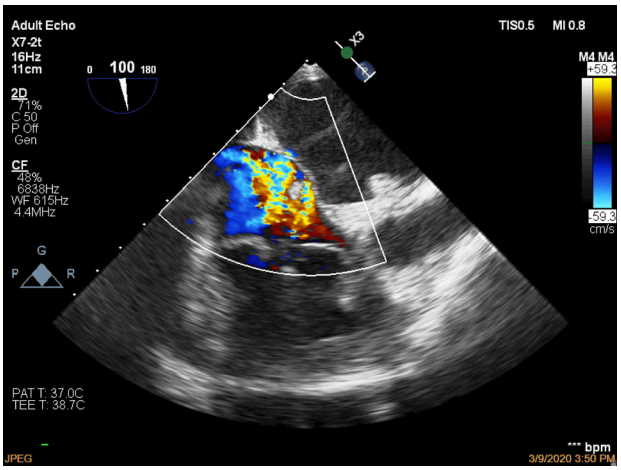


Fig. 1 Penetrating the Cor-triatriatium membrane under 2D TEE guidance

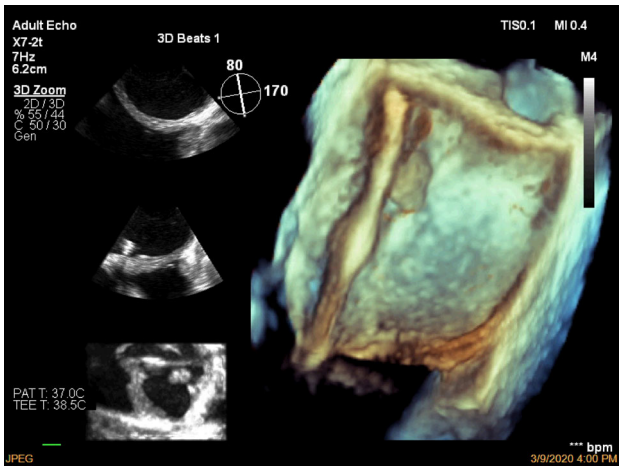


Fig. 2 Balloon dilatation under 3 TEE guidance

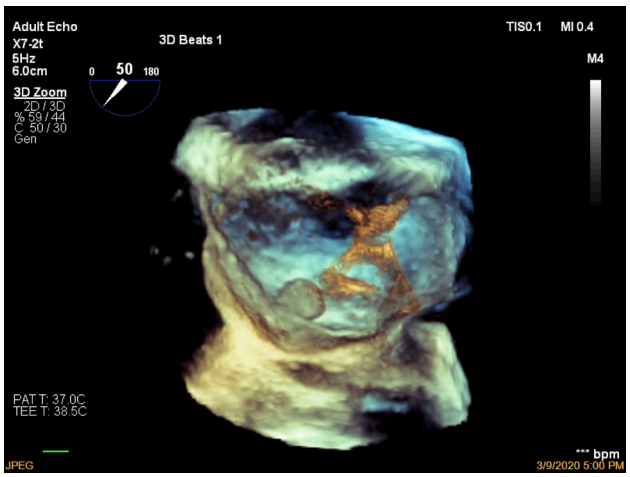
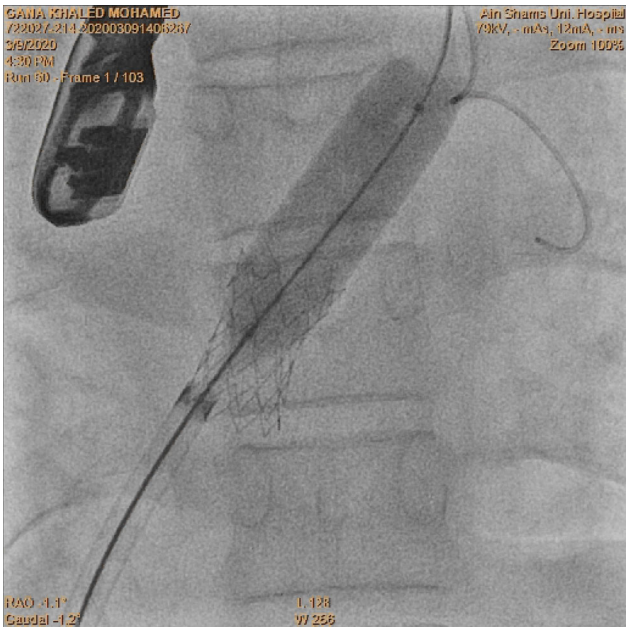
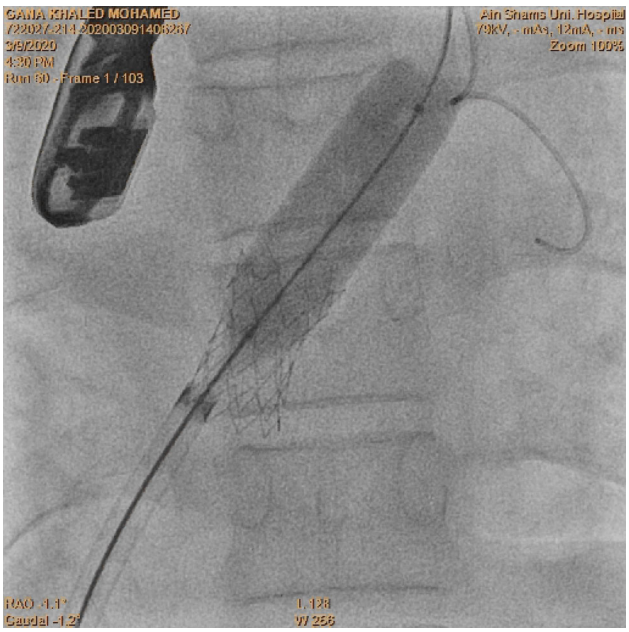
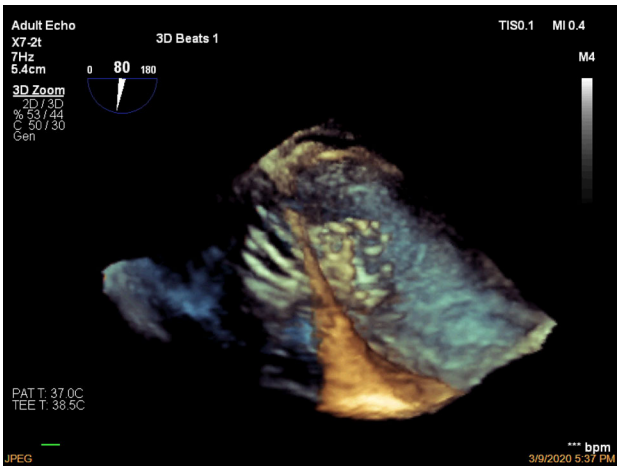


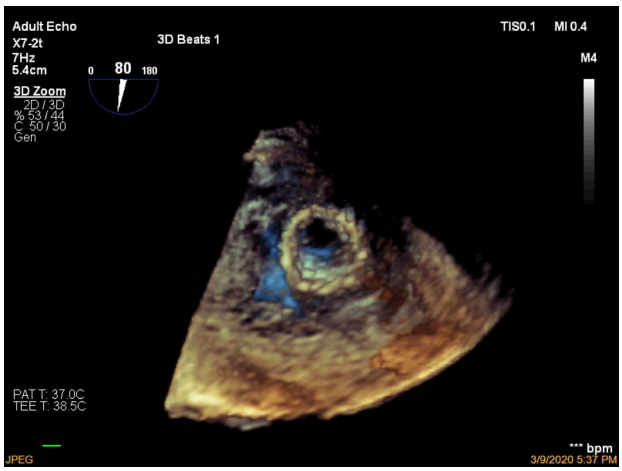
Fig. 3 Deployed stent across the Cor-triatriatium membrane by 3D TEE





Figs. 4, 5 Inflation of the proximal and distal parts of the larger stent using high-pressure balloons under fluoroscopic guidance.





Figs. 6, 7 3D TEE showing a well-deployed stent across the Cortriatriatium membrane.

028. Right Coronary Ostial Atresia and a Right Coronary Fistula to the Right Ventricle: A Case Report

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Introduction Right coronary artery ostial atresia and coronary artery fistulae are both rare congenital heart lesions. Here we present a case of both right coronary ostial atresia and a proximal right coronary artery to right ventricle (RV) fistula resulting in transient myocardial ischemia in a neonate. Case: A 2-week-old male dichorionic, diamniotic twin was born at 35 weeks gestation via uncomplicated caesarean section for maternal pre-eclampsia was found to have a murmur in the neonatal intensive care unit. An EKG and echocardiogram were obtained. The EKG demonstrated ST segment elevations in the inferior leads and lateral precordial leads with reciprocal ST depression in lead I. An echocardiogram identified a prominent right coronary artery fistula draining into the right ventricle with normal biventricular function, no regional wall motion abnormalities, and otherwise normal intracardiac anatomy. A high sensitivity troponin T was collected and found to be 191 ng/L (reference range is < 22 ng/L). Based on these findings, he was referred to our center where he underwent a diagnostic left heart catheterization with selective coronary angiography, which demonstrated right coronary ostial atresia with retrograde filling of right coronary distribution via dilated left circumflex coronary artery (Fig. 1). There was a fistulous connection of the proximal right coronary artery and the RV. At the time of these findings, the patient was otherwise clinically well. He was monitored without intervention and troponins normalized over the course of 4 days. After multiple interdisciplinary discussions, we opted to discharge the patient with no intervention and close follow-up given that he was asymptomatic with no concern for ongoing myocardial ischemia. Discussion: To our knowledge, this is the first reported case of right coronary ostial atresia and a right coronary fistula to the RV occurring simultaneously. Both right coronary ostial atresia and congenital coronary fistulas are rare entities (1–2). Coronary ostial atresia is frequently asymptomatic and may never require intervention in patients with robust collateral flow (1). Similarly, it is quite rare for coronary fistulas to result in significant coronary steal and ongoing ischemia, though patients may require treatment due to heart failure as a result of a left to right shunt (3). Our case is unique in that there was a transient, ischemic insult early in newborn life that would otherwise be uncommon if these anomalies were found in isolation. We presume the combination of run off via the coronary fistula as the pulmonary vascular resistance fell in the first few weeks of life combined with limited perfusion capacity of the right coronary system due to the ostial atresia put this patient at higher risk for coronary steal. We opted to continue to monitor this patient clinically rather than preemptively close the fistula as he was asymptomatic with improvement in surrogate markers for myocardial ischemia. We plan to intervene should he develop heart failure symptoms or there is concern for continued coronary steal. We remain hopeful that no intervention will be necessary.

ETHICS DECLARATIONS

Conflict of Interest: The authors declare they do not have any conflict of interests.

Ethical Approval: Not applicable.

Consent for Publication: Yes.

029. Successful Interventions for a Non-transplantable Fontan Patient with Cirrhosis, Pulmonary hypertension, and Severe Desaturations

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Introduction Fontan patients are at risk of multiple devastating complications including multi-organ failure that can involve liver, lungs, heart, and kidneys. Pulmonary hypertension (PH) is more disturbing in the passive Fontan circulation as it worsens hepatic and systemic congestion, decreases cardiac output (CO), and consequently worsens organ dysfunction. Here in we are presenting a Fontan patient with PH, multi-organ dysfunction and deteriorating overall condition and deemed non transplant candidacy and raise the management options for these complicated cases. Case discussion: Our patient is a 26-year-old male with hypoplastic left heart syndrome, double outlet right ventricle and coarctation of the aorta who underwent Norwood procedure when few days old, Hemi-Fontan at 7-months-old and Fenestrated lateral tunnel Fontan around 21-months-old. He presented to our institution at almost 25 years after moving to West Michigan. He had symptoms of dyspnea on mild

exertion, he quit work as he was having fatigue and exhaustion and unable to drive. He was known to have significant veno-venous (VV) collaterals (Fig. 1) that were not closed due to high Fontan pressures. Baseline O_2 saturation (O_2 sat) was 68–71%, with exercise it dropped to 50–52%, and he had hypoxemia-induced polycythemia with hemoglobin of 23 g/dL. His VO_2 was at the 10–25th percentile of age and sex matched Fontan patients. His liver MRI showed liver cirrhosis, portal hypertension, splenomegaly, ascites, and esophageal varices and chest CT was negative for interstitial lung disease. Cardiac catheterization showed Pulmonary artery pressure of 26 mmHg with transpulmonary gradient of 10–12 mmHg, and a non-reactive pulmonary vascular bed. On discussion of his case with outside transplant centers, he was considered unsuitable for heart-lung-liver transplant. In collaboration with PH team, decision was to aggressively treat his PH and he was started on Tadalafil and Macitentan to facilitate collateral closure. 3 months later, he reported improved symptoms with better exercise tolerance; his O_2 sat was 85% in the office. He was taken to the catheterization laboratory where pulmonary artery pressures were down to 17 mmHg, with no significant increase after closure of a big VV collateral (Fig. 2). He continued to improve, and repeat catheterization showed pulmonary artery pressures of around 10 mmHg with no change after closure of 4 major VV collaterals. Around 1 year of starting PH therapy, and after closure of multiple collaterals, he is much better clinically with better exercise tolerance, his O_2 sat in the clinic is 88-90%. He walked 85% of total predicted distance compared to 76% when he initially presented with lowest O_2 sat of 74% compared to 50% on initial test. Comprehensive evaluation of Fontan patients with multi-organ dysfunction involving multi-disciplinary team can help implement stepwise management plan that will help improve life of patients deemed to palliative management.

ETHICS DECLARATIONS

Conflict of Interest: The authors declare they do not have any conflict of interests.

Ethical Approval: Not applicable.

Consent for Publication: Not applicable.

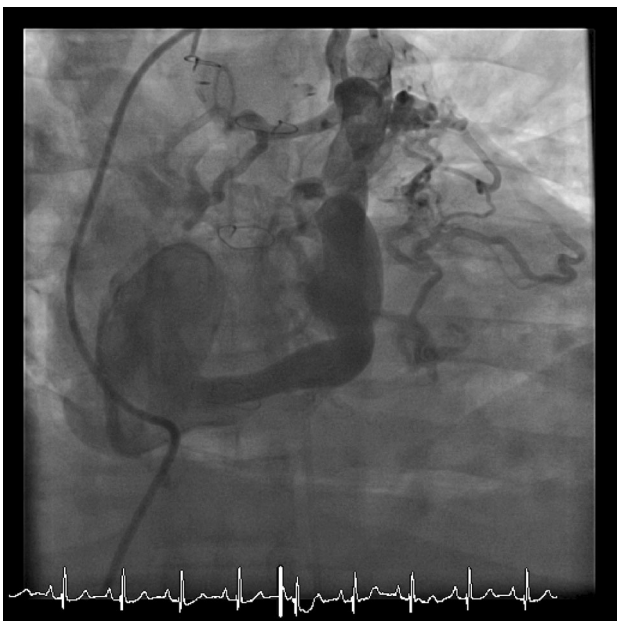

Fig. 1 Angiogram showing multiple veno-venous collaterals

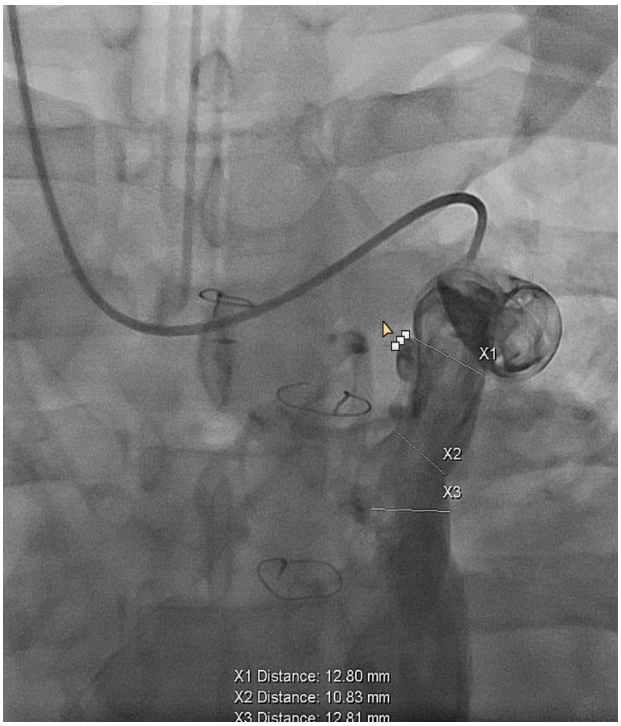

Fig. 2 Big veno-venous collateral with diameter up to 12.8 mm

030. "Two-String" Technique to Treat Native Coarctation of the Aorta in a Young Child: Novel Approach

Bassel Mohammad Nijres[1], Osamah Aldoss[1]

[1]Stead Family Children's Hospital, University of Iowa, Iowa, USA

Introduction Stent placement to treat a native coarctation of the aorta in infancy is underutilized, mainly due to the need for a long, large-bore arterial sheath to deploy a stent that has a potential to be dilated to adult size. We describe a novel technique that allows an adult size stent to be placed through short, small sheaths. Case presentation: A 3-year-old female presented with systemic hypertension. An echocardiogram showed coarctation of the aorta with a peak and a mean pressure gradient of 50 mmHg and 27 mmHg. After proving the principle of the "Two-String" technique outside the body, this treatment option was offered to the family who has favored it over the surgical repair option. Vascular access was obtained in the right femoral and axillary arteries using 4- and 5-Fr sheaths, respectively. Aortic angiogram showed a short segment coarctation of the aorta measuring 4.3 mm. The normal descending aorta measures 7 mm. A 0.014" Grand Slam (GS) wire was inserted in the right axillary artery (RAA) sheath and snared out from the right femoral artery (RFA) sheath. The GS wire was exchanged for a 4-Fr Navicross catheter (the catheter was inserted from the RFA sheath with the tip exteriorized from the right RAA sheath). A 1910B Genesis XD stent was selected. A 0 (150 cm) string was passed through the bottom (inferior) strut of the stent. The string ends were exteriorized from the femoral artery

sheath. A 3-0 string was passed through the opposite end of the stent (superior strut). The catheter was exchanged for the GS wire. A 3 × 30 mm NC Emerge balloon was inserted through the RFA sheath over the GS wire and exteriorized from the RAA sheath. The stent was manually crimped on the NC Emerge balloon. The stent/balloon unit was inserted inside the RAA sheath by slowly pulling the balloon and the inferior string together from the RFA sheath. After confirming the stent is in a satisfying position, the balloon was inflated. The balloon was removed while stabilizing the stent by fixing the superior and inferior strings. An 8 × 20 mm Sterling balloon was inserted in the right axillary artery sheath over the GS wire and centered inside the stent with ease. The stent position was adjusted by pulling on the superior and inferior strings as needed. Then, the sterling balloon was slowly inflated while maintaining tension on the strings. The strings were pulled out of the body. No gradient was recorded across the stent. Complete resolution of the coarctation was achieved without complications. At one year follow-up, no difference in the upper and lower extremities' blood pressure was measured and only a minimal gradient was recorded across the stent by echocardiogram. **Conclusion** The "Two String" technique enables precise placement of an adult size stent through small, short sheaths and should be considered as an alternative to surgery in small children. Although this novel approach requires two arterial accesses, this is counterbalanced by the sheaths being small and short.

ETHICS DECLARATIONS

Conflict of Interest: The authors declare they do not have any conflict of interests.

Ethical Approval: Not applicable.

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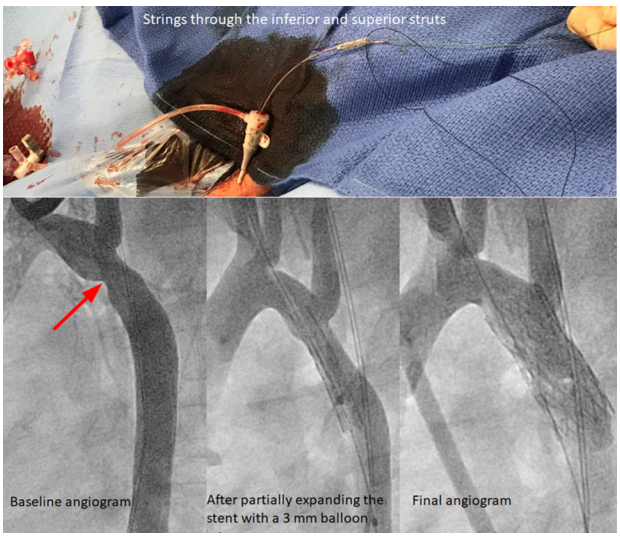


031. Left Atrial Appendage Occlusion in a Toddler Using Hydro Coils

Bassel Mohammad Nijres[1], Osamah Aldoss[1]

[1]Stead Family Children's Hospital, University of Iowa, Iowa, USA

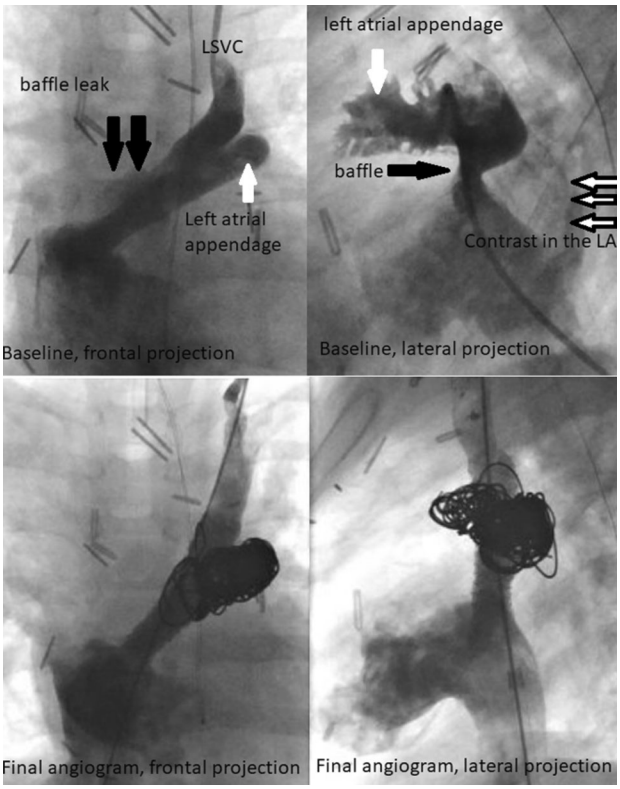
Case presentation: A 3 y.o female was born with Tetralogy of Fallot (TOF) and persistent left superior vena cava (LSVC) draining directly into the left atrium (LA). She underwent TOF repair and baffling of the LSVC and left atrial appendage (LAA) to the right atrium (RA). She presented with low systemic oxygen saturation in the mid-80 s that drops to the 70 s with activity. Angiogram and transesophageal echocardiogram revealed the presence of a baffle leak measuring 5-6 mm. The balloon waist (baffle leak sizing) measured 12 mm. It was determined that transcatheter device closure is not an option. To investigate whether the placement of a covered stent would be safe, a 10 × 40 mm Opta pro balloon was inflated at the purposed placement site of the covered stent (extending from the LSVC to the distal baffle). While the balloon was inflated, a bubble study was performed by injecting agitated saline inside the LAA which showed many bubbles crossing the baffle leak. It was concluded that placing a covered stent would partially isolate the left atrial appendage and result in the stagnancy of blood. Blood stagnancy could lead to clot-forming inside the LAA and potentially systemic thromboembolism. No intervention was performed. After considering different treatment options, the decision was made to occlude the LAA using hydro coils (to minimize the risk of LAA clotting) followed by placing a covered stent extending from the LSVC to the distal baffle (to redirect the entire LSVC flow to the RA). Aspirin was started 7 days prior to the cardiac catheterization. Access was obtained in the left internal jugular vein (LIJV) and the left femoral vein (LFV) using 7-Fr sheaths. Heparin was administered. To avoid the risk of coil embolization, the baffle leak was temporarily occluded with a 12 × 20 mm Tyshak II balloon introduced from the LIJV sheath. Through the LFV, an angled glide (AG) catheter was advanced inside the LAA through which the LAA was occluded using 0.035″ Azur coils (1 framing, 1 CX, and 9 hydro coils). After confirming adequate filling of the LAA with coils and allowing sufficient time for the gel to expand and solidify, we proceeded with covered stent placement. An 8 × 39 mm Gore Viabahn balloon-expandable stent (VBX) stent was advanced inside the LIJV sheath and deployed inside the baffle. An angiogram showed the stent did not cover the most proximal portion of the LSVC. An 8 × 29 mm VBX stent was deployed more distally overlapping with the previous stent. The final angiogram showed no residual baffle leak. No arrhythmia was observed during her overnight observation. She was discharged home on dual antiplatelet therapy (aspirin and clopidogrel) for 3 months with the plan to only continue aspirin then after. Discussion: LAA occlusion in children is feasible when the anatomy is favorable. The covering gel of the hydro coils has many advantages. They expand resulting in a better cavity filling with less metallic materials. It probably enhances the endothelialization process. It is at least theoretically less irritating to the myocardium (less arrhythmogenic).

ETHICS DECLARATIONS

Conflict of Interest: The authors declare they do not have any conflict of interests.

Ethical Approval: Not applicable.

Consent for Publication: Not applicable.



032. Absorbable Gelatin Sponge to Close a Large Transhepatic Tract: Tips for Success

Bassel Mohammad Nijres[1], Osamah Aldoss[1]

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Introduction Transhepatic access in patients with Fontan circulation is commonly needed for ablation procedures. Occlusion devices or coils are traditionally utilized to embolize the parenchymal tract. We describe a successful large transhepatic tract closure using an absorbable gelatin sponge. Case presentation: A 20 y.o. male with a history of hypoplastic left heart syndrome was palliated with lateral tunnel Fontan presented with intra-atrial re-entry tachycardia. He was on dual antiplatelet therapy. His Fontan pressure was 16-18 mmHg. Transhepatic access was obtained under fluoroscopy guidance using a 22-gauge Chiba needle. An 8.5 Fr steerable Agilis sheath was advanced through the transhepatic tract. The ablation procedure was completed through the Agilis sheath. The transhepatic tract was embolized using the following technique. Through the left femoral venous sheath, a 7-Fr wedge catheter was placed in the accessed hepatic vein. The Agilis sheath was exchanged for a 9-Fr 10 cm pinnacle sheath. A 2 cm × 6 cm × 0.7 cm Surgifoam (gelatin sponge) was chosen. The sponge was compressed by rolling a 5 syringe over it. Then, the sponge was cut to create strips. The strips were turned into torpedoes by tightly rolling them and loaded inside a cut 5-Fr sheath (Fig. 1A). The 9-Fr sheath dilator was cut to match the length of the sheath. A 0.035″ short access wire was inserted inside the dilator and the wire was stabilized within the dilator using a hemostat keeping the wire tip flushed with the tip of the dilator (Fig. 1B). This modification was created to fill the dilator lumen, so the gelatin "torpedoes" could be safely pushed through the sheath allowing precise deployment. The sheath was pulled back inside the tract. Angiogram through the sheath conformed that the tip was inside the hepatic parenchyma (Fig. 1C). With the help of the cut 5 Fr sheath, 2 torpedoes were loaded inside the 9-Fr sheath (Fig. 1D). The torpedoes were deployed sequentially inside the tract by pushing them with the combination of dilator and wire while pulling the sheath back. An angiogram in the right hepatic vein (the accessed vein) showed no residual contrast flow inside the hepatic tract (Fig. 1E). No blood oozing was seen at the skin access site. The patient was observed overnight, with no recurrence of arrhythmia and a benign abdominal exam. The next day abdominal ultrasound was negative for ascites or intrahepatic hematoma. Discussion: Gelatin sponge to close intraparenchymal tract has many advantages. It gets absorbed within a few weeks. Contrary to coil or occlusion devices, it does not create artifacts with magnetic resonance and it is cheap. Our patient has an increased risk of intraabdominal bleeding due to the use of a large-bore sheath, increased Fontan pressure, and being on dual antiplatelet therapy (aspirin and clopidogrel). Exclusive use of gelatin sponge should be considered for embolization of large transhepatic tract.

ETHICS DECLARATIONS

Conflict of Interest: The authors declare they do not have any conflict of interests.

Ethical Approval: Not applicable.

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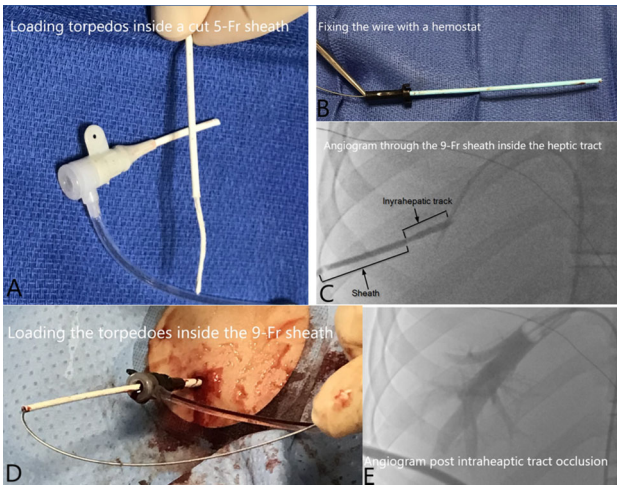

033. Successful Endovascular Treatment of a Giant Left Subclavian Artery Pseudoaneurysm in a Infant: Case Report

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A female patient with tricuspid atresia 1B was operated at the age of 2 months of Blalock—Taussig shunt (BTS) successfully. Three months later present deep cyanosis and a left heart catheterization was made to try an angioplasty of the shunt; when the contrast media was injected in the subclavian artery, a giant pseudoaneurysm was observed, so that the patient was translated to the operation room and a 5 mm right BTS was made. Three weeks later was made a CTA were observed a giant Pseudoaneurysm of 26 mm × 20 mm and a neck of 8 mm. A left catheterization was made with 6 Fr introducer and a MPA catheter with hydrophilic guidewire (Fig. 1a); the Pseudoaneurysm was canulated (Fig. 1b) and a Amplatz super stiff

guidewire was collocated inside; previously, a coronary guide wire was advanced to protect the subclavian artery distal to the lesion (Fig. 1c). We use guide catheter 5 Fr JR 3.5 placing it inside the pseudoaneurysm; an Amplatzer Vascular Plug II of 8 mm (Abbott, Chicago, Illinois) was used; open the distal disc and the central inside the pseudoaneurysm pulling it until the neck; later open the proximal disc. We noted the absence of flow distally in the artery (Fig. 1d), and use a coronary balloon of 3.5 mm to maintain the patency. In the control angiogram the arterial flow was good (Fig. 1e). Two days later was discharged and in the control CTA the lesion disappear.

Pseudoaneurysm develops when there is a lack of integral arterial wall structure, resulting in blood leakage through the wall, and then wrapped by perivascular tissue. (1) The subclavian artery Pseudoaneurysm (SAP) is a rare complication can occur by infection, traumatic accident, or weakness of the artery. Previous surgical stress tension caused by the suture shunt graft to the subclavian artery itself might be triggered formation of the pseudoaneurysm.

(2) The repair could be by surgery of end-vascular technique with the use of covered stent. (3) In children, just a few cases have been reported. (4) Covered stent use at infancy could be a problem because it hard to redilate to an adult size; for the above, we use the AVP II and we believe that it is a good option in pediatric patients.

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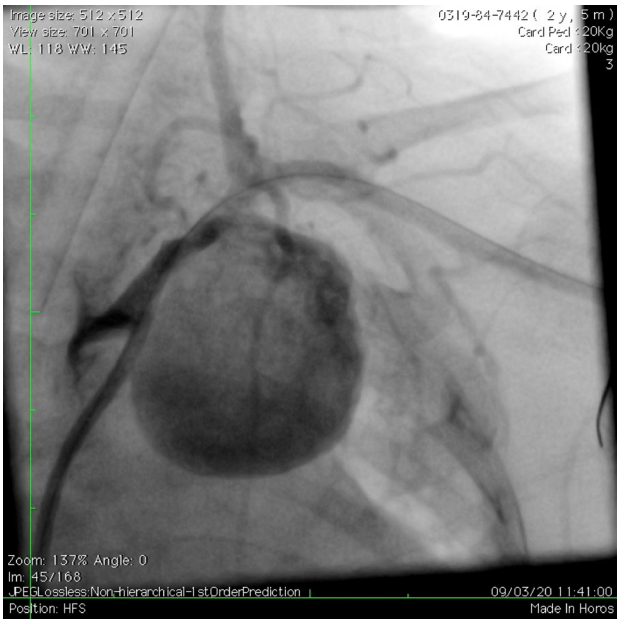

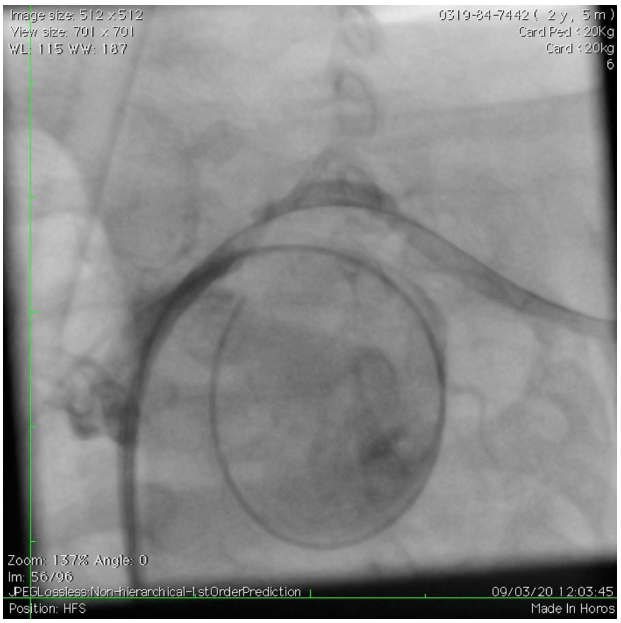

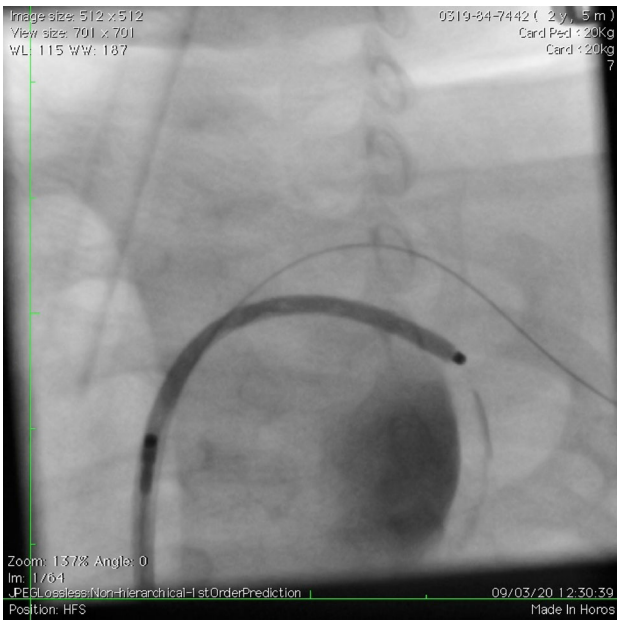

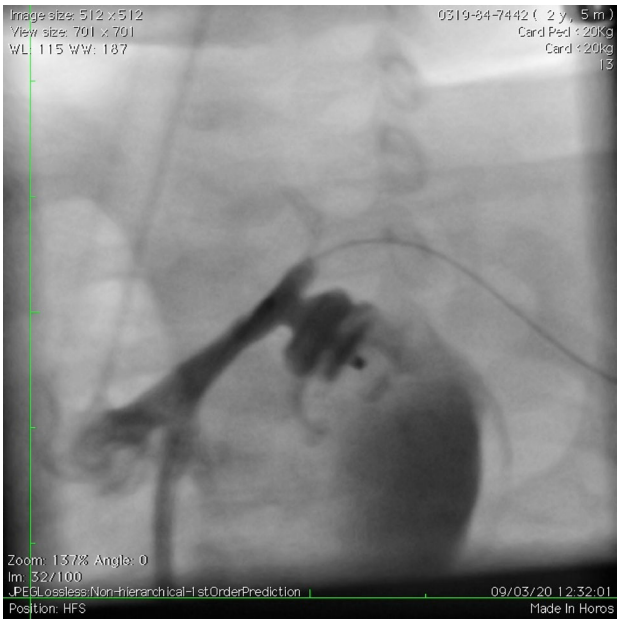

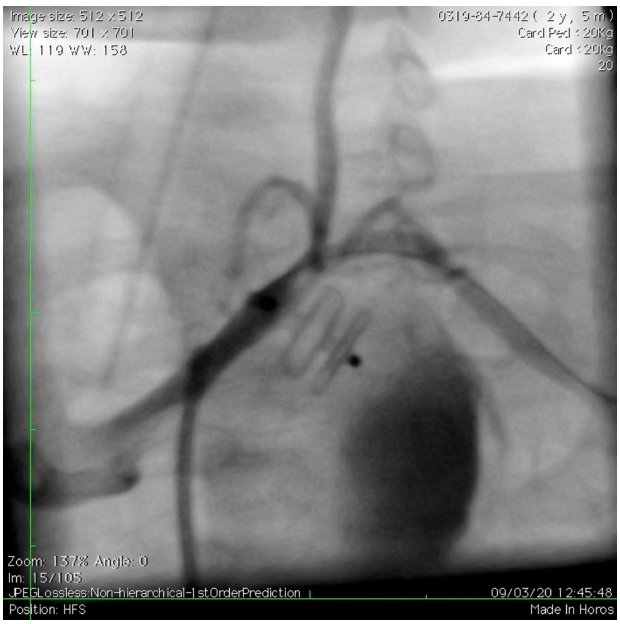

ETHICS DECLARATIONS

Conflict of Interest: The authors declare they do not have any conflict of interests.

Ethical Approval: Not applicable.

Consent for Publication: Not applicable.

034. PDA Closure with ASO Device. Balloon Assisted Technique to Reshape Left Disc

Gerardo Izaguirre-Guajardo[1], Mayra Ramírez—Vargas[2]

[1]University Hospital UANL, Monterrey, Mexico. [2]General Hospital 33, Bahia de Banderas, Mexico

A female of 9 years old was detected a persistent ductus arteriosus (PDA); the echocardiogram noted a large PDA with pulmonary side of 8 mm, aortic 14 mm and length of 10 mm, left to right shunt with gradient of 5 mmHg end left side of the heart dilated. A left and right heart catheterization show pulmonary artery pressure of 79/44 m50 mmHg and aortic pressure of 99/38 m63 mmHg, PVR 6.6 U.W.m2; vasodilatory oxygen test show drop of PVR to 2.1 U.W.m2. The angiography shows a PDA tipo B of Krichenko; the pulmonary side was 14 mm, aortic 22 mm and length 10 mm (Fig. 1). Due the anatomy and pulmonary hypertension decide to use Amplatzer Septal Occluder (ASO) of 22 mm. Deploy the left disc in the aorta and central part in the pulmonary end and later, deploy the right disc. We look the left disc obstructing totally the aorta (Fig. 2). Ascend a Tyshak balloon 14 × 30 mm and positioned front the disc and expand until the nominal pressure; the left disc was reshaped (Fig. 3). The angiography show no obstruction in the aortic side (Fig. 4) and the gradient was less than 10mmhg; in the left pulmonary artery, we did not found gradient. We release the ASO without problem (Figs. 5 and 6). Two days later was discharged at home with sildenafil; one year later the echo show systolic pulmonary artery pressure of 19 mmHg and no obstruction in the aorta or pulmonary artery. Conclusions: PDA is one of the most frequent congenital heart diseases; a lot of devices for the closure was made but, the patients with pulmonary hypertension to a systemic level and large PDA require other devices not formulated to this lesion. Other papers report the use of device for atrial and ventricular septal defect in the adult population (1). Nevertheless, the obstruction of the aorta and/or left pulmonary artery secondary to the shape of the device is a problem associated (2). In this patient, we present a new technique to reshape the left disc and avoid the aortic obstruction.

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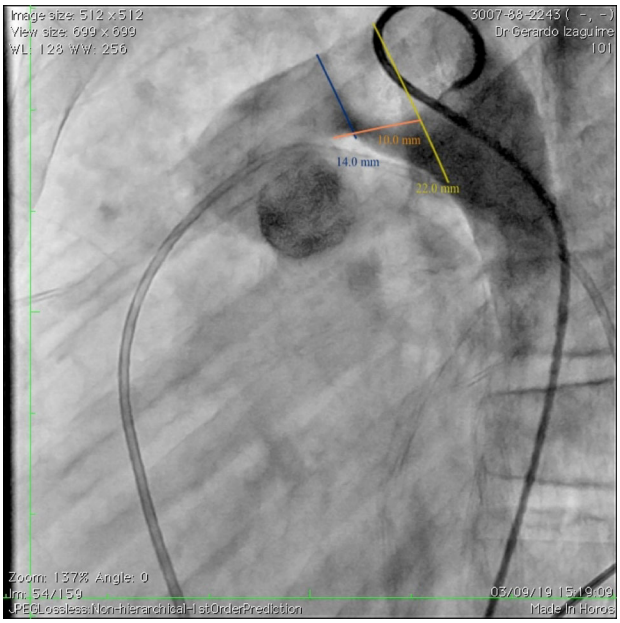
ETHICS DECLARATIONS

Conflict of Interest: The authors declare they do not have any conflict of interests.

Ethical Approval: Not applicable.

Consent for Publication: Not applicable.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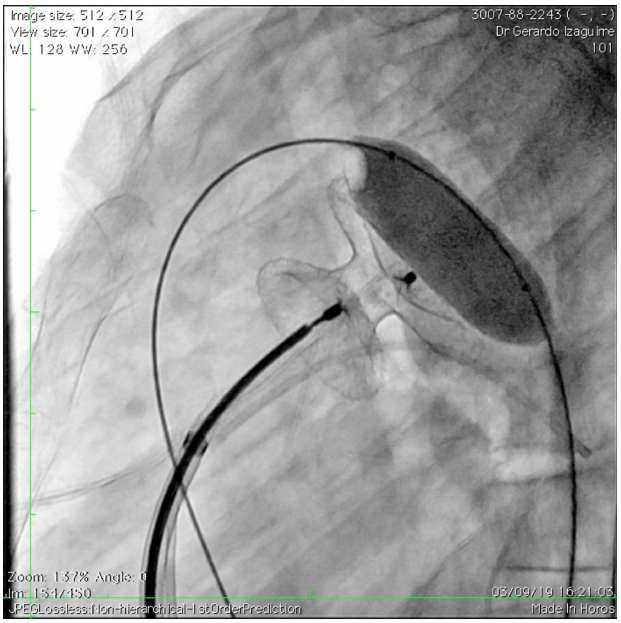
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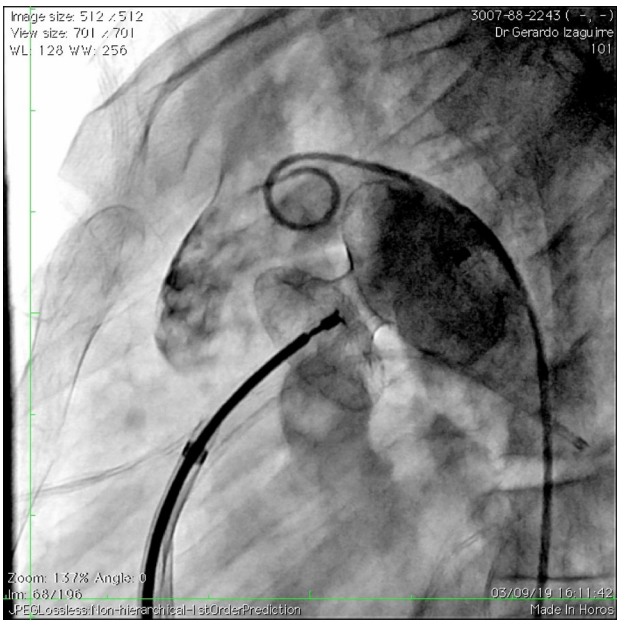
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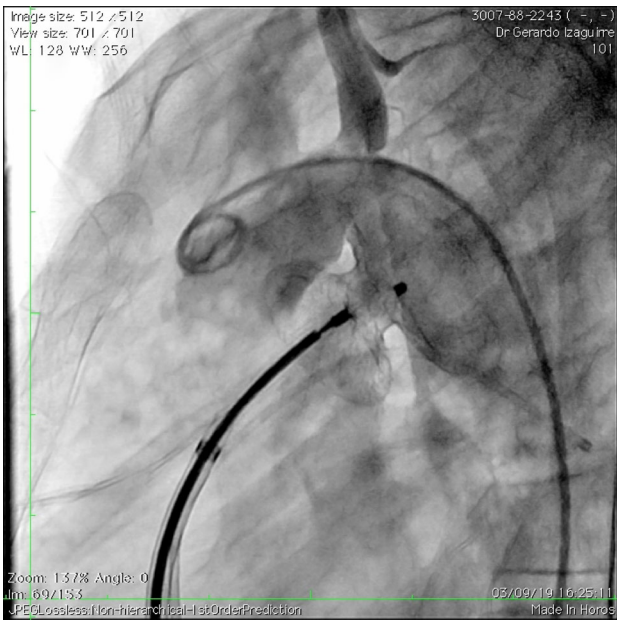
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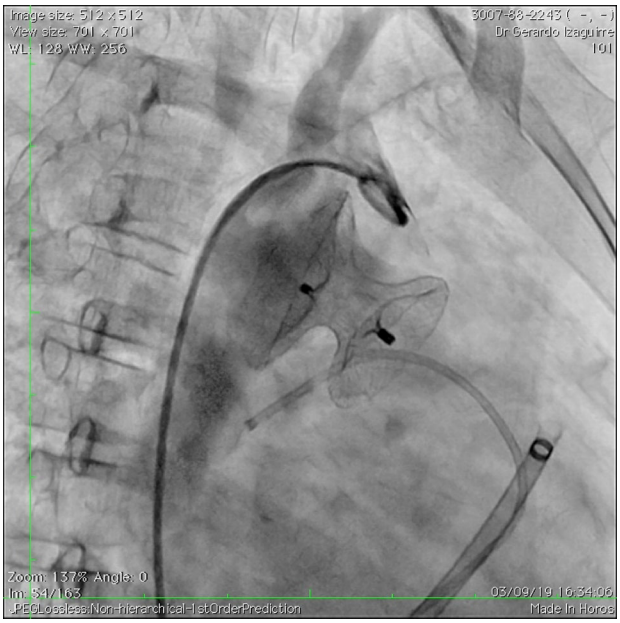

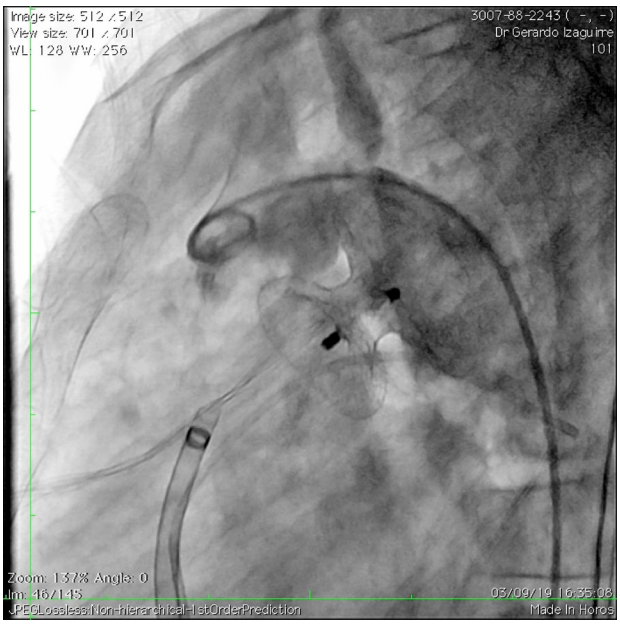

035. Aortic Valvuloplasty through the Axillary Artery in Children

Bayan Issa[1], Osamah Aldoss[1], Bassel Mohammad Nijres[1]

[1]University of Iowa, Iowa, USA

Introduction Aortic balloon valvuloplasty (ABV) in children with valvar aortic stenosis is widely accepted as the primary treatment option or alternative to surgery. Traditionally, ABV has been performed through the femoral artery. We describe our experience in utilizing the axillary artery for ABV. Methods: This a retrospective single-center study for patients who underwent ABV at Stead Family Children's Hospital from 04/2021-04/2022. Results: Three patients underwent ABV through the axially artery. Axially artery access was obtained under ultrasound guidance in all patients. Procedure was successful in all patients with no major complications. No thrombosis, pseudoaneurysm formation or poor extremity perfusion was encountered.

Patient	1	2	3
Age	2 days	27 days	11 years
Sex (M/F)	M	M	F
Weight (kg)	3.6	3.83	70.4
Aortic valve annulus by echocardiogram (mm)	6.1	6.7	20.1
Aortic valve annulus echocardiogram Z-score	− 1.78	− 0.48	− 0.67
Baseline peak gradient by echocardiogram (mmHg)	52	62	94
Baseline mean gradient by echocardiogram (mmHg)	27	40	52
Baseline regurgitation by echocardiogram	None	None	None
Post-ABV peak gradient by echocardiogram (mmHg)	36	36	55
Post-ABV mean gradient by echocardiogram (mmHg)	17	16	23
Post-ABV regurgitation by echocardiogram	Mild	Mild to Moderate	None
Position on the catheterization table	Flipped	Flipped	Usual
Axillary artery access site (R/L)	Right	Right	Left
Max sheath size (Fr)	4	4	8
Aortic valve annulus by angiogram (mm)	8	8.3	20.8
Max balloon size (mm)	7 × 20	7 × 20	18 × 60
Balloon to annulus size ratio	0.87	0.84	0.86
Baseline peak-peak gradient by catheterization (mmHg)	70	90	43
Post-ABV peak-peak gradient by catheterization (mmHg)	18	18	18
Procedure time (min)	121	50	151
Fluoroscopy time (min)	13.25	11.7	37.92
Radiation dose (mGy)	5.32	6.11	573.48
Radiation dose (cGy-cm2)	15.35	12.9	5665.43

Conclusion Transaxillary artery ABV is feasible and safe. It has many advantages. First, crossing the aortic valve is easy as the catheter does not need to travel through the aortic arch curve. Second, it allows taking post-intervention angiogram through the axillary artery sheath without the need to remove the wire or place a long sheath. Third, pulse amplification will not confound interpreting the gradient across the aortic valve. Although this technique requires the operator to stand at the head of the table, this can be avoided in infancy by flipping the infant (head toward the end of the table and the feet toward the head of the table).

ETHICS DECLARATIONS

Conflict of Interest: The authors declare they do not have any conflict of interests.

Ethical Approval: Not applicable.

Consent for Publication: Not applicable.

036. Infantile Percutaneous Coronary Interventions: Report of Three Cases

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Introduction: PCI is common and well-established for adult CAD, but not well-established in children and very limited for infants. We report three cases of infantile PCI and their outcome. Case 1: Nine-week-old male with DORV/TGA S/P ASO and VSD closure at one month age, presented 12 days after discharge with poor feeding and respiratory distress. He had high degree heart block with evidence of lateral wall ischemia and poor ventricular function. Degeneration of his AV node due to coronary compromise was considered. CTA showed absent left coronary artery (LCA) flow. Taken to OR and found inflammation and adhesions around LCA, which were dissected and released. Patient needed postoperative ECMO support. Catheterization next day showed persistent LCA narrowing. A 0.014″ BMW wire was advanced into the LAD, and a 1.5 mm × 12 mm balloon was positioned across the stenotic area. Multiple inflations were performed with complete obliteration of the waist and significant angiographic improvement in flow. Cardiac function recovered; patient got ECMO decannulated 4 days later. Two-year follow-up angiography showed normal LCA diameter and flow. Case 2: Twelve-month-old with HLHS palliated with cavopulmonary anastomosis at 4 months of age, presented with acute decompensation requiring mechanical ventilation. He had severe bradycardia with complete heart block. Despite emergency pacemaker placement, hemodynamics deteriorated requiring ECMO support and emergent catheterization. Selective angiogram showed complete occlusion of LCA. An 0.014″ Asahi Prowater wire was advanced into LCA over which a 4Fr JR catheter was further advanced. The maneuver was performed multiple times into the coronary branches to dislodge and aspirate clot. Heparin 1000 units were administered directly into LCA, and 1 mg of rTPA was injected directly into the lesion to facilitate thrombolysis. Repeat angiogram after 4 min showed complete recanalization of all the major branches of LCA. Follow-up cath after 5 days showed complete resolution of the thrombus. Unfortunately, patient passed away after one month due to other comorbidities. Case 3: Three-week-old, with VACTERL association had worsening LV function and MR. ALCAPA was confirmed by echocardiogram and angiogram. He underwent LCA surgical re-implantation. On post-op day 5 he had cardiac arrest needing ECMO support. Angiogram on ECMO showed completely occluded LCA with back filling from the RCA. A cut 4F Pigtail catheter was then advanced successfully over a 0.014″ Whisper wire across the stenotic origin of the LCA anastomosis. Selective angiogram showed external compression of LCA origin. Wire was positioned into distal LAD and angioplasty was performed using a sprinter 2.5 × 12 mm balloon. Post-angioplasty angiography showed excellent flow into the LCA with no residual stenosis. Patient was ECMO decannulated within 2 days, then discharged 3 weeks later. Follow-up echocardiogram at 5 months shows antegrade flow into coronary arteries and 30% LV Fractional Shortening. Discussion: Coronary intervention is uncommon and challenging in infants and newborns. It is a viable alternative to be considered in setting of coronary obstruction. It remains technically difficult in small children due to its rarity, nature of the anatomy and the lack of dedicated PCI material.

ETHICS DECLARATIONS

Conflict of Interest: The authors declare they do not have any conflict of interests.

Ethical Approval: Not applicable.

Consent for Publication: Yes.

037. Simulated Transcatheter Intervention on 3D-printed Prototypes as Multimodal Strategic Planning for Complex Structural Heart Disease Repair. A Novel and Emerging Joint Program in a Biomedical Engineering Research Center to Support Cardiovascular Surgery Programs that Improve the Strategic Planning of Endovascular Repair of Complex Congenital Heart Disease

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Structural heart disease can be primary congenital lesions or acquired as part of late post-surgical or degenerative sequelae. In pediatric and early adulthood, the highest incidence is found by pathologies that compromise the flow of the pulmonary circuit and implicitly bring RVOT dysfunction. The percutaneous implantation of biological valves is increasingly used in patients with primary RVOT or post-surgical residual dysfunction due to the use of prosthetic material. There are a large number of anatomical variations that lead to the appearance of these obstructive or incompetent lesions. A correct selection of the size of the new prosthesis is required for its subsequent approximation, positioning, anchorage, and impaction, and the anatomical precision of the RVOT is essential. 3D model printing is a prototyping technology that provides the possibility of producing tangible replicas of the geometry of a specific organ, reconstructed from three-dimensional diagnostic images. Hands-On Training, also known as experiential learning, is in other words the act of learning by doing and reproducing. Among the multiple applications of 3D printing in cardiology, there are the positioning tests of devices prior to the procedure. It is intended to make a comparative account and analysis with the world literature of the first experiences in Colombia of the use of this sequential strategy. A joint program was started in a biomedical engineering research center to support 4 cardiovascular surgery programs to improve the strategic planning of endovascular repair of complex congenital heart disease. Materials and Methods: We present our first three cases of patients with a history of complex trunk heart disease with multiple surgical corrections and late RVOT dysfunction. Considering the complexity of a new surgical approach and the difficulty in its post-surgical anatomy, it was decided to acquire digital CT angio images with volumetric reconstruction and digital impression of a 3-dimensional prototype and carry out a simulation under fluoroscopy and cineangiography, defining the minimum details. of the anchorage zone and the selection of the diameter of the materials and supplies as well as their sequence of approach and subsequent impact on the prototype. RESULTS: The patients were finally taken to the planned procedures with successful results. The information obtained by printing prototypes and models acquired from volumetric CT images was definitive in the strategic

planning of the approach and sequencing of the procedure as well as in the selection of the material used. Conclusions: The use of 3D-printed models resulted in a more precise selection of materials and operational strategies. By using the technological simulation strategy, it is possible to foresee the therapeutic approach sequence and to avoid and correct probable errors. The development of a prototyping program with 3D models has the potential to improve the results of endovascular and complementary surgical repair in complex CHD.

ETHICS DECLARATIONS

Conflict of Interest: The authors declare they do not have any conflict of interests.

Ethical Approval: Not applicable.

Consent for Publication: Not applicable.

038. Surgically Placed Sapien S3 Valve Followed by Intraoperative Balloon Valvuloplasty in 2 Patients with Multi-valvar Disease Operation

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Hybrid approaches in patients with congenital heart disease (CHD) have emerged as methods to combine cardiac surgery and cardiac catheterization to achieve less invasive option and better outcomes. Typically, these cases are performed in an off-CBP (cardiopulmonary bypass) setting and most commonly in the catheterization laboratory. In the following two cases, we present a different kind of Hybrid approach where patients are already in the operating room and on CPB. Our patients have very complex congenital heart disease including multi-valvar failure requiring a very high risk and extensive operation. In this case series we are presenting the use of a transcatheter designed valve that was placed in two different positions (pulmonic and tricuspid) after being prepped by the interventionist. The valves were only partially inflated to facilitate placement by the surgeon, followed by limited and carefully conducted suturing in place for stability. Finally balloon valvuloplasty took place to achieve the desired size for the valve. Although the need for such approach will be rare, it is an option to be considered in certain cases where anatomy and surgical field deemed to be inadequate for the classic surgical valve placement. Case 1: 14 years old with complete AV canal defect and TOF, S/P multiple operations including insertion of a BT shunt followed by a complete repair, followed by the left ventricular outflow tract tissue resection for obstruction as well as a pulmonary valve insertion using a 21 Hancock valve. Preoperative evaluation demonstrated a dilated aortic root with severe aortic insufficiency through a quadricuspid aortic valve, severe left ventricular outflow tract obstruction caused by a complex mechanism including a fibromuscular tissue as well as accessory chordae connecting the left atrioventricular valve to the ventricular septum. In addition, the pulmonic bioprosthetic valve has severe stenosis. As a result, he required surgical intervention including an aortic valve replacement, left ventricular outflow tract obstruction relief and finally pulmonary valve replacement. Case 2: A 41-year-old female with history significant for pulmonary atresia and ventricular septal defect who underwent multiple previous cardiac operations including a Blalock-Taussig shunt, a complete repair, several pulmonary valve replacements, and homograft insertions. She also had tricuspid valve replacement as well as maze operation and insertion of a pacemaker. For the last 2 months before surgery the patient has been treated for severe endocarditis involving the bioprosthetic tricuspid pulmonary valves with extensive vegetation in the main pulmonary artery and extended into the right pulmonary artery. She failed medical therapy and she also underwent attempted transcatheter removal of the vegetations and thrombus material in the right PA with no significant benefit. Therefore, it was decided to proceed with very high-risk salvage surgery due to the comorbidities and number of previous sternotomies and severity of the clinical picture involving extensive endocarditis.

ETHICS DECLARATIONS

Conflict of Interest: The authors declare they do not have any conflict of interests.

Ethical Approval: Not applicable.

Consent for Publication: Not applicable.

039. Partially Open Stent After Balloon Catheter Iatrogenic Perforation. How to Solve This Complication Using a Novel Technique? The Mij-Her Technique

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Complications related to pulmonary artery stenting are potentially life threatening. We reported a novel technique of how to achieve the introduction of a partial dilated stent into a long sheath using a snare in the event of a iatrogenic perforation of a balloon catheter. There are no publications of similar techniques describing successful resolution of this type of complication.

ETHICS DECLARATIONS

Conflict of Interest: The authors declare they do not have any conflict of interests.

Ethical Approval: Not applicable.

Consent for Publication: Not applicable.

040. Ventricular Septal Defects Closed With Lifetech Konar Device; Our Short and Medium Term Results Of Multicenter Study

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Background: Ventricular septal defects (VSD) are one of the most common congenital heart defects. Newly developed devices allow transcatheter closure of large VSD. The multicenter study aimed to share early findings in patients with VSD whose defects were closed with transcatheter method and Konar-Multifunctional Occluder (MFO). Methods: Between November 2018 and April 2022, a total of 40 patients, 5 of whom were less than 24 months old, underwent VSD closure with MFO device. The median age of the patients was 5.9 years (4.5 months-17 years). 32 patients had perimembranous, 6 patients had mid-muscular, and 2 patients had apical-muscular VSD. Mean QP / Qs: 1.82 ± SD (1.56-2.2), mean right side orifice diameter of the defect was 4.7 mm ± SD (3-8) and mean left side orifice diameter was 6.8 mm ± SD (4-11). 30 of the patients were closed by antegrade route and 10 of them closed by retrograde route. The largest

device used was 14 × 12 mm, and the smallest device was 5 × 3 mm. Considering all cases, the procedure success rate was calculated as 100%. There was no complication observed. A patient whose VSD was closed with ADO-II but embolized previously, was successfully closed with MFO. Our average follow-up time is 712 days ± SD (30-1056). No major complications were observed. Minor complications were as follows: A residual VSD continued in one patient, a hematoma in the femoral region in one patient, and a temporary minor rhythm disorder in 3 patients. Results: Closure of both congenital and residual VSDs can be effectively performed in patients with transcatheter method using LifeTech MF-Konar devices. Compared to other devices, its more flexible and lightweight structure, antegrade, and retrograde bi-directional usage in patients with larger VSD and safety use even in low-weight infant provide significant advantages. **Conclusion** Perimembranous and muscular VSD can be successfully closed by transcatheter method in pediatric patients with Lifetech Konar MFO device. The device's design, flexibility, and two-way availability, which ensure high compatibility with septal defects, stand out as important advantages. In addition, its use at an early age and at low weight makes a difference compared to other devices. More patients will support these findings in new studies involving long-term outcomes.

Keywords: Konar, MFO, VSD closure, Transcatheter Intervention, Congenital heart disease

ETHICS DECLARATIONS

Conflict of Interest: The authors declare they do not have any conflict of interests.

Ethical Approval: Not applicable.

Consent for Publication: Not applicable.

041. Neurodevelopmental Outcomes are Better in Congenital Heart Disease Patients who Undergo Patent Ductus Arteriosus Stenting for Initial Palliation Compared to Those who Receive a Blalock-Taussig-Thomas Shunt

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Background: Patent Ductus Arteriosus (PDA) stenting is a non-surgical palliative alternative for infants with ductal-dependent congenital heart disease (CHD). Although mortality and rates of unplanned reinterventions were found to be similar in PDA stent versus Blalock-Taussig-Thomas (BTT) shunt palliation, the PDA stent group had shorter intensive care unit (ICU) length of stay, reduced procedural complications, and larger pulmonary arterial size [1]. Besides reduction in morbidity and mortality, increasing emphasis is being placed on understanding long-term outcomes in patients with CHD including maximization of their neurodevelopmental potential [2–4]. In this single-center study, we compare neurodevelopmental outcomes in infants who underwent BTT shunt as initial palliation versus PDA stenting. Methods: Retrospective chart review from 2013-2021 for any patient who underwent PDA stenting or BTT shunt placement at Rady Children's Hospital. Bayley Scales of Infant and Toddler Development Screening Test, Third Edition" (Bayley-III) reports were collected for both groups. Only patients from both groups who had received a complete Bayley-III assessment during the above time period were included in this study. Statistical analysis was performed using RStudio version 4.0.4. Results: A total of 27 patients had complete Bayley-III assessments by the age of 12 months, of which 12 (44%) underwent BTT shunt placement and 15 (56%) PDA stenting. Comparing the 2 cohorts, more patients who underwent PDA stenting were found to be developmentally appropriate in most domains assessed, including cognitive (67% vs 58%, p = 1), expressive language (53% vs 25%, p = 0.3), fine motor (67% vs 42%, p = 0.4) and gross motor (53% vs 17%, p = 0.1). BTT shunts did perform better in receptive language (83% vs 67%, p = 0.6). A similar performance pattern was observed when patients with genetic syndromes known to affect neurodevelopment were excluded from the analysis; with fine motor skills nearing statistical significance (57% vs 18%, p = 0.06). **Conclusion** PDA stenting is associated with better neurodevelopmental outcomes in multiple domains as assessed by the Bayley-III test. Due to the small sample size of the cohort these values did not reach statistical significance but give a strong signal that PDA stenting is associated with better neurodevelopmental outcomes when compared to BTT placement. Factors such as avoidance of cardiopulmonary bypass, reduced length of stay in the intensive care unit or hospital could be contributing variables to this finding.

ETHICS DECLARATIONS

Conflict of Interest: The authors declare they do not have any conflict of interests.

Ethical Approval: Not applicable.

Consent for Publication: Not applicable.

042. Bronchial Stenting in Pediatric Patients with Congenital Heart and Tracheobronchial Disease

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Background: Tracheobronchial disease can lead to significant morbidity and mortality in infants with congenital heart disease. Bronchial stents provide a unique therapeutic option allowing for the advancement of care in these patients without the need for invasive surgery. A multi-disciplinary approach can be used to deploy these stents prophylactically or post-surgery leading to progression in care. We report our outcomes in patients with congenital heart and tracheobronchial disease who underwent bronchial stent placement. Methods: We reviewed all patients who presented between Feb 2019 and March 2022 with congenital heart and tracheobronchial disease who received a bronchial stent at our center. Results: Nine patients were identified of which 8 received the bare metal coronary stent (Integrity, Medtronic, Minneapolis, MN), and 1 received a Visipro EV3 stent. Median (IQR1–IQR3) age and weight at tracheobronchial intervention were 4.8 (3.4–8.7) kg and 2.6 (2.4–4.2) months respectively. 4/9 patients had identified genetic syndromes and 7/9 patients survived (1 died of sepsis and 1 from graft rejection post-heart transplant). Cardiac diagnosis is listed in Fig. 1. 7/9 had cardiac surgery and 2 had tracheoplasty done. Most patients had severe bronchomalacia with acute life threatening events requiring sedation and paralysis which improved immediately after bronchial stent placement. All patients required a single stent with a median fluoroscopy time of 7.2 (1.9–13) minutes. 4 patients have had their stent removed and 3 patients stents are still in place with a median time of stent therapy of 169 (38—313) days. Median follow-up in living patients since time of stent placement is 12 (5–24) months. Bronchoscopy post-stent removal demonstrated remodeling of the bronchus into a more round configuration. There were no bronchial stent erosion events and only 1 developed mild granulation tissue on surveillance bronchoscopy. **Conclusion** Bronchial stents have

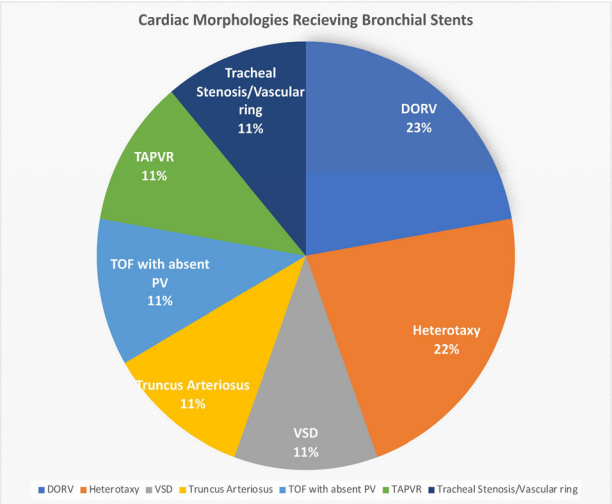
provided good clinical results and allowed for the advancement of care without erosion or complications in congenital cardiac patients.

ETHICS DECLARATIONS

Conflict of Interest: The authors declare they do not have any conflict of interests.

Ethical Approval: Not applicable.

Consent for Publication: Not applicable.



043. Mid-term Outcome of PULSTA New Self Expandable System for Percutaneous Pulmonary Valve Implantation in The Native Right Ventricular Outflow Tract Dysfunction in a Single Center

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Background: Percutaneous pulmonary valve implantation (PPVI) is a good treatment option for right ventricular outflow tract (RVOT) dysfunction. This study reports the clinical use in various morphology of RVOT and mid-term outcome of a novel transcatheter self-expandable pulmonary valve (Pulsta valve, Teawoong Medical Co, South Korea) in native RVOT dysfunction. Methods: A total of 43 patients who underwent PPVI with Pulsta valve in a single center from December 2017to May 2022 were retrospectively and prospectively enrolled. Patients' demographics and pre-procedural, intra-procedural, and short and mid-term follow-up data were collected and analyzed. Results: The most of patients were female (n = 27, 63%), with a mean age of 27.0 ± 9.1 years (range: 12-61 years) and a mean weight 61.0 ± 14.8 kg (range: 39.6–90.5 kg). 38 of 43 Patients showed moderate to severe PR, with a mean PR fraction derived cardiac MRI of 40.7 ± 9.9% (range: 23.0–63.0). The procedure success rate was 97.6% with a mean fluoroscopy time of 25.0 ± 10.8 min and mean procedure time of 103.2 ± 22.0 min. Valve sizes used were 26 (n = 3), 28 (n = 13), 30 (n = 7), 32 (n = 15), and 33.5 (n = 5). Procedural complications were arrhythmia requiring treatment (n = 2), delivery catheter associated complication (n = 1), device embolization (n = 1). 1-year follow-up cardiac MRI showed a decreased pulmonary regurgitation (PR) fraction (14.5 ± 8.4%) and that the right ventricular end-diastolic volume index decreased from 153.2 ± 27.7 to 120.3 ± 20.6 mL/m^2, the right ventricular end-systolic volume index decreased from 81.3 ± 24.0 to 62.4 ± 15.6 mL/m^2. After PPVI, NYHA functional class of patients improved to class 1 in most of patients overtime. There was no significant PR and PS overtime. There was no mortality, or re-intervention during follow-up. And no patients had more than mild PR and paravalvular leakage. Conclusions: PULSTA valve provides excellent short and mid-term outcomes in patients with the various morphology of RVOT and special situation in high-risk patients.

ETHICS DECLARATIONS

Conflict of Interest: The authors declare they do not have any conflict of interests.

Ethical Approval: Not applicable.

Consent for Publication: Not applicable.

044. Percutaneous Closure of a Ruptured Sinus of Valsalva Aneurysm Using the Amplatzer Duct Occluder I. 10-year Long-Term Follow-Up

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Introduction Rupture of a sinus of valsalva aneurysm (S.O.V.A.) is rare and of variable causes. Congenital or acquired, being secondary to infections or connective tissue diseases. In the congenital presentation, the most common site is the right coronary sinus, followed by the non-coronary sinus, draining into the right ventricle or right atrium, with clinical picture ranging from asymptomatic murmur to varying degrees of heart failure and shock. Aortic sinus aneurysmal dilation occurs more commonly in the right aortic sinus (70%-80%), compared to the noncoronary sinus (23%-25%), and more rarely the left coronary sinus (5%). Diagnosis is made by transthoracic echocardiography with careful interpretation of color Doppler images. Can be approached surgically or percutaneously. Objective: Report the percutaneous occlusion of a ruptured sinus of valsalva aneurysm, in the region of the right coronary sinus draining to the right atrium, with "Amplatzer" A.D.O.I (A.G.A.) prosthesis closure and a 10-year long-term follow-up. Material and **Method:** A 20-year-old female patient, weighing 60 kg, with Down Syndrome, developed a continuous murmur in aortic focus with clinical signs of aortic insufficiency and need for anticongestive medication. Under general anesthesia and with transesophageal echocardiography, right femoral artery and vein punctured, full heparinization, using a retrograde arterial route, we crossed the aneurysm region from the aorta to the R.A., placing an exchange guide in the inferior vena cava that was looped through the venous route, establishing an arteriovenous loop. A 7F long sheath is advanced over the exchange guide, intravenously, and an Amplatzer ADO I number 12/10 (A.G.A.) prosthesis is released. No change in aortic valve function. Early discharge within 24 h. Initial review 1 week, steel residual shunt. One month review no residual shunt, 3 and six months and subsequent annual clinical visit an echocardiogram. Discussion: The sinus of Valsalva aneurysm, first published case in 1831, the rupture published in 1840. Aneurysm occurs in 1% a 3% of congenital heart diseases, five times more prevalent in Asian population, three times more frequent in males. It occurs in association with other congenital defects, ventricular sept defect the most common. Rupture is a less common event. Usually, the lesion remains silent until the rupture, when the clinical picture varies according to the course and the drainage site. Surgical repair of ruptured SOV

aneurysm was first reported in1957 by Lillehei et al. and in 1965 by Shumacker et al. Direct suture closure of the defect, patch closure, or a combination of the two methods has been described. Transcatheter closure technique of ruptured aneurism has emerged as an alternative to surgical treatment. The percutaneous approach was first reported in 1994 by Cullen et al. using a Rashkind umbrella. The Amplatzer duct occluder was introduced by Hijazi in 2003. Surgical treatment is well established but few studies demonstrate the efficacy of the percutaneous approach in the long-term. The percutaneous technique reduces the incidence of complications. Ten-year long-term follow-up shows no progression of the dilation, the occlusion remains effective and no change in the aortic leaflets has emerged.

ETHICS DECLARATIONS

Conflict of Interest: The authors declare they do not have any conflict of interests.

Ethical Approval: Not applicable.

Consent for Publication: Not applicable.

045. Echocardiographic Assessment of Left Ventricular Ejection Fraction Recovery After Primary Percutaneous Coronary Intervention in Patients Under 40 Years of Age

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Background/Objectives: The main aim of primary percutaneous coronary intervention (PCI) in patients with ST-elevation myocardial infarction (STEMI) is to rejuvenate blood flow of the infarct-pertinent artery, and to protect myocardium from further damage. As LVEF helps to assess myocardial systolic function. The purpose of the study was to evaluate LVEF recovery in post-primary PCI patients under the age of 40 years. Methods and Material: This observational study was conducted on 104 patients at the Hyderabad Satellite Center of National Institute of Cardiovascular Disease (NICVD), Pakistan. STEMI patients of both genders, between 18 to 40 years of age, and those who underwent coronary angiography were included in this study. LVEF of post-PPCI patients were assessed at admission, 40 and 90 days post-primary PCI. The McNemar-Bowker Test was conducted to assess the variations in the distribution of LVEF at 40 and 90-days as compared to the baseline. Results: A total of 104 patients were included in this study. The mean age of patients was 34.84 ± 4.82 years. The most common risk factors were hypertension 38.5% (40) and smoking 18.3% (19). At 6 weeks 18.3% Patient's ejection fraction was 40 to 50%. At 90 days 23.1% ejection fraction was at 40 to 50%. Maximum improvement in EF was seen in patients who timely underwent PPCI. **Conclusion** A significant improvement in LV ejection fraction was observed in young STEMI patients after 40- and 90-days of primary PCI. Timely intervention by primary PCI not only preserve LV function at baseline but also associated with better improvement at short-term follow-up in premature STEMI patients.

ETHICS DECLARATIONS

Conflict of Interest: The authors declare they do not have any conflict of interests.

Ethical Approval: Not applicable.

Consent for Publication: Not applicable.

046. Closure of a Residual Ventricular Septal Defect with a Konar-MF™ VSD Occluder in a Patient After Atrial Switch Mustard Palliation

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We present a 36-year-old man after palliation according to Mustard at the age of 1.5 years including closure of a ventricular septal defect (VSD). A residual VSD remained, but was hemodynamically insignificant. As his systemic right ventricular function slowly and progressively declined, he receives heart failure medication. An ICD was implanted as a primary prophylaxis after induction of sustained ventricular tachycardia 11 years ago. He suffered from endocarditis affecting his regurgitant tricuspid valve and the ICD lead, which were extracted. After completion of intravenous antibiotics, obstruction of the superior baffle was noted. Therefore, before reimplantation of the ICD, interventional implantation of a stent in the superior baffle stenosis and closure of the residual VSD was intended. He underwent catheterization under general anesthesia, venous access via the right femoral and jugular veins, as well as the right femoral artery was obtain. A full dose of heparin was administered. First, baffle obstruction was treated by implantation of a 45-mm-long covered CP-stent, which was redilated with a high-pressure Mullins balloon without a residual gradient or narrowing. Then, under transesophageal echocardiographic (TEE) guidance, the VSD, close to the pulmonary valve, could be engaged with a Terumo glide wire via a regular 5F Judkins coronary catheter, retrogradely. As the retrograde approach was preferred in this anatomy and the rim to the pulmonary valve was small, a Konar-MFTM VSD Occluder (Lifetech), which can be implanted from both sides, was chosen for implant. The VSD measured 4 mm by TEE and a Konar-MFTM VSD Occluder (LT-MFO-7-5, 5-7 mm waist) was chosen, which could be implanted without problems by TEE guidance via a low-profile 5F guiding catheter. The device could be delivered in good position, without increase in pulmonary or other valve insufficiency, but with a residual shunt under heparin. Subsequently, the ICD was implanted and 2 weeks after the procedure, no residual shunt through the VSD could be documented. In conclusion, the Konar-MFTM VSD Occluder is a good alternative for VSD closure in complex anatomies for its soft asymmetric structure, low profile and the possibility by its double sided screw to implant it via a retrograde or antegrade aortic approach.

ETHICS DECLARATIONS

Conflict of Interest: The authors declare they do not have any conflict of interests.

Ethical Approval: Not applicable.

Consent for Publication: Not applicable.

047. My Nightmare Case in the Cath Lab: Sapien3 Valve Detached from Shaft During Percutaneous Pulmonary Valve Implantation

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We describe a challenging case of percutaneous pulmonary valve implantation in a five-year-old, 16.7 kg girl, with history of Tetralogy of Fallot, Pulmonary Atresia, who developed symptoms due to

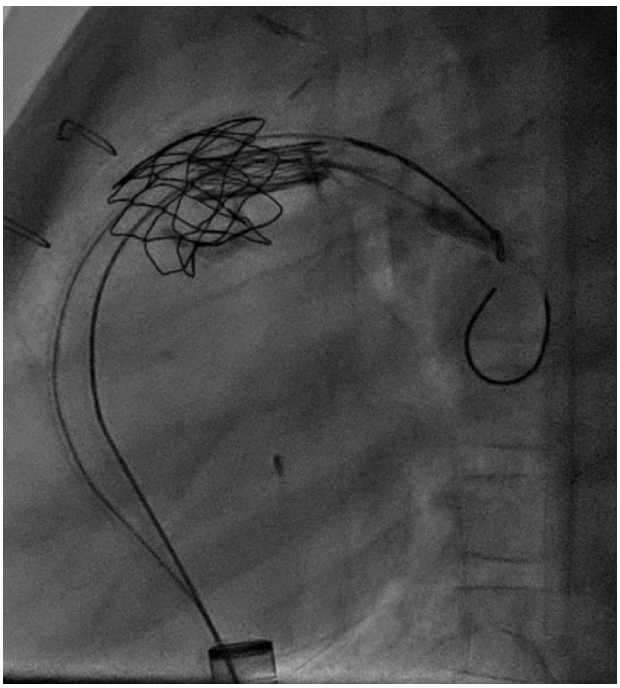
homograft dysfunction and severe right ventricular dilation and dysfunction. Due to a history of four previous heart surgeries, the child was referred for percutaneous pulmonary valve implantation. Vascular ultrasound showed a large femoral vein, however it was decided to implant the valve using the expandable Edward's 14Fr sheath (eSheath) to avoid vascular injury. Attempts to advance the valve to the right ventricular outflow tract required multiple maneuvers, and when the valve was finally positioned in the pulmonary artery, it appeared that the balloon on which the valve had been crimped had burst. Attempts to dilate the balloon revealed that the delivery system was no longer intact, with the pusher and sheath having come apart from the valve crimped on the balloon. The eSheath and pusher were removed and replaced with a 26Fr Gore® DrySeal sheath, while maintaining the balloon and valve on the Lunderquist® wire in the pulmonary artery. A 15 mm Amplatz Gooseneck snare (ev3) was advanced next to the stranded balloon-valve component, and the wire and carrot were snared and pulled into the sheath and removed from the body. After ascertaining that the child was well, a 26Fr Gore® DrySeal sheath was inserted in the other femoral vein and a 20 mm Sapien3 valve was successfully implanted in the pulmonary artery with good result. The child is well, and her pre-procedure symptoms have resolved.

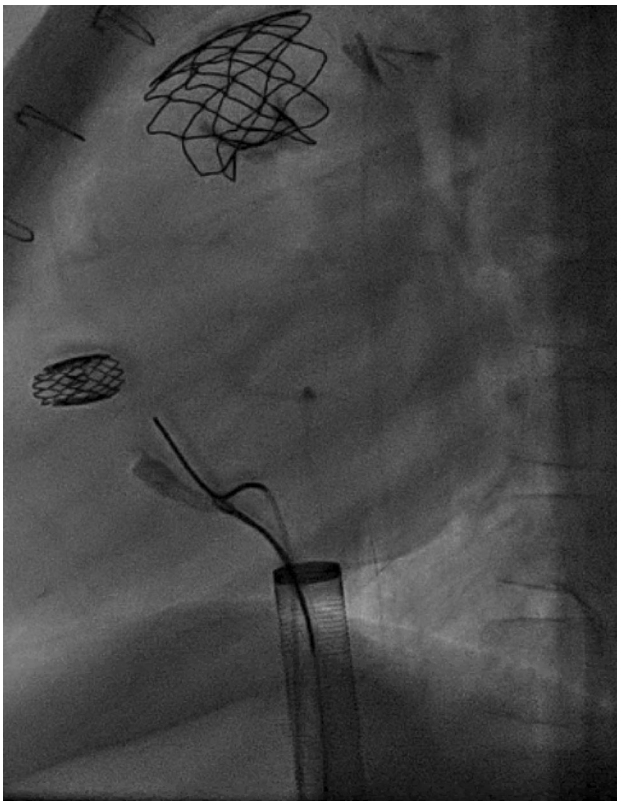
ETHICS DECLARATIONS

Conflict of Interest: The authors declare they do not have any conflict of interests.

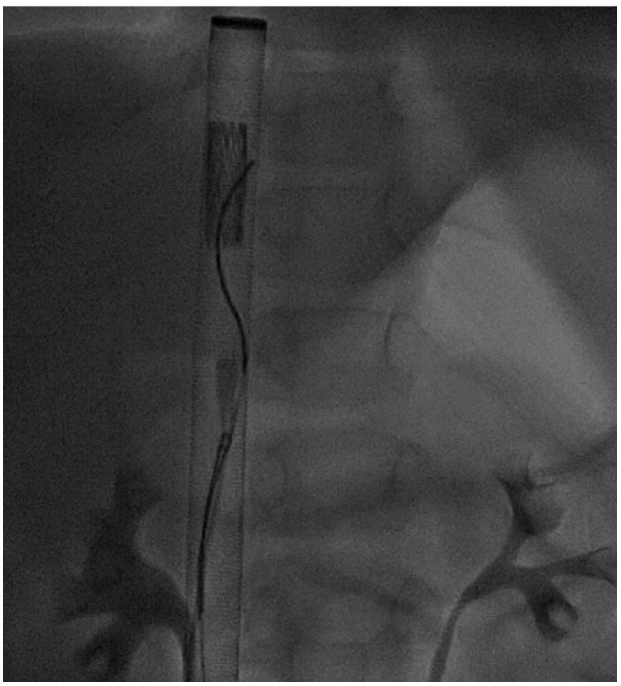
Ethical Approval: Not applicable.

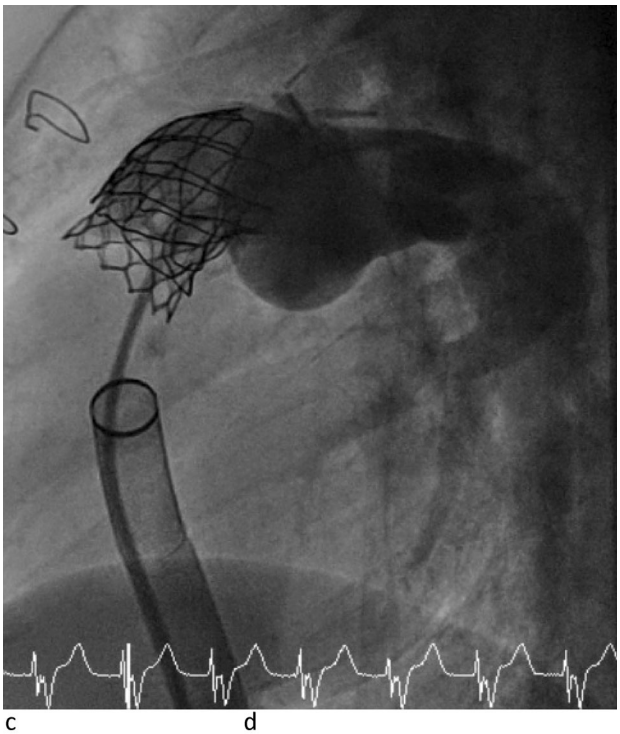
Consent for Publication: Not applicable.



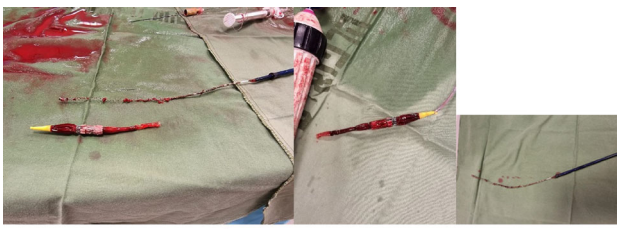


a b





a Carrot & wire snared
b Valve pulled into 26Fr sheath
c Valve removed from body
d Final result



a Pusher detached from valve-on balloon component
b Valve-on-balloon with broken shaft
c Dismantled pusher

048. Pulmonary Artery Stenting in Small Children Using Novel Low Profile Stent with High Potential for Successive Dilation

Sharon Borik[1,2], **Ihab Khatib**[1], **Uriel Katz**[1,2]

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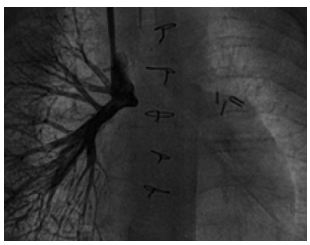
Background: Pulmonary artery stenting in small children and babies is often avoided due to the uncertainty of future ability to dilate the stented pulmonary artery to adult size. However, in many cases stenting is the best clinical option for a critically ill child. We describe a novel flexible, cobalt-chromium, pre-mounted, low-profile balloon-expandable TalonTM stent (Intelligent Kinetics, Qualimed, Q3 Medical Group, Winsen, Germany) with easy maneuverability and deployment in the pulmonary arteries and excellent potential for future expansion to adult size. Methods: Prior to implantation in the pulmonary arteries, the stent was checked on the bench to assess potential for post-dilation and intentional fracture. The medical charts, angiographic imaging, and hemodynamic data of the first ten cases of children weighing below 15 kg who underwent pulmonary artery stenting with the TalonTM stent were reviewed. Results were assessed using the SPSS® statistical analysis software. Results: Ten children with complex congenital heart disease underwent pulmonary artery stenting with the TalonTM stent, four with biventricular physiology and six in the process of single-ventricle palliation. One child was weaned from ECMO following successful stent implantation. Median(range) patient age was 1.6 years (23 days-6.2 years), and median(range) weight 10.3 (2.5-15) kg. All stents were implanted through 5Fr (0.18"platform) or 6FR (0.35" platform) sheaths, successfully increasing stenotic pulmonary artery diameter from 3.6 ± 1.2 mm to 6.0 ± 1.1 mm ($p = 0.0001$), and all pulmonary arteries are widely patent an average of $10(\pm 4)$ months of follow-up after the stenting procedure. Three stents have been post-dilated with high pressure balloons and current diameters are 160% the initial stenotic diameter ($p = 0.04$), supporting bench findings of potential for 240% post-dilation capability and possibility for future cracking at 14 atmospheres to 300% diameter. Conclusions: The TalonTM stent is an excellent new option for pulmonary artery stenting in children with complex congenital heart disease. The stent is easily implanted and offers excellent immediate and short-term outcomes. Early post-dilation results support initial bench findings of excellent potential for pulmonary artery rehabilitation through gradual stent dilation and subsequent intentional fracture and restenting in the future.

ETHICS DECLARATIONS

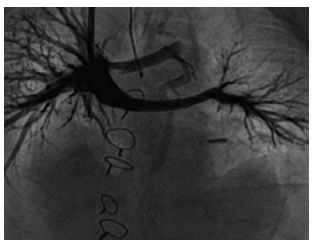
Conflict of Interest: The authors declare they do not have any conflict of interests.

Ethical Approval: Not applicable.

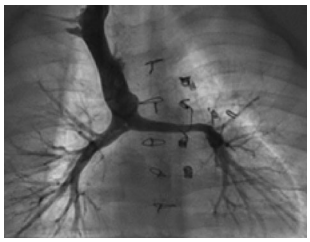
Consent for Publication: Not applicable.



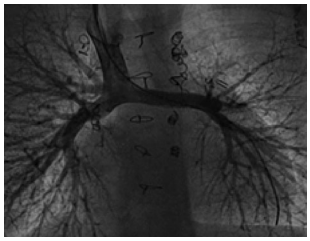
Occluded LPA after Glenn procedure in a child with Hypoplastic Letf Heart Syndrome



LPA after recanalization, dilation and thrombolysis



Restenosis requiring LPA dilation & stenting with 5*26 mm TalonTM stent



LPA stent redilated with 6 mm MustangTM balloon

Talon 5 mm stent partly postdilated with 12 mm balloon, in pre-implantation testing

TalonTM stent subsequently dilated and fractured with 16 mm AtlasTM balloon

049. Aortic Valve Endocarditis Post-Ventricular Septal Defect Device Closure: Case Report

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[1]Minia University, El Minya, Egypt

Objective: Ventricular septal defect (VSD) is a common congenital heart disease (CHD) in childhood, and its incidence is about 20% of CHD. Surgical closure or repair is safe with acceptable results. Transcatheter VSD closure offers excellent results. Coil system is developed for transcatheter VSD occlusion. Infective endocarditis (IE) post-device implantation is very rare, however it is possible. IE represents a surgical challenge associated with perioperative mortality (1). Methods: Post-VSD device closure is a source of infection which is extended to aortic valve. Emergency case of infective endocarditis post-VSD device closure, removal of device and surgical closure of VSD with pericardial patch. Also, aortic valve replaced by bioprosthetic valve as result of IE with removal all infected tissue. **Result:** excellent result without mortality or morbidity following IE post-VSD device closure. **Conclusion** In spite of VSD device closure is safe and less invasive than surgery, infection of device and its extension to other structure like aortic valve leading to emergency surgical intervention with its complications.

ETHICS DECLARATIONS

Conflict of Interest: The authors declare they do not have any conflict of interests.

Ethical Approval: Not applicable.

Consent for Publication: Not applicable.

050. Double Barrel Stent Side-Cell Crush Technique for Pulmonary Vein Rehabilitation

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[1]Ann & Robert H. Lurie Children's Hospital of Chicago, Chicago, USA

Primary pulmonary vein stenosis (PVS) is a severe and unrelenting disease often characterized by the development of multi-vessel obstruction. As disease extends to previously healthy sites over time, treatment is obligatorily piecemeal and we commonly encounter de novo lesions developing near a pre-existing stent. This is a particular challenge in patients with pulmonary vein anatomic subtypes involving common or adjacent venoatrial connections. In such cases any intervention on the new lesion runs the risk of damaging the previously placed stent and obstructing flow. To address this challenge, we have placed double barrel stents in a series of patients (A). The second stent is deployed while a balloon is inflated within the first stent, thus ensuring patency of both vessels. This yields immediately satisfactory results but with subsequent interventions it can be technically challenging to canalize the true central lumen of both stents. To mitigate this problem, we have modified the side-cell crush technique commonly used in percutaneous coronary artery interventions. Using a steerable sheath, a guidewire is placed through the central lumen of the stent with greatest potential diameter (S1), in this case the LLPV (B). Next, using a buddy wire and microcatheter system the side-cells of both stents are crossed and distal wire position established through the second stent (S2). Starting with a 2 mm coronary balloon the side-cells are dilated to the target diameter appropriate for upper vein rehabilitation (C). Leaving the upper wire in position a second balloon is advanced into the lower vein, which is then rehabilitated as indicated, in this case disease had progressed and an additional stent was placed in the left lower pulmonary vein. Finally, to create a common origin at the venoatrial junction, both balloons are aligned with the proximal edge of the stents and simultaneously inflated to effectively crush the proximal portion of S2 and dilate the proximal portion of S1 to create a circumferentially stented "Y" at the vein bifurcation (D). Retrograde pulmonary vein angiogram demonstrates patency of both vessels and a single functional orifice relative to the left atrium (E). The final position of each stent is illustrated in image (F). Stents are an essential tool in the treatment of PVS but they have several well-known limitations. As illustrated in this case, disease progression is unpredictable and

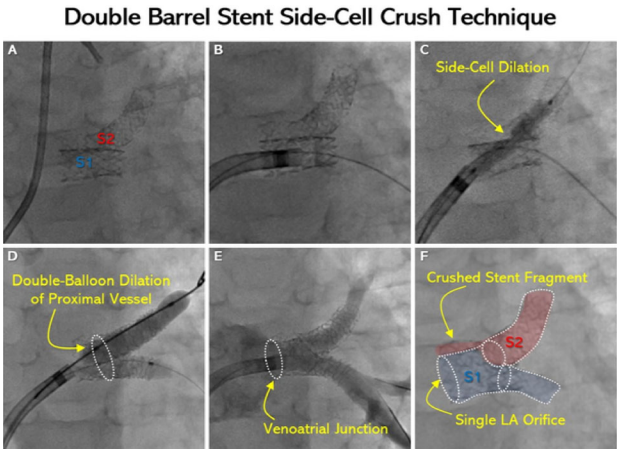
previously placed stents can render future interventions more challenging. The side-cell crush technique can be invaluable in simplifying pulmonary vein access in the setting of double barrel pulmonary vein stents.

ETHICS DECLARATIONS

Conflict of Interest: The authors declare they do not have any conflict of interests.

Ethical Approval: Not applicable.

Consent for Publication: Consent granted.



051. Hepatic Venous Access Site Closure Using the VASCADE Vascular Closure System Following Cardiac Catheterization in a Pediatric Patient with Femoral Vein Occlusion

Lindsay Eilers[1], Miguel Montero[2], Gary Stapleton[1]

[1]Baylor College of Medicine, Houston, USA. [2]Houston Methodist Hospital, Houston, USA

Background: Hepatic venous access is specialized technique used to perform cardiac catheterization in pediatric patients with congenital heart disease who have developed occlusion of major systemic veins. Bleeding events are the most commonly reported complication following hepatic access. Various methods for closure of the hepatic tract have been deployed to achieve hemostasis after sheath withdrawal. The VASCADE Vascular Closure System (VCS) (Cardiva Medical Inc. Santa Barbara, CA) is an approved device for closure of venous and arterial access tracts in patients > 18 years of age. To date, use of this device has not been described in pediatric patients or for closure of a transhepatic access tract. We report the use of the VCS in a pediatric patient following cardiac catheterization using hepatic venous access. Case: A 2-year-old patient with multiple pulmonary vein stenosis developed bilateral femoral vein occlusion following repeated intervention in the cardiac catheterization lab for pulmonary vein stent implantation and serial balloon angioplasty. The patient was brought to the cardiac catheterization laboratory for planned repeat pulmonary vein intervention. Using ultrasound guidance, a 6F Prelude sheath was placed in a hepatic vein. Heparin was given to maintain ACT > 250 throughout the procedure. Cardiac catheterization and balloon angioplasty of 3 pulmonary vein stents was performed as planned. After completion of the intervention, the VCS was inserted into the sheath and the collagen patch was deployed in the hepatic access tract under ultrasound guidance. Manual pressure was then applied for 5 min after withdrawal of the delivery system and venous sheath. Doppler ultrasound demonstrated closure of the hepatic tract. Abdominal girth was followed post-procedure with no change from baseline in the 12 h following the procedure. A repeat ultrasound the day after the procedure demonstrated no hematoma near the access tract and no intraabdominal fluid. The patient's hemoglobin remained stable, with no abdominal distension or irritability noted. **Conclusion** This is the first case reporting the use of the VCS to occlude a transhepatic access tract in a pediatric patient. Hemostasis was achieved and there was no evidence of bleeding during post-procedure observation. Further evaluation in a larger cohort of patients is needed to ensure the VCS is safe for use in select pediatric patients and provides adequate hemostasis following transhepatic access.

ETHICS DECLARATIONS

Conflict of Interest: The authors declare they do not have any conflict of interests.

Ethical Approval: Not applicable.

Consent for Publication: Not applicable.

052. Percutaneous Pulmonary Flow Restriction in Premature Infants with Hypoplastic Left Heart Syndrome

Matthew Warren[1], Ana Vasquez-Choy[1], Rakesh Donthula[1], Megan Childress[1], Matthew Brown[1], Kiran Mallula[1]

[1]University of Texas Health Science Center at Houston, Houston, USA

Background: The use of surgically placed external pulmonary artery bands has been a mainstay of treatment for limiting pulmonary blood flow in infants with congenital heart disease. Patients with prematurity or other comorbidities would benefit from a lesser invasive approach. Placement of internal pulmonary blood flow restrictors (PFR) via percutaneous approach has been described recently but its use has been limited. Methods: Three patients underwent percutaneous placement of bilateral PFRs. All were premature (34.6 ± 0.5 weeks), low birth weight (1.97 ± 0.02 kg) and had hypoplastic left heart syndrome with mitral and aortic atresia. Pulmonary overcirculation developed in the first few weeks of life, prompting this intervention at 6-14 days of life. Medtronic vascular plugs (MVP) were modified with a triangular fenestration in the Goretex covering the proximal cells, and were placed in the proximal branch pulmonary arteries under fluoroscopic and echocardiographic guidance. The mean proximal branch pulmonary artery diameter was 4.7 ± 0.4 mm angiographically, and in all cases MVP 7Q devices were selected. This allowed patients to reach 38 weeks corrected gestational age prior to surgical repair. Results: A total of 6 MVP 7Q devices were placed with no acute complications. Oxygen saturation was 94 ± 0.02% at baseline and decreased to 86 ± 0.08% after intervention. PaO2 was 52 ± 6.1 mm Hg at baseline and decreased to 42.7 ± 4 mmHg after the procedure. The peak Doppler gradient in the proximal right pulmonary artery (RPA) was 31 ± 6.8 mm hg and proximal left pulmonary artery (LPA) was 29.6 ± 6.8 mmHg immediately after the procedure. Prior to the Norwood procedure, the peak gradient increased to 49 ± 16.6 mmHg in the RPA and 50 ± 23.5 in the LPA. All patients underwent Norwood procedure after 5 (± 4.4) weeks after PFR placement. There was no residual branch pulmonary artery stenosis or difficulty extracting these devices. One patient developed Candida fungemia unrelated to the procedure. **Conclusion** Percutaneous placement of PFRs is a feasible, safe and lesser invasive alternative to external surgical PA bands for managing pulmonary over-circulation in premature infants as a bridge to Norwood procedure. More studies need to be done to determine the optimal procedural modification of the MVP devices as well as adequate timing for removal of these devices.

ETHICS DECLARATIONS

Conflict of Interest: The authors declare they do not have any conflict of interests.

Ethical Approval: Not applicable.

Consent for Publication: Not applicable.

0053. Echocardiography Guided Aortic and Pulmonary Valvuloplasty: Towards a Contrast Free Procedure

Conor O'Halloran[1], Nazia Husain[1], Nicholas Brown[1], Jeremy Fox[1], Sandhya Ramlogan[1], Alan Nugent[1], Paul Tannous[1]

[1]Lurie Children's Hospital, Chicago, USA

Background: Percutaneous balloon valvuloplasty is the preferred treatment in neonates and infants with clinically significant aortic or pulmonary valve stenosis. Traditionally, contrast angiography is used to measure the valve annulus and degree of regurgitation prior to valvuloplasty and again for interval reassessment. No amount of ionizing radiation is considered safe and there is growing appreciation that neonates and infants may be at risk for iodinated contrast-induced hypothyroidism. To mitigate these exposures, here we describe the implementation of trans-thoracic echocardiogram (TTE) guided aortic and pulmonary valvuloplasty protocols, and the effect of these protocols on contrast administration, radiation, and technical outcome. Methods: Patients < 10 kg undergoing percutaneous balloon valvuloplasty of the aortic (BAV) or pulmonary (BPV) valve were retrospectively investigated. TTE guided procedures began in 2019. In order to obtain sufficient control subjects aortic valvuloplasty from 2013 to present and pulmonary valvuloplasty from 2017 to present were analyzed. During the first stage of echocardiogram guided (EG) valvuloplasty real time TTE was utilized; angiography was performed to measure the valve annulus, but subsequent angiograms to assess valve regurgitation were omitted, with echocardiography used instead. During the second stage of program development angiography was omitted completely, with the valve annulus measured solely by TTE measurements, thus performing valvuloplasty without contrast administration. Technical success was defined as invasive gradient < 30 mmHg for BPV and as invasive gradient < 35 mmHg and mild or less AR by echocardiography for BAV. Outcomes were compared between traditional and EG-BV using multiple linear or logistic regression to control for valve (aortic vs pulmonary), patient weight, and pre-procedural PGE requirement. Results: A total of 68 patients undergoing valvuloplasty were analyzed, including the first 28 EG valvuloplasty patients (9 Aortic, 19 Pulmonary), and 40 historical controls (19 aortic, 21 pulmonary). Most recently, 11 BPV and 2 BAV procedures were performed without contrast administration. There was no difference between EG and traditional valvuloplasty with regards to age, weight, need for prostaglandin before valvuloplasty, baseline saturation, baseline valve regurgitation, annulus diameter, or initial invasive gradient (Table 1). Compared to angiographic annulus measurements, intraprocedural echocardiographic annulus measurements displayed excellent reliability (ICC 0.92, $p < 0.01$), in contrast to pre-procedural echocardiography, which displayed only moderate reliability (ICC 0.70, $p < 0.01$) (Fig. 1). After controlling for valve location (aortic vs pulmonary), patient weight, and pre-procedural PGE requirement, EG was associated with lower radiation (71 v 220 mGy·cm^2, $p = 0.03$) and lower contrast administration (0.5 v 2.0 ml/kg, $p < 0.01$). There was no difference in sheath time, final invasive gradient, change in regurgitation grade, technical success, serious adverse events, or 30-day reintervention rate. When comparing the 13 s stage procedures (EG, contrast free) and 15 first stage procedures (EG, single angiogram for valve annulus) there was no difference in any of the safety or efficacy outcome measures listed above, apart from lower contrast administration.

Conclusions: EG for balloon aortic valvuloplasty in neonates and infants significantly reduces contrast and radiation exposure, while maintaining safety and efficacy. After establishing interventionalist and echocardiographer experience and expertise, contrast free valvuloplasty can be performed safely.

ETHICS DECLARATIONS

Conflict of Interest: The authors declare they do not have any conflict of interests.

Ethical Approval: Reviewed by IRB, full waiver received.

Consent for Publication: Reviewed by IRB, full waiver received.

Table 1 Baseline characteristics of the cohort divided by the location of valvuloplasty and use of echocardiogram guidance

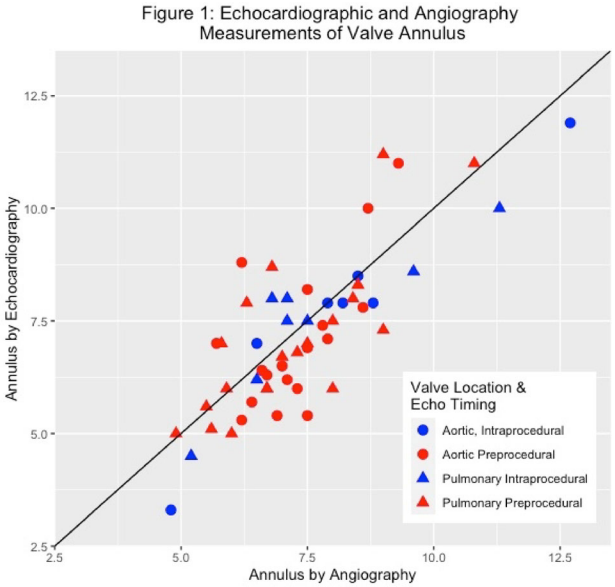
	Aortic Valvuloplasty			Pulmonary Valvuloplasty		
	Echocardiogram Guidance			Echocardiogram Guidance		
	No	Yes	p	No	Yes	p
n	19	9		21	19	
Age (Days)	46 [17, 68]	33 [12, 120]	0.83	48 [4, 135]	25 [2, 106]	0.61
Weight (kg)	4.4 [3.0, 5.1]	4.4 [3.2, 6.5]	0.79	3.7 [2.9, 5.9]	3.4 [3.2, 4.8]	0.96
Prostaglandin Use	3 (16%)	2 (22%)	1.00	7 (33%)	6 (32%)	1.00
Baseline Saturation (%)	99 [99, 100]	98 [98, 99]	0.12	98 [96, 99]	98 [93, 99]	0.35
Baseline Regurgitation (Echo)			0.61			0.49
None	10 (55%)	6 (67%)		3 (15%)	4 (22%)	
Trivial	3 (17%)	2 (22%)		9 (45%)	10 (56%)	
Mild	5 (28%)	1 (11%)		8 (40%)	4 (22%)	
Annulus by Echo (mm)	6.7 [6.1, 7.7]	7.9 [7.4, 8.5]	0.09	6.9 [6.0, 7.9]	7.9 [7.0, 8.5]	0.11
Initial Invasive Gradient (mmHg)	50 [43, 61]	61.00 [54, 70]	0.13	45 [32, 50]	45 [41, 56]	0.58

Table 2 Comparison of Outcomes between valvuloplasty

	Echocardiogram Guidance		p
	No	Yes	
n	40	28	
Fluoroscopy Time (Minutes)	12 [6, 9]	16 [9, 17]	0.01
Total Dose Area Product (mGy·cm^2)	220 [91, 325]	72 [34, 161]	0.03
Contrast (ml/kg)	2.0 [1.2, 3.4]	0.5 [0.0, 0.7]	< 0.01
Sheath Time (Minutes)	53 [43, 70]	48 [34, 81]	0.40
Balloons Used (n)	1 [1, 2]	2 [1, 2]	0.13
Final Invasive Gradient (mmHg)	17 [9, 19]	15 [10, 19]	0.54
Change in Regurgitation Grade by Echocardiography			0.42
− 1	2 (5%)	1 (4%)	
0	19 (52%)	17 (63%)	
+ 1	12 (32%)	7 (26%)	
+ 2	3 (8%)	2 (7%)	

Table 2 continued

	Echocardiogram Guidance		p
	No	Yes	
+ 3	1 (3%)	0 (0%)	
Technical success	37 (93%)	28 (100%)	1
Serious adverse events	3 (7%)	2 (7%)	0.59
Reintervention within 30 days	1 (2%)	1 (4%)	0.58



054. Trends and Outcomes of Different Stage One Palliative Procedures for Hypoplastic Left Heart Syndrome in the United States from 2003 to 2016: A Population-Based Analysis

Saif Aljemmali[1,2], Krishna Kishore Umapathi[2], Joshua Murphy[2]

[1]Children's Heart Center at Ascension St. Vincent, Indianapolis, USA. [2]Rush University Medical Center, Chicago, USA

Introduction

- About 1025 babies in the United States are born yearly with hypoplastic left heart syndrome (HLHS).
- Surgical management involves three stages of palliative procedures. Stage one palliation is typically performed during the neonatal period.
- Stage one palliation is currently consist of Norwood's procedure with either Blalock–Thomas–Taussig shunt (N/BTT) or right ventricle to pulmonary artery shunt (N/Sano), or the Hybrid procedure. The Hybrid procedure is performed without the use of cardiopulmonary bypass, mainly as an alternative procedure for high-risk neonates.
- There is limited data comparing the trends of the frequency and outcomes of these different procedures over the past two decades.

Methods

- This study aims to trend the frequency of the performance of different stage one palliative procedures and to trend in-hospital mortality and to compare in-hospital outcomes from 2003 to 2016.
- Data from National Inpatient Sample and Kids Inpatient Database were collected using ICD codes.
- Multiple logistic regression was used to estimate the risk of mortality, length of stay (LOS) and charges after adjustment for demographics and comorbidities including prematurity, total anomalous pulmonary venous return, congenital malformations, necrotizing enterocolitis, renal failure, stroke, seizure, cardiac arrest, cardiac tamponade, cardiogenic shock, arrhythmias, cardiopulmonary resuscitation, heart transplant, dialysis, mechanical ventilation, and tracheostomy.

Results

- A total of 8009 neonates with HLHS was included, in which 5786 had N/BTT, 1755 had N/Sano, and 468 had the Hybrid procedure.
- The trend of performance of N/Sano increased significantly with decreasing mortality trend as compared with N/BTT and the Hybrid group (Fig. 1).
- As compared to the hybrid group, there were reduced adjusted odd ratio (aOR) for mortality and an increase in length of stay (LOS) by 13 days for N/Sano (mortality aOR 0.4, $p < 0.001$, LOS + 13 days, $p < 0.001$) and N/BTT groups (mortality aOR 0.6, p 0.001, LOS + 13 days, $p < 0.001$).
- Increase in inflation-adjusted hospitalization charges across all stage one palliative procedures from 2003 to 2016. Hospitalization charges were higher with Norwood: N/Sano was $182,382 ($p < 0.002$) and for N/BTT ($p < 0.002$) was $162,193 higher compared to Hybrid group.

Conclusion

- N/Sano procedure has become increasingly favorable for HLHS patients with a declining mortality rate from 2003 to 2016.
- N/Sano group has an in-hospital length of stay similar to the N/BTT group.

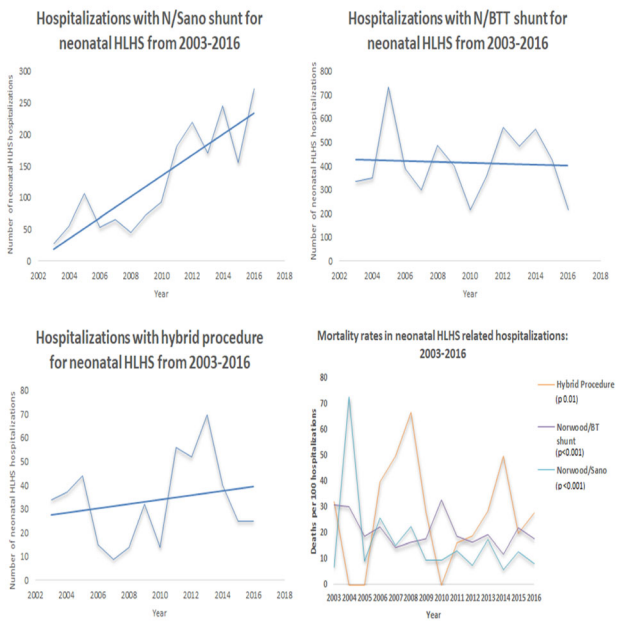
ETHICS DECLARATIONS

Conflict of Interest: The authors declare they do not have any conflict of interests.

Ethical Approval: Not applicable.

Consent for Publication: Not applicable.

Figure (1)



055. Hypoplastic Left Heart Syndrome Surveillance and Early Catheter Intervention Program May Improve Survival

Katherine Price[1], Srujan Ganta[1], John Artrip[1], Jessica Haley[1], Shylah Haldeman[1], Rachel Weber[1], John Nigro[1], Howaida El-Said[1]

[1]Rady Children's Hospital, UCSD, San Diego, USA

Background: Studies have shown that the hypoplastic left heart syndrome (HLHS) cohort are the highest risk single-ventricle patients with continuous attrition of transplant free survival 2–3 years post-Norwood procedure. There has been significant improvement in initial Norwood mortality over the past few decades but this remains a complex and resource intensive patient population. The aim of our study is to capture all HLHS patients that are at risk using an objective marker of risk and intervening early to improve overall and transplant free outcomes. Methods: Our institution initiated a focused HLHS surveillance committee and created a risk scoring system based on graded echocardiographic criteria (TR 0–3, Aortic Arch gradient 0–3 and Single ventricle function 0–2). A maximum score of 8 represents the highest risk category. Inclusion criteria were all HLHS patients at all stages and ages dating back 2 years until present who had at least 1 risk scored echo. A snapshot of their score was obtained every 6 months and this was used to track their progress as well as capture at risk patients and create a programmatic dashboard. Patients with a score ≥ 3 were referred for advanced imaging and early intervention. Results: 78 patients were identified for inclusion in our surveillance program of which 2 are in Stage 1, 17 are in Stage 2 and 54 are in stage 3. Current median age and weight for the entire cohort is 9.4 (4.4–15.6) years and 26.7 (15.5–47) kg. Survival was 95% (71/75) over the 2 year period with 3 mortalities and 1 transplant (Fig. 1). Mean (IQR1-IQR3) risk score over the 2 year period for the entire cohort was 2.30 (2.18–2.45). Over the entire study period 43% of patients had a mean risk score of $^{3}3$. During our final 6 month snap shot 22 patients decreased their risk score and 6 patients increased their risk score. Figure 2 illustrates risk score proportions during 6 month intervals. All patients with a score ≥ 4 had an intervention. 22% had referrals to the heart failure team for optimization and possible transplant consideration. 49 patients had catheter intervention. The interventions performed were closure of AP or VV collaterals, balloon coarctation or balloon dilation of branch PAs. For those with a high score (> 4), cath was done in 9 and improved the score in 89% by an average of -1.44 change in score, but those with a low score of < 1 had no improvement in score. **Conclusion** Patient surveillance utilizing an echo-based risk score system to identify and intervene in HLHS patients throughout their palliation pathway can improve decision making in this high-risk cohort. This objective approach can provide a bird's eye view of the different risk profiles of patients in a HLHS program and can hopefully lead to proactive intervention by heart teams and provide programmatic insights regarding quality of care for HLHS patients.

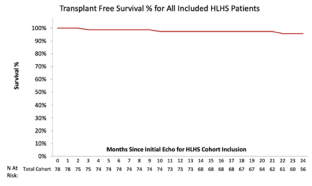
Conclusion Patient surveillance utilizing an echo-based risk score system to identify and intervene in HLHS patients throughout their palliation pathway can improve decision making in this high-risk cohort. This objective approach can provide a bird's eye view of the different risk profiles of patients in a HLHS program and can hopefully lead to proactive intervention by heart teams.

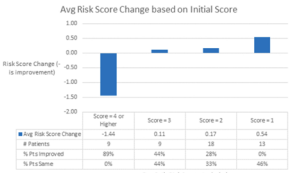
ETHICS DECLARATIONS

Conflict of Interest: The authors declare they do not have any conflict of interests.

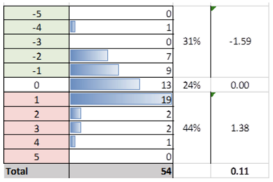
Ethical Approval: Not applicable.

Consent for Publication: Not applicable.





Cath Type #	Cath Type	Avg Score Change Pre/Post Cath: Score 4 or Higher	Score 3	Score 2	Score 1	Total: Score 1 or Higher	# Patients: Score 4 or Higher	Score 3	Score 2	Score 1	Total: Score 1 or Higher
1	Diagnostic Only	-1.00	-2.00	0.00	0.33	-0.20	1	1	5	3	10
2	Closing AP Collaterals	-1.67	0.50	0.00	0.57	0.08	3	6	9	7	25
3	Closing VV Collaterals	-2.00	1.00			-0.50	1	1			2
4	Balloon Coarctation	0.00				0.00	2				2
5	Balloon Branch PAs	-1.00	-1.00		0.50	-0.25	1	1		2	4
6	Other	-4.00		0.75	1.00	0.00	1		4	1	6
Grand Total		-1.44	0.11	0.17	0.54	-0.04	9	9	18	13	49



056. Comparative Transcatheter Treatment for Pulmonary Valve Stenosis: Multicenter Collaborative Study Across Pediatric and Veterinary Cardiology Centers

Lauren Markovic[1], Brian Scansen[2], Gurumurthy Hiremath[3], Heidi Kellihan[4], Amanda Coleman[1], Sonja Tjostheim[4], Caitlin Calkins[5], Katie Hodges[1], Erin Cahill[2], Brianne Tainter[3], Mary Carter[4], Dennis Kim[5,6]

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Background: The first balloon pulmonary valvuloplasty (BPV) was performed successfully in a dog in 1980, and reported in a child in 1982. Since this time, transcatheter therapeutics have revolutionized the ability to treat pulmonary valve stenosis (PS). Balloon pulmonary valvuloplasty is currently performed routinely in children and animals. This comparative interventional cardiology study is meant to enhance the understanding of PS and transcatheter therapies across human and animal species, while working to identify useful animal models of disease. Objective: To describe characteristics and outcomes of PS in patients that underwent BPV in pediatric and veterinary populations. Methods: Multicenter, retrospective review analyzing PS data of patients from two pediatric cardiology centers, and dogs from three veterinary cardiology centers between July 1, 2019 – June 30, 2021. Demographics, pre-procedural, procedural and post-procedural characteristics were collected. Data are presented in mean $\pm$ standard deviation, or median (interquartile range) when appropriate. Results: Balloon pulmonary valvuloplasty was performed in 78 humans and 165 dogs. Distribution of PS morphology (non-dysplastic, intermediate or dysplastic) differed between humans and dogs ($p < 0.0001$). There was a significant difference in the distribution of isolated PS and cases with concurrent subvalvar or supravalvar stenosis between groups ($p = 0.002$). Stenosis isolated to the valve, 64/78 (82%) human and 141/165 (86%) dogs, did not differ ($p = 0.50$). Presence of pulmonary annular hypoplasia did not differ amongst groups ($p = 0.17$). Initial transpulmonary pressure gradients obtained with echocardiography were significantly higher in dogs (canine 122 mmHg $\pm$ 39; human 70 mmHg $\pm$ 22) ($p < 0.0001$). Dogs were more likely to be receiving a beta blocker at intervention, 151/165 (92%), compared to humans 2/78 (3%) ($p < 0.0001$). Proportions of humans with congestive heart failure at time of diagnosis was 0/78 and significantly lower than dogs 14/164 (9%) ($p = 0.006$). In humans, the right femoral vein approach was most common (92%)

compared to left femoral vein (8%); whereas in dogs right external jugular vein was most common (88%), compared to right femoral vein (8%) or other (4%) ($p < 0.0001$). Vascular introducers were significantly larger in dogs than humans (canine 8F (7-10F); human 4F (4-5F) ($p < 0.0001$). Compliant percutaneous transluminal angioplasty catheters were more common in humans, whereas non-compliant balloons were more common in dogs. Pulmonary valve annulus diameter and balloon:annulus ratio, respectively, were significantly different (canine 12.6 mm ± 4.2, 1.28 ± 0.24; human 8.7 mm ± 3.4, 1.19 ± 0.3,) ($p < 0.0001$). Vascular closure differed between groups ($p < 0.0001$), with manual compression in 78 (100%) humans, compared to dogs; manual compression in 59 (36%), suture-based percutaneous closure in 69 (43%), vascular closure device in 2 (1%), and ligation or vessel repair after cut-down in 31 (19%). Conclusions: At these centers, BPV in dogs comprised a greater proportion of the interventional caseload compared to the pediatric interventional cardiology caseload. Pre-procedural transpulmonary pressure gradients are higher in dogs compared to humans, with similarities and differences across PS morphology, procedural approach and technique. Future studies are needed to promote One Health within interventional cardiology and enhance crosstalk between pediatric and veterinary cardiology.

ETHICS DECLARATIONS

Conflict of Interest: Intramural funding: UGA SAMS 2021 Internal Research Grants Program.

Ethical Approval: Yes.

Consent for Publication: Yes.

057. Comparative Transcatheter Occlusion of Patent Ductus Arteriosus: Multicenter Collaborative Study Across Pediatric and Veterinary Cardiology Centers

Lauren Markovic[1], Gurumurthy Hiremath[2], Brian Scansen[3], Heidi Kellihan[4], Caitlin Calkins[5], Amanda Coleman[1], Sonja Tjostheim[4], Brianne Tainter[2], Katie Hodges[1], Erin Cahill[3], Mary Carter[4], Dennis Kim[5,6]

[1]University of Georgia, Athens, USA. [2]University of Minnesota Masonic Children's Hospital, Minneapolis, USA. [3]Colorado State University, Fort Collins, USA. [4]University of Wisconsin, Madison, USA. [5]Children's Healthcare of Atlanta, Atlanta, USA. [6]Emory University School of Medicine, Atlanta, USA

Background: Percutaneous transcatheter therapeutics have revolutionized the ability to treat congenital heart disease. Interventional therapies are developed in pre-clinical trials prior to implementation in clinical practice. Cardiovascular interventional procedures, including patent ductus arteriosus (PDA) occlusion, are currently being performed in clinical practice in animals at many veterinary cardiology centers. While structural heart diseases in children and animals have similar hallmarks and pathophysiologic sequelae, subtle differences exist. This comparative clinical interventional cardiology project is meant to enhance the understanding of PDA and respective transcatheter therapies for this defect across human and animal species, while working to identify useful animal models of disease. **Objectives**: To describe characteristics and outcomes of PDA in patients that underwent transcatheter occlusion in the pediatric and veterinary population. To identify animal models of human disease for future translational interventional research. To increase awareness of collaborative and mutually beneficial relationships amongst pre-clinical, clinical and research cardiovascular communities. Methods: Multicenter, retrospective record review analyzing interventional congenital cardiology data of patients from two pediatric cardiology centers, and dogs from three veterinary cardiology centers between July 1, 2019 – June 30, 2021. Demographics, pre-procedural, procedural and post-procedural characteristics for PDA occlusion cases were collected. Data are presented in mean ± standard deviation, or median (interquartile range) when appropriate. Results: PDA intervention was performed in 202 humans and 106 dogs. Active or historical congestive heart failure was present in 45/202 (23%) humans and 19/106 (18%) dogs at the time of catheterization ($p = 0.40$). In human PDA occlusion, a transvenous approach using the right femoral vein was most common 173/202 (86%), compared to a transarterial approach using the right femoral artery in dogs 101/106 (95%). Vascular introducers were significantly larger in dogs compared to humans ($p < 0.0001$), with a positive correlation (rho = 0.43, $p < 0.0001$) of introducer size and body weight. Use of anticoagulants during human PDA intervention 165/165 (100%) significantly differed from canine intervention 15/103 (15%) ($p < 0.0001$). The distribution of PDA morphology was significantly different between pediatric and veterinary patients ($p < 0.0001$). Pulmonary ostium diameter differed between humans (2.38 mm ± 1.16) and dogs (3.33 mm ± 1.46). Distribution of PDA device selection differed between groups ($p < 0.0001$). Sizes of sheaths or catheters that PDA devices were deployed through were significantly larger in dogs compared to humans ($p = 0.01$). Vascular closure techniques differed, with manual compression in all 202 (100%) humans, and in the dog, vessel ligation 76 (73%) and vessel repair 25 (24%) due to vascular cut-down, suture-based percutaneous closure 2 (2%), and manual compression 1 (1%) ($p < 0.0001$). Successful intervention defined as appropriate device deployment was seen in 98% of human intervention compared to in 93% of dogs ($p = 0.051$). Conclusions: Transcatheter PDA occlusion, an established procedure in humans, is performed increasingly for canine patients with high success rates. Procedural differences with vascular access techniques, vascular approach and equipment exist. Data from this study may be useful for optimization of interventional techniques in the pre-clinical setting and for ongoing discovery of animal models for human disease in interventional cardiology.

ETHICS DECLARATIONS

Conflict of Interest: Intramural funding: UGA SAMS 2021 Internal Research Grants Program.

Ethical Approval: Yes.

Consent for Publication: Yes.

058. CT Imaging of Congenital Malformations of the Great Vessels of the Mediastinum: Our Experience

Sara Azzabi Zouraq[1,2], Meryem Haloua[1,2], Badr Alamo[1,2], Youssef Alaoui Lamrani[1,2], Mustapha Maaroufi[1,2], Meryem Boubbou[1,2]

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Congenital malformations of the great vessels of the mediastinum are rare pathologies, due to an abnormal development of heart and vascular structures, responsible for more or less complex malformations of the heart and great vessels. The precise morphological evaluation of these malformations is crucial for management, especially in cases of complex congenital heart disease. The cooperation between radiologists and cardio-pediatricians makes chest computed tomography (CT) angiography a powerful complementary examination to echocardiography. The aim of our work is to know the most revealed

congenital malformations of the great vessels of the mediastinum, and the contribution of thoracic CT angiography in the positive diagnosis and postoperative control of these malformations. Review of 160 files of congenital malformations of the large vessels of the mediastinum, collected in the radiology department of the CHU HASSAN II in Fez over a period of 5 years. The average age of our patients was 4 years and 5 months, with extremes ranging from one day to 24 years. A discreet male predominance (84 boys against 76 girls) is found in our series, with a sex ratio $\approx$ 1.1. Circumstances of discovery were cyanosis, dyspnea, respiratory infections, and a murmur on auscultation in symptomatic patients. Almost all patients provided an initial echocardiogram. A chest CT angiography was performed in all patients, the constants were adapted to the weight and size of the child (low doses: 80 kV, 30 mA) The protocol included 02 acquisitions in arterial and venous time, after injection of the contrast product at a dose of 2 cc/kg (automatic or manual injection with adjustable flow rate and pressure). Fine reconstructions of 1.25 and 0.625 mm were established from thick native sections allowing a precise morphological study in the different planes. RESULTS AND DISCUSSION: The diagnosis of congenital malformations of the great vessels of the mediastinum is the first step in the management of these anomalies. Especially complex malformations that combine several anomalies. In our series, the malformations detected were as follows: Ø Pulmonary atresia: 46 cases Ø Tetralogy of Fallot: 37 cases Ø Transposition of the great vessels: 35 cases Ø Anomaly of the venous return: 29 cases Ø Coarctation of the Aorta: 13 cases Ø Double Aortic arches: 3 cases Ø Persistence of the arterial duct: 15 cases Ø Birth anomaly of the pulmonary artery: 8 cases Ø. **Conclusion** Thoracic CT angiography is one of the non-invasive means of cardiac imaging, alongside MRI, which are complementary to echocardiography. Thoracic CT angiography allows the diagnosis of the vascular malformation, as well as associated malformations, and a complete morphological assessment, with multiplanar reconstructions, necessary for the therapeutic decision. It also makes it possible to evaluate surgical corrections and to guide the management of immediate complications. Irradiation is its only drawback.

ETHICS DECLARATIONS

Conflict of Interest: The authors declare they do not have any conflict of interests.

Ethical Approval: Not applicable.

Consent for Publication: Not applicable.

059. Post-Operative CT Imaging of Congenital Heart Disease: Chu Hassan II of Fez Experience

Sara Azzabi Zouraq[1,2], Meryem Haloua[1,2], Badr Alami[1,2], Youssef Alaoui Lamrani[1,2], Mustapha Maaroufi[1,2], Meryem Boubbou[1,2]

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Congenital heart disease are malformations of the heart and/or large vessels, present at birth, related to a developmental anomaly, as well as the abnormal persistence of structures generally present during fetal life. In the last decades the survival of children with corrected or palliated congenital heart disease has increased dramatically. However, post-operative abnormalities frequently occur and therefore a noninvasive imaging tool is mandatory for the detection of morphological as well as functional abnormalities. Computed tomography (CT) is ideally suited for the noninvasive diagnosis and post-operative follow-up of congenital heart disease. We present an analysis of the events of the immediate and distant periods of 45 cases of congenital heart disease operated on, collected in the radiology department of the CHU HASSAN II in Fez, over a period of 04 years. A chest CT angiography was performed following clinical warning signs (chest pain, respiratory distress, state of shock), biological (infectious syndrome), electrical (ECG abnormality, arrhythmias), and/or radiological (chest X-ray, echocardiography). Postoperative complications were in order of frequency: infectious complications, cardiovascular complications, and peripheral embolic complications (respiratory, renal, neurological, and digestive). Our patients underwent palliative surgery given the risk of mortality associated with definitive corrective surgery. The most commonly used palliative procedures are: pulmonary artery banding, the Blalock-Taussig shunt, the Glenn shunt, and Fontan. **Conclusion** Thoracic CT angiography allows, using multi-planar reconstructions and echocardiography data, to evaluate surgical corrections and guide the management of immediate complications.

ETHICS DECLARATIONS

Conflict of Interest: The authors declare they do not have any conflict of interests.

Ethical Approval: Not applicable.

Consent for Publication: Not applicable.

060. Radiation Dose Comparison in Single-Plane vs. Biplane Pediatric Cardiac Catheterization

Samantha Gilg[1,2], Hannah Whiting[1,2], Priya Gaiha[3], David Danford[1,2], Christopher Curzon[1,2]

[1]Children's Hospital and Medical Center, Omaha, USA. [2]University of Nebraska Medical Center, Omaha, USA. [3]Siemens Healthineers, San Francisco, USA.

Background: Fluoroscopic guided interventional and diagnostic catheterizations are an important management tool for pediatric patients with congenital heart disease. Many patients receive multiple catheterization procedures throughout their lives which can be a large total radiation exposure and dose over a lifetime. Research has shown that there are increased risks for adverse health effects caused by radiation exposure particularly in early childhood, both deterministic and stochastic. Because of this, there have been many efforts at decreasing patient radiation exposure in the pediatric catheterization laboratory by changing radiation technology as well as optimizing procedural techniques to limit fluoroscopic time. Generally, pediatric congenital catheterization laboratories are biplane fluoroscopic systems. The objective of this study is to compare radiation exposure dose between cases performed in a prior biplane catheterization laboratory and a newer Siemens Artis Pheno single–plane catheterization laboratory. Methods: A single-center, retrospective chart review of catheterization laboratory cases in pediatric patients (ages 0–18). Cases from the biplane catheterization laboratory were obtained from 2016–2019 and from the single-plane laboratory from 2019 to 2022. To correct for potential confounding effects of age, procedure date, and type of catheter intervention, multivariable linear regression models were constructed to predict outcomes, incorporating these factors along with the type of imaging system as independent variables. Stepwise model construction required $p < 0.15$ for both addition and retention of variables in the model. Results: A total of 868 cases were analyzed, 585 (67.4%) from the biplane system and 283 (32.6%) from the single-plane system and in total 53.5% were diagnostic cases and 46.5% were interventional cases with no significant difference in patient demographics or type of cases between the two systems (p value 0.136). There was a statistically significant difference in age between the single-plane (mean 3.3 mos) and biplane groups (mean 4.5 mos), p value 0.025. After multivariable linear regression models to correct for confounding factors of age and

intervention vs diagnostic case, the single-plane system resulted in an average of 449 mGy x m2 less DAP (p = 0.059). Additionally, when controlling for type of intervention performed via a multivariable linear regression model, the single-plane system again resulted in an average of 338 mGy x m2 less DAP (p = 0.097). When comparing procedural time after controlling for age and type of intervention being performed, the single-plane system adds on average 7 min compared to the biplane system (p = 0.078). There was no statistically significant difference between total fluoroscopic time between the two systems. **Conclusion** While typically pediatric and congenital catheterization labs utilize a biplane fluoroscopic system, we demonstrate that use of a single-plane system can be done. Despite having slightly longer total procedure times, the total fluoro time was not statistically different between the single-plane and biplane systems. Most importantly, there was a statistically significant reduction in radiation exposure doses when compared to a biplane system after controlling for age and type of procedure performed.

ETHICS DECLARATIONS

Conflict of Interest: The authors declare they do not have any conflict of interests.

Ethical Approval: Not applicable.

Consent for Publication: Yes.

061. Feasibility of MRI-Guided Cardiac Catheterization, Angioplasty, and Stenting in a 0.55 T Scanner with Limited Gradient Performance

Aimee Armstrong[1], Ramkumar Krishnamurthy[2], Jason Swinning[1], Yingmin Liu[2], Matthew Joseph[2], Orlando Simonetti[2]

[1]Nationwide Children's Hospital, Columbus, USA. [2]The Ohio State University, Columbus, USA

Background: Low-field (0.55 T) magnetic resonance imaging (MRI) may allow MRI-guided catheterization and intervention using available equipment, as radiofrequency-induced heating of interventional devices is reduced at low field strength. Objective: The purpose of this study was to test the feasibility of performing right and left heart catheterization (R&LHC), inferior vena cava (IVC) angioplasty, and IVC stenting with real-time imaging in a commercially available 0.55 T MAGNETOM Free.Max MRI system (Siemens Healthcare, Erlangen, Germany) with maximum gradient amplitude and slew rate limited to 26 mT/m and 45 mT/m/ms, respectively. A secondary aim was to evaluate three different sizes of proprietary MR-visible markers (Nano4Imaging, Dusseldorf, Germany) on Z-Med balloons (NuMED Inc., Hopkinton, NY). Methods: Six juvenile Yorkshire pigs (61.4 ± 9.8 kg) under general anesthesia had sheaths placed in the right femoral vein and artery via cutdown. Arrow balloon wedge catheters (Teleflex, Wayne, PA) with carbon dioxide in the balloon were used for RHC, and Judkins Right catheters (Cook Medical, Bloomington, IN) were used for LHC. The EmeryGlide guidewire (Nano4imaging) was used for both R&LHC. To enhance blood pool signal and visualize markers, 2 mg/kg ferumoxytol was infused over 20 min. Trade-offs between temporal and spatial resolution were investigated using the following spoiled gradient echo MRI sequence for real-time visualization of devices: high temporal resolution: 7 frames/sec, TE/TR = 2.8 ms/6.0 ms, Rate 3 GRAPPA, 3.5 × 3.5 x 10 mm voxels; high spatial resolution: 2.2 frames/sec, TE/TR = 2.8 ms/6.2 ms, Rate 2 GRAPPA, 1.8 × 1.8 × 9.5 mm voxels. In 4 pigs, IVC angioplasty was performed using 20 mm × 3 cm Z-Med balloons with two MR markers of varying widths (0.25 mm, 0.5 mm, 1 mm) and 1% gadolinium in the balloon. Mega and Max LD stainless steel stents (Medtronic, Dublin, Ireland) were deployed on Z-Med balloons, and a Covered Mounted CP stent (NuMed) was deployed. Results: One pig expired during ferumoxytol infusion, but catheterization was still performed. RHC was successful in all pigs with the balloon tip seen well in all MRI sequences. LHC was attempted and successful in 2 pigs, with the EmeryGlide entering the left ventricle easily. IVC angioplasty was attempted in 4 pigs and was successful in all. Implantation of 3 stainless steel stents and one platinum-iridium stent was attempted and successful in all. The 0.5 and 1 mm wide MR markers on the Z-Med could be well distinguished from the stent before and after deployment. The stainless steel stents were seen well before and after deployment, but the platinum-iridium stent caused significant artifact, leading to inability to assess wall apposition. Conclusions: This study is the first to demonstrate the technical feasibility of R&LHC, IVC angioplasty, and IVC stenting using real-time MRI with a commercially available low field scanner with limited gradient performance. Stainless steel stents were seen well without significant artifact, whereas the platinum iridium stent had poor image quality. Marking conventional catheters with available passive marker technology (Nano4Imaging) shows conspicuity to allow angioplasty and stenting. Ferumoxytol 2 mg/kg leads to superior imaging of all MR markers, balloons, and stents.

ETHICS DECLARATIONS

Conflict of Interest: Funded by Nano4Imaging and NuMed.

Ethical Approval: Study was IACUC approved.

Consent for Publication: Yes.

062. Tissue Engineered Transcatheter Pulmonary Valve Replacement in the Fetus: Delivery Technique Development

Aimee Armstrong[1], Candace Style[1], Stacey Carey[1], Tyler Kyhl[1], Bernadette Richards[1], Martin Bocks[2], Texter Karen[1], James Strainic[2], Ellie Ragsdale[3], Christopher Breuer[1]

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Objective: The purpose of this study was to develop a percutaneous, transcatheter approach to delivering a completely bioabsorbable tissue engineered heart valve (TEHV) into the fetal pulmonary annulus, as a possible method for minimally invasive fetal pulmonary valve replacement. The fetal environment may be ideal for TEHVs, due to the large number of circulating progenitor cells, and may prevent the development of single-ventricle heart disease in fetuses with pulmonary atresia. Methods: Technique development started with deploying 10-mm-long bioabsorbable zinc-aluminum alloy stents on custom made 7 mm × 12 mm TYSHAK MINI balloons (NuMED, Orlando, FL) advanced through a 17-gage (g) blunt-tipped needle percutaneously through the pregnant ewe's (gestational age mean 110.18 ± 1.79 days, 72% of term) abdominal wall, uterus, and fetal chest wall into the right ventricle with ultrasound guidance. After iterative development of the technique, trileaflet TEHVs, made of electrospun polycaprolactone were sewn into the stents, and the same technique was used with either 7 or 9 mm diameter balloons and 17- or 15-g needles. Pulse duplicator testing of the valved construct was performed showing trivial stenosis and regurgitation. Procedural success was defined as implantation of the stent or TEHV into the right ventricular outflow tract (RVOT), pulmonary annulus, or main pulmonary artery (MPA). Results: The procedure was performed on 20 pregnant ewes, and intervention was attempted on 26 of 32 fetuses. Pulmonary annular diameters ranged from 5.7 to 8.8 mm (mean

7.03 ± 0.82 mm). Stent implantation was attempted in 14 fetuses, and a 17-g needle and 7 mm balloon were used in all cases. Procedural success occurred in 7 (50%) and in 5 of the last 6 attempts, showing improvement over time. Pulmonary annular implantation was achieved in 5, and the stent was implanted in the MPA in 2. A total of 6 (43%) fetuses survived to necropsy (30 min after procedure), including two with the stent implanted in the MPA. No patient with an annular implant survived to necropsy, due to severe bradycardia within 30 s of implant. TEHV implantation was attempted in 12 fetuses, and a 15-g needle was used for all but three. A 9 mm TYSHAK balloon was used in 6 attempts. Procedural success was achieved in 6 (50%). Pulmonary annular implantation occurred in two, while two were implanted in the RVOT and two in the MPA. A total of 5 (42%) fetuses survived to necropsy, including one fetus who was allowed to survive to term birth after the TEHV migrated to the MPA with no stenosis or regurgitation of the TEHV on serial echocardiograms. This was the first animal to be born with a TEHV and has been reported previously. Neither fetus with an annular implant survived to necropsy, due to immediate bradycardia. Conclusions: This study demonstrates the technical feasibility of fetal pulmonary valve replacement with a completely bioabsorbable TEHV via a percutaneous and transcatheter approach. Pulmonary annular implants of both bare metal stents and TEHVs were universally fatal, and further investigation is needed to determine the cause. TEHV competence needs additional in vivo evaluation, as bench testing showed trivial regurgitation.

ETHICS DECLARATIONS

Conflict of Interest: Funded by Intramural (Nationwide Children's Hospital).

Ethical Approval: Study was IACUC approved.

Consent for Publication: Yes.

063. Implementation of Quality Improvement Methodology for Risk Mitigation in Congenital Cardiac Catheterization

Elsa Bjornlund[1], Mary Yeh[1], Kimberlee Gauvreau[1], Fatima Ali[2], Nadeem Aslam[2], Sarosh Batlivala[3], Darren Berman[4], Martin Bocks[5], Kristin Chenault,[6], Thomas Doyle[7], Todd Gudausky[8], Michael Hainstock[9], Juan Ibla[1], Michael O'Byrne[10], Gina Papili[11], Brian Quinn[1], Shabana Shahanavaz[3], Ruchik Sharma[9], Sara Trucco[12], Wendy Whiteside[13], Lisa Bergersen[1], Aimee Armstrong[6]

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Purpose: Create and implement a multi-center Quality Improvement methodology to mitigate risk and reduce adverse events (AEs) in congenital cardiac catheterization through goal-directed change strategies. Methods: The Congenital Cardiac Catheterization Project on Outcomes (C3PO) aimed to reduce AEs in congenital catheterization. A 32-person, interdisciplinary working group, with participants from 12 sites, analyzed audited procedural and outcome data for all diagnostic and interventional congenital cardiac catheterization cases from January 1, 2014 to December 31, 2017. The primary outcome was defined as the occurrence of any level 3/4/5 AEs. AEs were summarized by event type including: technical events, sedation/airway events, arrhythmias, and other events. Cases were organized from shortest to longest duration, and level 3/4/5 and 4/5 AE rates were summarized for each case duration decile. In order to account for time to manage an AE as recorded by participating sites, the time to manage an AE was subtracted from case length. Results were stratified by hemodynamic vulnerability, age category, and case type to identify opportunities for improvement. Observations from the pilot analysis were used to inform the creation of a key driver diagram and to determine change strategies and implementation tools. Results: Between 2014 and 2017, 14,717 cases were entered from 11 sites, including 5,662 (38%) diagnostic and 9,055 (62%) interventional cases. High-severity (3/4/5) AEs occurred in 1,214 (4.8%) cases, while 4/5 AEs occurred in 393 (1.6%) cases. The key driver diagram defined three drivers: (1) Pre-Procedure Risk Assessment, (2) Possibly Preventable Events, and (3) Procedure Length Optimization. Actionable change strategies organized around five communication timepoints were developed in inter-disciplinary discussions and compiled into posters distributed to sites for quick reference (Fig. 1). To facilitate pre-procedure communication and risk assessment, an online risk calculator was developed using pilot data and results from the PREDIC3T analysis (Fig. 2). Outputs included pre-procedure cardiac status, PREDIC3T case type risk category, hemodynamic vulnerability score, expected radiation exposure category, C3PO median case duration, and the risk of a high severity AE as low, medium, or high. Results generated were available as a case summary print out and incorporated into a calendar for weekly schedule planning. Discussion: The C3PO collaborative's Risk Mitigation QI interdisciplinary working group utilized a large, multicenter dataset to guide the formulation of a QI protocol. The novel use of risk assessment tools provides an opportunity for participants to evaluate individual case risk. Through improved resource planning, the protocol equips catheterization teams to respond efficiently to AEs and possibly prevent escalation into dangerous events. This protocol provides reproducible interventions that can be adapted to local practice. This is important due to the diversity of practice conventions and local needs at participating sites. The change strategies are easily reproducible and accessible to participating centers and aim to improve the effectiveness of this protocol across the collaborative.

ETHICS DECLARATIONS

Conflict of Interest: Funded C3PO (Boston Children's Hospital).

Ethical Approval: Study was IRB approved.

Consent for Publication: Yes.

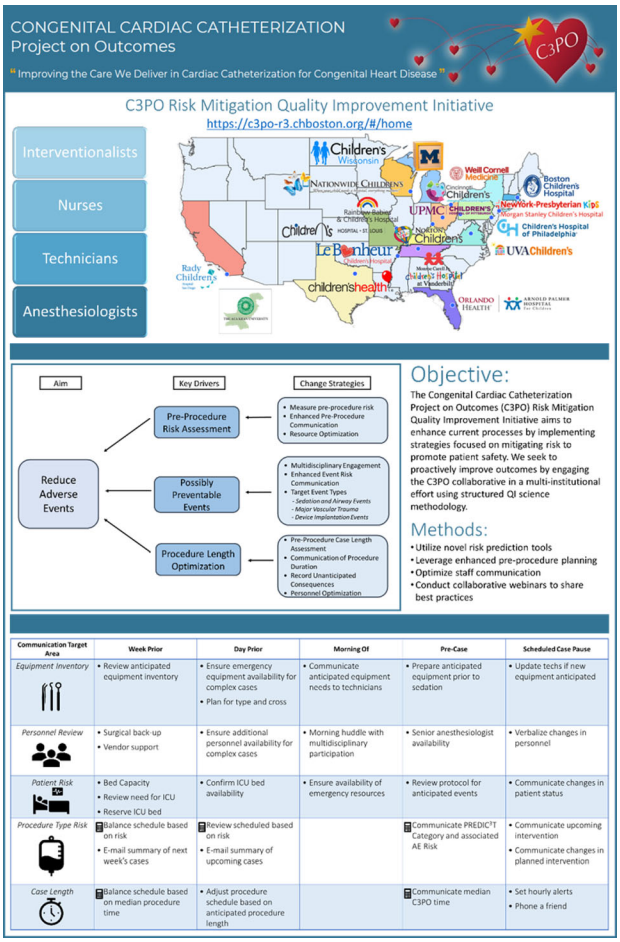
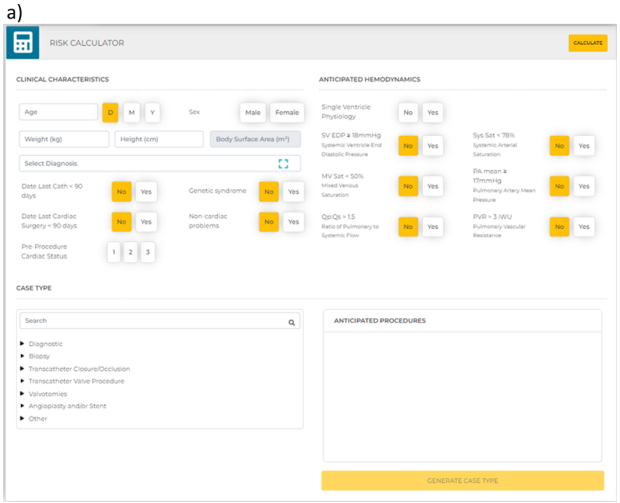


Fig. 1 Risk mitigation poster

a)



b)

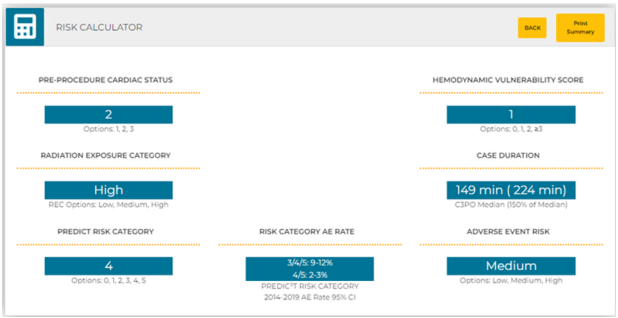


Fig. 2 Pre-procedure risk calculator (a) input and (b) output

064. Transcatheter Closure of Cardiac Defects with Lifetech ™ Konar-Multifunctional Occluder-experience in a Tertiary Care Centre

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Objective: To assess the immediate and short-term efficacy and safety of transcatheter closure of cardiac defects with Lifetech™ Konar-MFO in a tertiary cardiac care centre. Study design: Descriptive, cross sectional Setting and duration of study: AFIC/NIHD Rawalpindi; from Mar 2019 to Dec 2021 Methodology: Patients of all ages and either gender undergoing transcatheter closure of a cardiac defect with Konar-MFO from Jan 2021 to Dec 2021 were included in the study by consecutive, non-probability sampling after informed consent and approval by the institutional ethical review committee. Data of patients treated by transcatheter closure with Konar-MFO from Mar 2019 to Dec 2020 was also reviewed retrospectively for assessing immediate and short-term efficacy and safety of the occluder. Statistical package for social sciences version 21 was used for data entry and analysis. Results: A total of 138 patients had transcatheter closure of a cardiac defect with Lifetech™ Konar-MFO during the study period. Case of VSD were 124 (89.9%), PDA 9 (6.5%), post-operative cases 4 (2.9%) along with 1 (0.7%) case of coronary artery fistula (CAF) to the right ventricle. Out of 138 patients, 73 (52.9%) were females while 65 (47.1%) were males. The mean age was 9.3 ± 8.1 years with a range of 6 months to 36 years. Mean fluoroscopy time was 13.68 ± 9.74 min with a range of 2.2 to 61.5 min. The procedure was successful in 137 (99.27%) cases. The device embolized in 2 (1.45%) cases. **Conclusion** In selected cases of VSD, PDA and in some post-operative cases, occlusion with Lifetech™ Konar-MFO is safe and efficacious, with the added benefits of softness and versatility of the approach.

Keywords: Congenital heart disease; Transcatheter closure; Ventricular septal defect.

ETHICS DECLARATIONS

Conflict of Interest: The authors declare they do not have any conflict of interests.

Ethical Approval: Not applicable.

Consent for Publication: Not applicable.

065. Partial Congenital Portosystemic Shunt Occlusion

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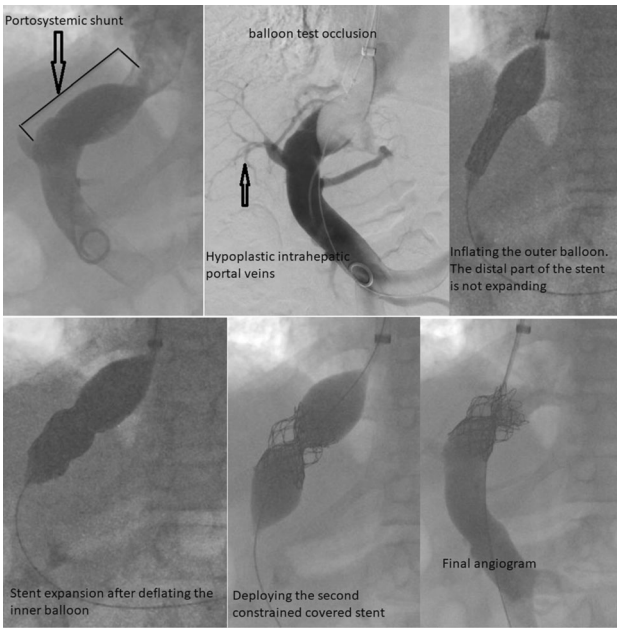
Introduction Congenital portosystemic shunt is a rare anomaly. When intrahepatic portal veins are diminutive, staged closure is warranted. We describe a successful partial shunt closure using a "stent-on-stent" technique after the failure of a "snare-on-balloon" method. Case presentation: A 13 y.o male presented with pulmonary hypertension. Workup revealed the presence of type 1 intrahepatic portosystemic shunt. Access was obtained in the right internal jugular vein. Angiogram showed diminutive intrahepatic portal veins with a portosystemic shunt measuring 22 and 15.1 mm at its largest and smallest dimensions. With balloon test occlusion, the portal vein pressure and gradient rose to 17 mmHg (6 mmHg at baseline) and 11 mmHg (0 mmHg at baseline), respectively. The decision was made to partially occlude using a constrained covered stent. Two 5 mm gooseneck snares were placed over the center of a 24 × 50 mm BIB balloon (modified Diabolo technique). Then, a 3.9 cm 8 zig covered CP stent was crimped over the snares-balloon unit (with the aim that the mid stent will expand to only 5 mm). After placing the entire system inside the shunt, the inner balloon was inflated to 5 atms. Then, during inflating the outer balloon, it was noticed that only the proximal part of the stent was expanding. At this point, we realized that the inner balloon was preventing expanding the distal part of the stent. The inner balloon was deflated with a simultaneous increasing the outer balloon pressure to 5 atms. This resulted in an adequate expansion of the proximal and distal parts of the stents. However, the constrained segment has overexpanded. The snares and balloon were removed. The snares were found to be broken. As the stent was not providing any restriction to the flow, we decided to place another covered stent using a different constraining method. An identical covered CP stent was mounted on the same BIB balloon followed by crimping a 4 × 12 mm formula 418 stent over the covered CP stent. The stents were deployed inside the first covered CP stent by solely inflating the outer balloon to 5 atms. The two stents are well-positioned inside the old stent with a central constrain measuring 6 mm. Portal vein pressure measured 11 mmHg with a 4-mmHg gradient across the stent. The abdominal US at 6 months after the procedure showed patent flow across the stent with improved intrahepatic portal vein flow. **Conclusion** Placing a constrained covered stent to treat congenital portosystemic shunt provides an excellent option to promote intrahepatic portal vein growth without causing pathologically portal vein hypertension. The snare-on-balloon technique is ineffective due to the lack of radial strength. When using a BIB balloon to deploy a constrained stent, only the outer balloon should be inflated. Inflating the inner balloon could potentially prevent expanding the distal portion of the outer balloon.

ETHICS DECLARATIONS

Conflict of Interest: The authors declare they do not have any conflict of interests.

Ethical Approval: Not applicable.

Consent for Publication: Not applicable.



066. Transcatheter Closure of Ascending Aortic Pseudoaneurysm following Cardiac Surgery

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Background: Ascending aorta pseudoaneurysm following reconstructive aortic surgery is rare but well-known complication, associated with high morbidity and mortality. Open surgical approach has been the management of choice but high risk of rupture at the time of sternotomy. Transcatheter interventional procedures to occlude the aortic pseudoaneurysm may offer as an effective alternative or palliation prior to the surgery, in selected patients. Case Report: A 31-year-old male was admitted with swelling in the right upper chest, following ascending aortic repair. He had congenital aortic valve stenosis and had multiple aortic valve surgeries including Ross operation, Tirone David root replacement and ultimately mechanical aortic valve replacement with a 21 mm St. Jude valve. Three months after the aortic valve replacement, he presented with NYHA class 3 symptoms and was found to have a large mediastinal hematoma in the chest due to tear in the ascending aorta likely at the aortic cannulation site; this tear was surgically repaired. Five months following this surgery, he developed swelling in right upper chest. Computed tomography angiography (CTA) revealed a large ascending aortic pseudoaneurysm located just above the sinotubular junction, measuring 5.5 × 3.8 × 7.2 cm and partially compressing the main pulmonary artery (Fig. 1A). Due to high risk of intrathoracic bleeding with sternotomy, the multiple prior surgeries and complications, he was referred to the catheterization laboratory for intervention to treat the pseudoaneurysm. The goal of intervention was to reduce the risk of catastrophic bleeding with sternotomy for hematoma evacuation. Ascending aortogram confirmed the pseudoaneurysm. With the help of a 5F Jr2 catheter and 0.035″ Wholey wire, the pseudoaneurysm was entered. Angiogram in the pseudoaneurysm showed it had an irregular margin, with maximum diameter of 5 mm (Fig. 1B, C). A 12 mm AVPII vascular plug, 18 mm, and 25 mm Amplatzer cribriform device slipped easily trying to deploy. The

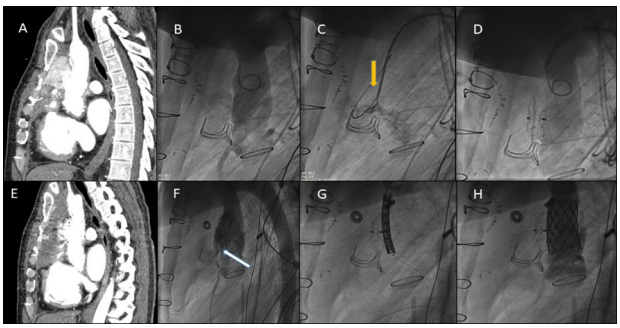
defect was successfully occluded with a 14 mm Amplatzer septal occluder device through a 8F Treviso sheath (Fig. 1D). Follow-up CTA, a month later, revealed a small leak from the inferior margin of the device with slight increase in size of the pseudoaneurysm (Fig. 1E, F). He was taken back to the cath lab and the residual leak was successfully covered with a custom made 10 Zig covered CP stent 4.5 cm mounted on a 26 BiB balloon (Fig. 1G, H). He was temporarily paced during stent deployment with care taken to prevent stent migration proximally close to coronary artery origins.. After containing the ascending aorta leak, he was taken to the operating room 6 days later for hematoma evacuation and aortic root replacement. Post-operative course was prolonged, and he was discharged to home a month later. **Conclusion** Ascending aortic pseudoaneurysm are commonly repaired surgically. However, for many adult congenital heart disease patients with multiple prior sternotomies or those with large pseudoaneurysm close to the sternum, the surgical risks are high. These patients can benefit from transcatheter closure either with vascular plugs, atrial septal occluder and/or covered stents; endovascular grafts can also be an option. This procedure can significantly reduce risk of fatal blood loss during sternotomy. Residual leaks can lead to progressive increase in aneurysm and therefore must be followed up closely with CT scans.

ETHICS DECLARATIONS

Conflict of Interest: The authors declare they do not have any conflict of interests.

Ethical Approval: Not applicable.

Consent for Publication: Not applicable.



067. Harmony Transcatheter Pulmonary Valve Implantation in the Right Pulmonary Artery

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Introduction Treatment of chronic pulmonary insufficiency by placement of transcatheter pulmonary valves (TPV) in the branch pulmonary artery position has been well-described since the first case report of a Melody TPV implantation in 2011. In 2021, the Harmony TPV received FDA approval for the treatment of pulmonary regurgitation in patients with native or patched RVOTs. We report the first case of branch pulmonary artery implantation of the self-expanding Harmony TPV in the right pulmonary artery. Case Report: A 41-year-old male with Tetralogy of Fallot who underwent mBTT shunt at 6 months of age followed by complete repair at 6 years of age. He developed LPA isolation that could not be corrected at time of his repair. He was referred to ACHD with complaints of worsening dyspnea on exertion and generalized fatigue. Cardiac MRI demonstrated a severely dilated RV (RVEDV index 179 ml/m2) with mildly decreased function and severe pulmonary regurgitation. Based on clinical and cMRI criteria he met criteria for TPVR. The patient was deemed not a candidate for Harmony TPV RVOT placement based on fit-analysis provided by Medtronic. He was re-evaluated for an RPA placement and was deemed a candidate for both the Harmony TPV22 and TPV25. The patient underwent standard right and left heart catheterization and angiography determined that the anatomy was best for the HarmonyTPV22. The Harmony TPV22 was deployed with careful attention being placed on delineating the take-off of the RUPA. Post-implantation angiogram demonstrated no valvar or perivalvular leak with a residual peak gradient of 6 mmHg. Discussion: Despite having more transcatheter valve options to treat patients with post-operative RVOT dysfunction, not all patients will be candidates for on-label use of even the newest devices. For our patient, we chose to place the Medtronic Harmony TPV22 in the proximal RPA when the RVOT position was not amenable and did so with excellent outcome. Although both the TPV22 and TPV25 devices could have been used based on fit analysis, our angiograms showed less pulsatile dilation of the distal portion of the RPA and our concern was that the TPV25 would be oversized distally. Getting the DrySeal sheath to take the additional turn into the RPA took considerable inward pushing and coordination with deep RPA wire position. However, once the DrySeal was past the MPA-RPA turn, advancing the Harmony delivery system to the distal RPA was not particularly difficult. Once the DrySeal sheath was pulled back to the proximal RVOT, unsheathing the Harmony was extremely difficult and took considerable force both inward on the valve apparatus and outward on the Harmony delivery sheath and DrySeal sheath to prevent the valve from "jumping" proximally. In this sense, it was the extreme version of a horizontal deployment and required careful coordination between both operators. **Conclusion** This is the first ever implantation of a self-expanding transcatheter valve in the branch pulmonary artery. Although the deployment is technically difficult, Harmony TPV implantation in a branch pulmonary artery represents a potential alternative to surgery when standard RVOT implantation is not possible.

ETHICS DECLARATIONS

Conflict of Interest: The authors declare they do not have any conflict of interests.

Ethical Approval: Not applicable.

Consent for Publication: Not applicable.

068. The Subtleties of Sizing in Percutaneous Atrial Septal Defectclosure: An Institutional Experience

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Background: Atrial septal defect (ASD) accounts for approximately 10% of congenital heart diseases. In asymptomatic patients, ASDs with a small defect diameter that does not cause heart failure can be followed without closure as spontaneous closure is expected, but ASD closure is required in patients who do not close spontaneously and have significant shunts. Transcatheter closure therapy is a common technique used to treat secundum atrial septal defects and can be closed percutaneously using a variety of device models. In this study, it was aimed to compare the relationship between atrial septal defect (ASD) dimensions and device waist diameter dimensions after percutaneous ASD closure in children. Material and methods: This study includes patients with ASD who were admitted to Erciyes University

Pediatric Cardiology Unit between March 2016 and May 2021 and underwent percutaneous ASD closure. Clinical data such as demographic data and other concomitant heart defects were obtained from the patient's files. The maximal diameter of the defect were measured by transthoracic echocardiography (TTE) and transesophageal echocardiography (TEE) in the four-chamber axes, the aortic axis, and the bicaval axes. In addition, the arithmetic mean of the values and cube root values obtained from the TEE axes; device types, device waist diameters, and balloon sizing diameters were recorded. **Result:** 204 children (75 boys, 129 girls) aged between 4 months and 23 years were included in our study. In the angiographic examination, balloon sizing was applied in 174 patients, and TEE was applied to 84 patients during the procedure. Comparing the results of the fit analysis; all defect measurement techniques were correlated with the final device waist diameter measurements. However, when compared among themselves, the largest defect diameter measured by TEE was found to be the most compatible, and the most accurate measurement was calculated to be the aortic axis diameter measurements in TEE. **Conclusion** According to our results, all defect measurement techniques were correlated with the final device waist diameter measurements. We believe that it would be more beneficial to use all techniques together and decide to exact size of the device, but in restricted conditions if it is possible, ASD size measured by TEE on aortic position should be preferred for device selection to percutaneous closure of ASD.

Keywords: Atrial Septal Defect (ASD), interventional cardiology, sizing methods, transcatheter closure of Atrial Septal Defect, transesophageal echocardiography, transthoracic echocardiography.

ETHICS DECLARATIONS

Conflict of Interest: The authors declare they do not have any conflict of interests.

Ethical Approval: Not applicable.

Consent for Publication: Not applicable.

069. Transcatheter Closure of Aortic and Pulmonary Artery Pseudoaneurysms: Report of 3 cases

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Introduction Pseudoaneurysms are rare pathologies found in the systemic or the pulmonary arteries with a potential for rupture. They can occur either following interventions or in association with endocarditis. When treated surgically, reported mortality can reach 46% in high-risk patients, making percutaneous closure desirable. We report three cases of successful transcatheter closure of pseudoaneurysms of the great arteries. Case 1: A 3-year-old male with the diagnosis of Pulmonary Atresia with VSD and MAPCAs S/P RV-PA conduit, presented with endocarditis of the conduit extending in the RPA, with a mycotic pseudoaneurysm of the right lower lobe branch seen on CTA. Pseudoaneurysm expansion continued despite 6-weeks of IV antibiotics. Angiography showed a large fusiform pseudoaneurysm measuring 21 × 18 mm with a 6 mm neck. An 8 mm Amplatzer vascular plug II was deployed through a 5Fr flexor sheath with one disc inside the pseudoaneurysm and the proximal disc in the neck. Repeat angiogram confirmed complete occlusion with patent adjacent branch Pas. He is doing well on follow-up. Case 2: A 32-year-old female with diagnosis of partial AV canal S/P 25 mm On-X in mitral position, a Konno ventriculoplasty, and 23 mm On-X-aortic Valsalva root replacement. Seven months after repair, she was noted to have anterior pulsatile fluid collection on TTE. CTA showed a 30 × 50 mm pseudoaneurysm of anterolateral aortic root communicating with the RVOT. A telescopic system, including 5F Jacky catheter, Penumbra microcatheter, and 0.014″ Whisper wire were used to access the pseudoaneurysm. A combination of four 20mmx60cm soft Ruby coils, one 16mmx50cm soft Ruby coil and one 60 cm pod packing coil were deployed into the lumen. Post-intervention angiography showed complete pseudoaneurysm occlusion. Follow-up TTE after 4 months showed occluded pseudoaneurysm, and stable mild flow acceleration across RVOT. Case 3: A 20-year-old male with diagnosis of Von Willebrand disease, pulmonary atresia with VSD and MAPCAs, pulmonary hypertension, most recently S/P RV-PA conduit replacement with 27 mm Homograft and aortic root replacement with 29 mm On-X-composite Valsalva graft. He underwent balloon angioplasty of LL branch that resulted in distal pseudoaneurysm formation measuring 16 × 28 mm, likely due to trauma during angioplasty. CTA done 24 h later showed a 29 mm pseudoaneurysm arising from the proximal left pulmonary artery. He was taken for percutaneous closure and a combination of 30, 24, 20, 16, 14 mm x60cm Penumbra Ruby soft embolization coils were deployed through a 5F JR catheter. Post-intervention angiogram showed no residual flow into aneurysm sac and unobstructed flow into the surrounding vasculature. Follow-up TTE after 2 months showed no evidence of pseudoaneurysm and no LPA obstruction. **Conclusion** We present 3 cases of pseudoaneurysm formation secondary to infection, surgery, and balloon angioplasty trauma. Transcatheter closure is a safe procedure especially in high-risk patients. Coil packing has been the most reported technique but plugging of the feeding vessel is feasible and safe if done carefully. Long-term outcome differences of the two approaches have not been reported as of yet.

ETHICS DECLARATIONS

Conflict of Interest: The authors declare they do not have any conflict of interests.

Ethical Approval: Not applicable.

Consent for Publication: Not applicable.

070. Pressure-Wire Guided Hybrid Branch Pulmonary Artery Band Placement for Palliation of Single-Ventricle Congenital Cardiac Lesions

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Background: Branch pulmonary artery band (bPAb) placement is an early palliation technique for neonates with complex single or biventricular circulation. Historically, bPAb placement was guided by surrogate markers for pulmonary blood flow including systemic blood pressure (BP) and arterial saturations. Utilizing these metrics alone may result in suboptimal bPAb placement. We present a novel hybrid bPAb (hPAb) procedure employing intraoperative angiography and pressure wire assessment to evaluate pulmonary hemodynamics and improve procedural outcomes. Methods: We performed the hPAb procedure on 23 patients between August 2016 and May 2022. Procedures involved MPA angiography followed by pressure-wire assessment of each bPAb. The goal mean bPAb pressure was 15-20 mmHg. Standard surrogates of mean BP and saturation were

also assessed including pre and post-revision when revision was indicated. Results: Median total hPAb procedure time was 188 min [122-460 min]. Ten cases (43%) involved revision of at least one hPAb, all of which were of a restrictive band. Mean BP had increased and saturations had increased within the typical range for all patients who underwent revision. Five patients (22%) underwent an interstage intervention on a branch PA. Fifteen patients (65%) have undergone the next operation. Four (17%) underwent branch PA intervention after the subsequent operation, over a median period of 7 days [3 – 270] including two (8.7%) bPAb stent implants. **Conclusion** Hybrid bPAb procedures, guided by angiographic and pressure-wire data, lead to increased bPAb revisions, typically of a restrictive band. Traditional markers of appropriate bPAb placement were in the expected range for patients who underwent revision, demonstrating the imperfect nature of surrogate markers and the greater utility of angiographic and pressure data in assessing optimal band placement.

ETHICS DECLARATIONS

Conflict of Interest: The authors declare they do not have any conflict of interests.

Ethical Approval: IRB project approved by Cincinnati Children's Hospital IRB.

Consent for Publication: Not applicable.

071. Therapeutic use of I.V hydrogen peroxide in ischemic heart disease

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Hydrogen peroxide has been used for more than a century, the abstracts of articles published from 1966 through 1988 alone reaches 2″ high when printed on 8–1/2″X11″ paper. A number of clinics in the United States and Mexico use hydrogen peroxide therapy, as well as other treatment modalities, on a routine basis, usually given by intravenous injection (IV). It must emphasize that, our immunological system are macrophages and leucocytes, one of which uses hydrogen peroxide to oxidize the invaders of microbes; and that vitamin C is effective principally by its ability to promote hydrogen peroxide use against foreign invaders, including parasites, viruses, bacteria, yeast/fungus; all body tissues contain catalase and that hydrogen peroxide in the presence of catalase is reduced to oxygen and water. So, there is strong reason to believe that added hydrogen peroxide, used properly, may be both effective against certain organisms and safe. Hydrogen peroxide is an essential metabolite, meaning that it is necessary to life process. Physicians have independently discovered such treatments to be effective against some types of coronary heart disease, arterial circulation disorders. The First International Conference of Bio-oxidative Medicine was held February 17–19, 1989 in Dallas/Ft. Worth, TX. Physicians presented papers on the efficacy and safety of hydrogen peroxide infusions. Since that date the non-profit International Bio-Oxidative Medicine Foundation1 has grown rapidly. While Chelation Therapy is an extremely useful treatment and preventive measure for at least 80% of peripheral circulation problems, it apparently cannot clean out hardened plaque in arteries, like the coronary,large arteries and the aorta3. According to Douglas, the Baylor University Medical Center may "have gone a long way toward proving that H2O2 dripped into the leg and carotid vessels of patients known to have severe arteriosclerosis will clear those arteries of disease. Dr. Douglass added that, "The investigators also reported that the improvement is not temporary. The physiological effects of bio-oxidation and, in particular hydrogen peroxide, should be investigated with a new prospect. Hydrogen peroxide is produced by all cells of the body for many different physiological reasons. The granulocytes produce H_2O_2 as a first line of defense against bacteria, yeast, virus, parasites, macrophages, and most fungi. It is involved in any metabolic pathway which utilize oxidases, peroxidases, cyclo-oxygenase, lipoxygenase, myeloperoxidase, catalase and probably many other enzymes. Hydrogen peroxide is involved in protein, carbohydrate and fat metabolism, immunity, vitamin and mineral metabolism or any other system. Our studies demonstrate a positive metabolic effect to intravenous infusion of H_2O_2. Its ability to oxidize almost any physiological or pathological substance, in addition to producing increased tissue and cellular oxygen tensions, has proven it to have therapeutic value. The evidence presented should stimulate a new appreciation in the study of the potential therapeutic application of bio-oxidative mechanisms, namely hydrogen peroxide in ischemic heart disease. There are two ways to administer hydrogen peroxide for medical purposes. Both means require a pure grade of hydrogen peroxide which is something different than one can purchase at the drug store for topical treatment of sores and wounds. The 3% drug-store hydrogen peroxide also contains tin and phosphate compounds that are dangerous to consume either by means of IV (intravenous) or orally. Our study didn't recommend oral use,as free-radicals are produced in the stomach when H2O2 is administered orally, and these free-radicals are not safe. Combinations of fatty acids which are likely to be in the stomach in the presence of iron and ascorbate may reduce hydrogen peroxide to hydroxyl and superoxide free radicals. These may have a deleterious effect upon the gastric and duodenal mucosa, with an increase of glandular stomach erosion, duodenal hyperplasia (abnormal increase in number of cells), adenoma and carcinoma, although in rats there seems to be inconsistencies in the studies related to carcinogenesis using 0.8% concentration for ten weeks versus 1% concentration for 32 weeks, the former indicating carcinogenesis, the latter not so. Since some clinics are using both intravenous and oral techniques with patients successfully, or to some good advantage, apparently not all possible research is in on the subject of oral versus IV administration. Hydrogen peroxide stimulates oxidative enzymes which increases the metabolic rate. To prepare the IV (intravenous) solutions, we begins with 30% H_2O_2 of USP food or cosmetic grade. Thirty percent H_2O_2 is a powerful oxidizer and should be handled with extreme caution. The 30% solution is diluted with equal amounts of sterile distilled water to make a 15% stock solution. The stock solution is passed through a Millipore 0.22 mm medium flow filter for sterilization and removal of particulate matter. The stock solution is stored in 100 ml sterile containers and kept refrigerated for future use. Infusion solutions are then prepared using sterile 5% dextrose in water. The addition of 1/4 ml sterile of the 15% H_2O_2 stock solution to each 100 ml of carrier solution produces a 0.0375% concentration that is finally used for the intravenous infusions. "Caution must be exercised that nothing is added to the H_2O_2 solution because of its tremendous oxidizing power. Even ascorbic acid (Vitamin C) is rapidly oxidized to the mono-dehydroascorbate radical, an unstable compound which degrades into numerous other chemical fragments.... Vitamins, minerals, peptides, enzymes, amino acids, heparin, EDTA, or other injectable materials should never be mixed with the H_2O_2 solution." Stimulation of Oxidative Enzymes: Charles H. Farr, M.D., Ph.D. has used hydrogen peroxide clinically, and has reported on research that he performed that sheds a great deal of light on how H2O2 functions. Contrary to popular belief, the use of H_2O_2 by either infusion or orally cannot supply as much oxygen as a good, deep breath. Instead, it is the stimulation of oxidative enzymes that does the useful trick. Dr. Farr's conclusions are appropriate and follow: There are a number of commercial products [that] claim to contain more oxygen on a volumes percent basis than Hydrogen Peroxide and consequently this has been interpreted as meaning they would somehow have more biological activity. There is a great deal of confusion about the difference between the terms 'Oxygenation' and 'Oxidation' when applied to biochemical reactions. A product which contains more oxygen per molecule may or may not have any

biological activity. “We reported1 Intravenous Hydrogen Peroxide has an oxidative stimulatory effect when administered to man which appears to be independent of the amount of oxygen produced. ”Hydrogen Peroxide is a very simple molecule produced by almost every cell in the body. This amazing molecule, essential for life in both plant and animal, has been generally overlooked for it’s role in oxidative metabolism. Every chemist knows any reaction must have an opposite reaction to balance the equation. This applies equally to reactions in the test tube and in living cells. The world seems to have been caught up in the idea all biological oxidation is harmful because free-radicals may be produced. Free-radicals can cause lipid peroxidation and membrane damage. Consequently many products, containing anti-oxidants, are being promoted to prevent peroxidation. Some researchers7, including this author, feel peroxidation serves a useful purpose in the biochemical balance and may need stimulating at times instead of preventing.“Hydrogen Peroxide as an oxidizer, under certain catalytic conditions, can degrade into water and oxygen. ”The fact that Hydrogen Peroxide may increase oxygen tension in the tissue is of secondary importance. the principal reaction of an oxidizer, such as Hydrogen Peroxide, is to accept electrons in the RedOx [reduction/oxidation] reactions of the body and has nothing to do with “Oxygen” or “Oxygenation.” It is true Hydrogen Peroxide increases the rate of oxidation in the body8, but this is not because it produces oxygen but rather it stimulates oxidative enzymes. “Hydrogen Peroxide is a naturally produced purposeful molecule in the body. It functions to aid membrane transport, acts as a hormonal messenger, regulates thermogenesis (heat production), stimulates and regulates immune functions, regulates energy production and many other important metabolic functions. These effects can occur without increasing the amount of oxygen. It is purposely used by the body to produce Hydroxyl Radicals to kill bacteria, virus, fungi, yeast and a number of parasites. This natural killing or protective system has nothing to do with increasing the amount of available oxygen. ”The amount of oxygen produced by a therapeutic infusion of Hydrogen Peroxide is very small. A single breath of fresh air contains many times more oxygen than found in either a therapeutic infusion or in a few drops of 35% Food Grade Hydrogen Peroxide taken In our study we investigated the safety and efficacy of iv hydrogen peroxide in patients with Ischemic heart disease and our conclusion showing its beneficial for iv use in ischemic heart.

ETHICS DECLARATIONS

Conflict of Interest: The authors declare they do not have any conflict of interests.

Ethical Approval: Not applicable.

Consent for Publication: Not applicable.

072. Serial Closure of Transhepatic Access Tract in an Infant with Pulmonary Vein Stenosis Using Bioabsorbable VASCADE Closure System

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Introduction: Pulmonary vein stenosis (PVS) is a chronic disease that often requires chronic central lines and multiple cardiac catheterizations which can compromise the patency of the femoral veins and IVC. Transhepatic access is employed when left atrial access is required and a femoral venous/IVC approach is not possible. Complications of transhepatic access include liver damage and intraperitoneal bleeding, typically from the access tract. To prevent intraperitoneal bleeding, many operators occlude the hepatic tract, either with a coil or a nitinol vascular plug, both of which are permanent and may impede subsequent transhepatic access, particularly in small patients with limited liver surface area for access. The VASCADE closure device (Cardiva Medical, Inc., Santa Clarita, CA) is an FDA-approved device which uses a moisture-activated bioresorbable collagen plug (type 1 bovine collagen) to obtain hemostasis after femoral vessel access. Here we describe the novel use of the VASCADE closure device after transhepatic access to occlude the hepatic tract in an infant requiring repeated catheterizations for pulmonary vein stenosis. Case Presentation: The patient is a 2-year-old with a history of extreme prematurity, bronchopulmonary dysplasia and progressive pulmonary vein stenosis which involves all but the right lower pulmonary vein. The child has been treated with multiple catheterizations, one surgery, and sirolimus. Chronic indwelling femoral central venous catheters and repeated catheterizations resulted in chronic IVC occlusion and the need for transhepatic access. At this patient’s 5 most recent catheterizations, we have used VASCADE devices to close the hepatic tract. Technique: Using ultrasound-guidance via linear array probe, access to a hepatic vein is obtained with attention to allowing a distance of at least 2 cm from the liver capsule to the hepatic vein entrance. This is to allow space for the VASCADE plug (which is 1.5 cm in length) to be deployed in the parenchyma proximal to the hepatic vein. At the end of the case, linear array ultrasound is used to demonstrate the liver capsule, the site of entry into the hepatic vein, and the length of the sheath. We have found it helpful for one operator to handle the ultrasound probe and another to manipulate the sheath and VASCADE device. Agitated saline contrast is injected through the sheath to identify its distal aspect, and the sheath tip is retracted into the hepatic vein. The VASCADE device is placed through the sheath and the sheath is removed over the VASCADE device. Under ultrasound guidance, the device components (foot-plate and collagen plug) are identified. The foot plate can be opened and closed to help identify it by ultrasound. The device is retracted such that the collagen plug is not in the hepatic vein but is in the liver parenchyma straddling the liver capsule. Once position confirmed, the plug is uncovered according to manufacturer instructions by sliding the colored “key” into the white “lock,” which allows the “black sleeve” to be retracted and the plug to be unsheathed and exposed to the hepatic tract. After 30 s, the plug is separated from the cable by advancing the green plunger, and the VASCADE cable is pulled out, leaving the plug behind (Fig. 1). Ultrasound with color doppler is used to ensure that there is no flow through the occluded tract. There are two VASCADE devices. The VASCADE Vascular Closure System (VCS) device is rated for arteriotomies and venotomies, and comes in two sizes: one for 5F sheaths and one for 6-7F sheaths. The VASCADE MVP Venous Vascular Closure System (VVCS) is rated for venotomies from 6 to 12F. The plug on each device is 1.5 cm in length, with the plug on the MVP VVCS device being slightly larger in caliber. We have used a VASCADE device appropriate for the largest sheath size used, without regard to whether it is the VCS or VVCS.

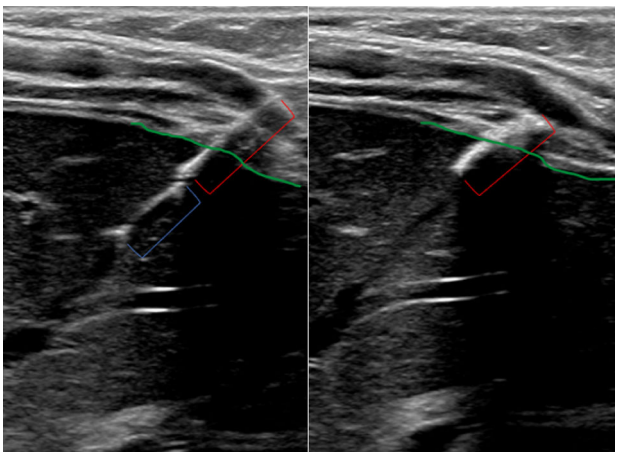

Fig. 1 The right panel shows the device before release. The blue bracket shows the foot plate which is not deployed; the red bracket shows the length of the collagen plug (yet to be unsheathed) which straddles the liver capsule (green line). The left panel shows the plug after release. The VASCADE cable (along with foot plate) have been removed, leaving the collagen plug (red bracket) straddling the liver capsule (green line)

Outcome: Use of VASCADE closure devices to close the hepatic tract has resulted in immediate hemostasis in all 5 catheterizations. There have been no episodes of intraperitoneal bleeding or other adverse events. The VASCADE devices have all biodegraded between placement and the subsequent catheterization.

Cath number	Age at Cath (d)	Weight at Cath (kg)	Largest sheath used for intervention (F)	Sheath through which VASCADE deployed (F)	VASCADE type
1	311	7.3	5	5	5F
2	430	7.61	6.5	7	6-12F (MVP)
3	514	8.41	6	5	5F
4	612	8.37	6	6	6-12F (MVP)
5	703	8.9	6	6	6-7F

Figure 2

Conclusion Closure of hepatic access tracts with resorbable VASCADE devices is feasible and facilitates subsequent access in this small child requiring multiple catheterizations via transhepatic access.

ETHICS DECLARATIONS

Conflict of Interest: The authors declare they do not have any conflict of interests.

Ethical Approval: Not applicable.

Consent for Publication: Not applicable.

073. Efficacy of Stent Implantation for Extracardiac Fontan Conduit Obstruction

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Background: Stenosis of the extracardiac conduit is a known long-term complication of the Fontan operation. Relief of obstruction is crucial for optimal Fontan hemodynamics. We report outcomes on transcatheter stent implantation to relieve extracardiac conduit obstruction. Methods: A retrospective chart review was performed of patients who underwent Fontan stent implantation from 2/2009 to 6/2022. The expected cross-sectional area of the conduit (CSA) was calculated based on the implanted conduit diameter. The minimum CSA before and after stent implantation was calculated based on measurements performed in the AP and lateral projections. Conduit stenosis was classified as diffuse or focal. Data are presented as median [interquartile range]. The minimum conduit CSA was compared pre- and post-intervention. Results: Nineteen patients underwent stent implantation for Fontan conduit stenosis (age: 13 [11.4, 14.6] yrs, weight: 44 [40.6, 55.5] kg). Most patients were male (16/19, 84%). The indication for cardiac catheterization was programmatic surveillance (8), PLE (3), cyanosis (3), reassessment of hemodynamics (2), anatomic abnormality by non-invasive imaging (2), and chylothorax with suspected Fontan thrombus (1). Five patients had a 16 mm conduit and 14 had an 18 mm conduit. The conduit was Gortex in 17 patients and unknown in 2 patients. The median Fontan pressure was 15 mmHg [6, 13]. A gradient from the IVC to the Fontan was present in 9 patients. The median cardiac index was 3.2 L/min/m^2 [2.6, 3.9]. The conduit stenosis was diffuse in 14 patients and focal in 5 patients. The median reduction in conduit CSA was 52.8% [33.5, 59.1]. The minimum CSA was significantly smaller than the expected CSA (121.6 mm^2 [83.6, 148.0] vs. 254.5 mm^2 [201.1, 254.5], $p < 0.05$). Following stent implantation, there was significant improvement in the minimum conduit CSA to 226.9 mm2 [189.9, 232.3] ($p < 0.05$). Following stent implantation, the minimum conduit CSA was a median 91% [75, 94] of the expected conduit CSA, and the minimum conduit CSA was greater than the expected CSA in two patients. Stents utilized included Palmaz XL (10), Palmaz Genesis XD (4), Intrastent LD Max (3), Intrasent LD Mega (1), and covered CP (1). Multiple stents were needed in 10 patients to cover the length of the diffuse stenosis. Post-dilation of the stent(s) with a high-pressure balloon was performed in 15 patients. The largest balloon used was the same size as the conduit in 13 patients, 2 mm larger in 3 patients, and 2 mm smaller in 1 patient. One patient was changed from aspirin to warfarin following stent implantation due to the presence of a fenestration. No other changes to anticoagulation were made. Minor complications occurred in two cases. At a median follow-up 2.7 [0.2, 3.8] years, two patients underwent subsequent dilation of the stents 1.8- and 4.4-years following implantation. Albumin levels stabilized in two patients with PLE. Conclusions: Extracardiac Fontan conduits can develop substantial obstruction and may not manifest with significant symptomology. Diffuse angiographic narrowing of the conduit was more commonly seen. Stent implantation can safely and effectively relieve conduit obstruction and can even expand conduits beyond the stated diameter.

ETHICS DECLARATIONS

Conflict of Interest: The authors declare they do not have any conflict of interests.

Ethical Approval: Not applicable.

Consent for Publication: Not applicable.

074. Can Echocardiogram Predict Ductus Arteriosus Angiogram Measurements in Premature Infants?

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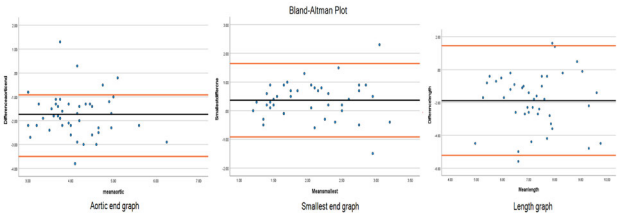
Background: Transcatheter patent ductus arteriosus (PDA) closure in premature infants has been adopted by many programs as the

preferred definitive PDA closure method. In this study, we aimed to assess the ability of the intraprocedural echocardiogram to predict the true PDA dimensions. Methods: Medical records of premature infants who underwent PDA closure at Stead Family Children's Hospital were reviewed (10/2019–12/2021) for all patients in whom a PDA device was placed in the PDA via transcatheter approach. PDA echocardiogram and angiogram measurements were obtained by blinded investigators. Results: Sixty premature infants underwent PDA device closure in the catheterization lab. All patients underwent an intraprocedural echocardiogram just prior to the closure. The echocardiogram was used to verify good device positioning. Access was obtained in either the right or left femoral vein in all patients using a 4-Fr sheath. No arterial access was needed. The median and range of the gestational age, procedure age, and procedure weight were 25.5 (21.4–34) weeks, 1 (0.33–5.3) months, and 1200 (600–2900) grams, respectively. The echocardiogram overestimated the narrowest PDA dimension and underestimated PDA length and ampulla (Table 1).

Comparing PDA Dimensions

Paired T-test	Aortic end	Narrowest PDA (42)	PDA length (N=42)
Echocardiogram (mean +/- SD)	3.2 +/-0.78	2.23 +/-0.67	6.30 +/- 1.43
Angiogram (mean +/- SD)	4.9 +/-0.87	1.86 +/- 0.64	8.18 +/- 1.46
P value	< 0.001	< 0.001	< 0.001



Mean difference [95% confidence interval] for the aortic end, narrowest diameter, and length were − 1.73 (− 3.50 to − 0.91), 0.36 (− 0.92 to 1.65), and -1.89 (− 5.23 to 1.45), respectively (Fig. 1). The median and range for the procedure time, fluoroscopy time, and radiation dose are 32 (17–139) min, 4.4 (2–18.3) min, and 2.72 (0.63–39) μGy m^2, respectively. Immediate complete occlusion was achieved in all cases except one patient in whom the small residual shunt resolved within 2 weeks. Complications included intraoperative device embolization (n = 1), mild left pulmonary artery stenosis, moderate tricuspid valve regurgitation (n = 1), and cardiac perforation resulting in death (n = 1).

Conclusion Transcatheter PDA device closure in premature infants is safe and effective with a low complication rate. The echocardiogram overestimated the narrowest PDA diameter and underestimated PDA length.

ETHICS DECLARATIONS

Conflict of Interest: The authors declare they do not have any conflict of interests.

Ethical Approval: Not applicable.

Consent for Publication: Not applicable.

075. Multicenter Early Feasibility Study of the Renata Minima Stent for the Treatment of Infant Vascular Stenoses

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Background: Both native and post-operative branch pulmonary artery stenosis (BPAS) and coarctation of aorta (CoA), are common obstructive lesions with important clinical sequela in infants. While endovascular stent therapy has become standard of care in older children and adults, there currently are no stents designed or approved for neonates, infants, or young children. In such cases, the ideal therapy would be a stent delivered through a small delivery system, be simple to implant and be expandable to adult dimensions to keep pace with somatic growth. The Renata Minima stent and delivery system are designed to fulfill this unmet need. Methods: Multicenter single-arm, prospective, non-randomized early feasibility study (EFS) evaluating the initial safety and effectiveness of the Renata Minima Stent for the treatment of BPAS and CoA in neonates, infants, and young children. Primary endpoints included: (1) successful deployment of the stent across the target lesion, (2) stenosis relief defined by an increase in angiographic diameter of > 50% following stent deployment, and (3) freedom from stent explant at 30 days post-implantation. Results: From 2/2022 to 5/2022, 11 patients were consented and underwent cardiac catheterization. One patient failed to meet inclusion criteria based on surrounding vessel size, resulting in 10 pts who underwent attempted stent implantation. The median (range) age and weight at time of intervention were 9 mos (4–43 mos) and 7.6 kg (5.1–16.9 kg). Stent implantation was attempted for CoA in 4 (re-CoA 3, native CoA 1) and BPAS in 6 (LPA 5, RPA 1), with successful deployment across the target lesion in 100% of cases (Fig. 1). Stenosis relief defined by an increase in angiographic diameter of > 50% following stent deployment was achieved in 100% of cases; with a median (range) percentage increase in angiographic diameter following stent implantation of 107% (59–362%). There were no major adverse events or deaths. Procedure-related adverse events occurred in 3 pts: diminished lower extremity pulse that required post-procedure anticoagulation (n = 2) and distal stent migration (n = 1), successfully managed in the catheterization suite. All patients were free from stent explanation at 30 days post-implant. Conclusions: In this EFS, implantation of the Renata Minima Stent was safe and effective for the treatment of BPAS and CoA in a small cohort of infants and young children. Continued evaluation of this novel technology is warranted with the performance of a prospective Multicenter Pivotal Trial. This technology has the potential to fill an unmet need for our patients.

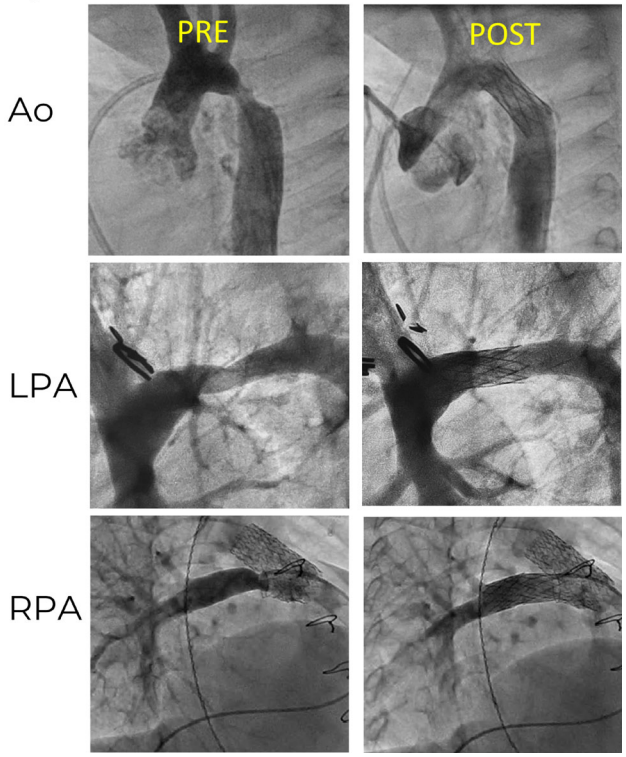
ETHICS DECLARATIONS

Conflict of Interest: The authors declare they do not have any conflict of interests.

Ethical Approval: Not applicable.

Consent for Publication: Not applicable.

Figure 1.



076. Radiation and Contrast Exposure During Transcatheter Patent Ductus Arteriosus in Premature Infants

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Background: Transcatheter patent ductus arteriosus (PDA) closure in premature infants has replaced surgical ligation in many programs. Early-life exposure to radiation has been linked to the development of cancers. Additionally, Food and Drug Administration has recently raised concern about contrast-induced hypothyroidism in small infants. In this project, we aimed to study radiation and contrast exposures in our program. Methods: Medical records of premature infants at Stead Family Children's Hospital who underwent device closure were reviewed (10/2019–12/2021). Radiation exposure from the frontal and lateral cameras and total radiations were studied. Results: Sixty premature infants underwent PDA device closure in the catheterization lab. An intraoperative echocardiogram and fluoroscopy were used to guide the closure in all patients. In all infants, Fluoroscopy and cine acquisition rates were set at 6 and 7.5 frames/seconds, respectively. The median and range of the gestational age, procedure age, and procedure weight were 25.5 (21.4–34) weeks, 1 (0.33- 5.3) months, and 1200 (600–2900) g, respectively. Median and interquartile ranges for the procedure time, total contrast volume, and number of contrast injections were 32 (26–39) min, 3 (3–5) ml, and 3 (2–4) injections, respectively. Radiation parameters are summarized in Table 1.

Table 1

Radiation parameters	Frontal Camera Median (IQR)	Lateral camera Median (IQR)	Frontal + lateral cameras Median (IQR)
Cine time (sec)	8.80 (6.75-13.75)	8.87 (6.91-13.93)	17.60 (13.85-27.85)
Total Fluoroscopy time (Cine + Fluoroscopy) (min)	1.65 (1.13-2)	2.80 (2-4.5)	4.40 (3.62-4.40)
Fluoroscopy only (mGy)	0.20 (0.2-0.30)	0.60 (0.40-1.08)	0.90 (0.60-1.30)
Fluoroscopy only indexed (μGym²)	0.46 (0.29-0.70)	0.89 (0.56-1.59)	1.27 (0.91-2.22)
Cine only (mGy)	0.3 (0.20-0.58)	0.40 (0.30-0.70)	0.7 (0.50-1.18)
Cine only indexed (μGym²)	0.56 (0.35-0.98)	0.56 (0.35-1.03)	1.26 (0.69-1.93)
Total fluoroscopy (Fluoroscopy only+ Cine only) (mGy)	0.6 (0.40-0.90)	1.00 (0.73-1.85)	1.63 (1.16-2.61)
Total fluoroscopy indexed (Fluoroscopy only Indexed+ Cine only indexed) (μGym²)	1.16 (0.70-1.72)	1.40 (0.91-2.90)	2.73 (1.62-4.19)

PDA device closure was successful in all cases except in one patient. No major complications were encountered except one death in an infant weighing 600 g.

Conclusion Transcatheter PDA device closure in premature infants is safe and feasible. It can be performed with low radiation and contrast exposure. In order to create a national exposure benchmark, more studies are needed to be carried out at other programs.

ETHICS DECLARATIONS

Conflict of Interest: The authors declare they do not have any conflict of interests.

Ethical Approval: Not applicable.

Consent for Publication: Not applicable.

077. A Novel Technique to Establish Stable Stiff Guidewire Position Using a Balloon Locking Maneuver with a Coronary Balloon During Ductal Stenting

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Background: Ductal stent implantation in patients with ductal-dependent congenital heart disease is well described. Most patients with pulmonary atresia intact septum or single-ventricle patients with pulmonary atresia will have long tortuous patent ductus arteriosus (PDA). Thorough PDA evaluation by echocardiography, and occasionally by CT angiography for 3D model creation, is essential in preprocedural planning. Technique: In order to accurately measure PDA length and successfully position and deliver the ductal stent, we have found it useful to utilize a stiff Iron Man wire (Abbott Hi-torque Iron Man 0.014 × 190 cm, Abbott Laboratories, Chicago IL) positioned deep within the distal branch pulmonary artery (PA). Both axillary and femoral arterial access are obtained. A 3F sheath in the femoral artery is utilized for descending aorta angiography to delineate ductal and branch PA anatomy. A 4F sheath is then positioned in the subclavian artery (the desired artery is selected based on the relationship of the PDA to either subclavian artery) via axillary approach. Utilizing a coaxial system consisting of a 4F angle Glidecath (Terumo Medical, Somerset NJ) and 2.8F Progreat microcatheter (Terumo) and a floppy tipped 0.014 Luge coronary wire (Boston Scientific, Natick MA) from the axillary approach, the PDA is crossed, and the coronary wire positioned within the selected distal branch PA. The Glidecath is positioned in the proximal PDA to provide stability, and the microcatheter is then advanced to the tip of the coronary wire in the distal branch PA. With the microcatheter tip in the distal branch PA, the floppy tipped coronary wire is then replaced with a stiff Iron Man guidewire. The Iron Man guidewire's position in the distal branch PA is essential in straightening the tortuous PDA,

which facilitates proper positioning and delivery of the ductal stent. As the stiff Iron Man is advanced through the microcatheter, the microcatheter will occasionally retract or be displaced into the proximal PA or PDA, preventing stable positioning of the guidewire. In order to prevent this occurrence, we utilize an over the wire (OTW) Trek coronary balloon (2–2.5 mm x 2 cm, Abbott) advanced over the floppy tipped coronary wire into a distal branch PA. Once the OTW coronary balloon is in the distal branch PA, it is inflated and locked in position. The floppy tipped coronary wire is removed and exchanged for the stiffer Iron Man guidewire. Once the Iron Man wire is positioned in the distal PA, the coronary balloon is deflated and removed, and an appropriately sized coronary stent is advanced over the Iron Man to successfully stent the PDA. Angiography is then performed, confirming proper stent position and flow to the distal PA lobar branch utilized to position the OTW coronary balloon. **Conclusion** We describe a novel technique utilizing an OTW coronary balloon inflated in a distal branch PA to lock the balloon catheter in place, and facilitate advancement of a stiff Iron Man guidewire into the distal branch PA. The stiff guidewire is then utilized for ductal stenting.

ETHICS DECLARATIONS

Conflict of Interest: The authors declare they do not have any conflict of interests.

Ethical Approval: Not applicable.

Consent for Publication: Not applicable.

078. Could Biomarkers Assess The Success of Balloon Pulmonary Valvuloplasty?

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Background: Congenital pulmonary stenosis (PS) is a progressive disease. Balloon pulmonary valvuloplasty (BPV) is the treatment of choice in valvular PS. **Aim:** We aim to study the relationship between biomarkers and echocardiographic markers in valvular PS and to assess the impact of BPV on these markers. Patients & Methods: Patients with moderate and severe valvular PS amenable for BPV were recruited. Serum troponin I was measured. Echocardiographic assessment of PS and right ventricular (RV)function were done. All patients underwent BPV. Troponin level and echocardiographic data were re-assessed two weeks & six months after BPV. Results: Fifty patients with valvular PS were recruited. There was significant correlation between peak SPG and troponin ($p < 0.001$). Troponin was significantly decreased 2 weeks after BPV. Similarly, there was an initial improvement in RV function.After 6 months of follow-up, we divided patients into 2 groups: Group A: 36 patients with no restenosis. Group B: 14 patients with restenosis. There were high significant differences between both groups regarding troponin level and RV functions with re-elevated troponin in group B that correlated with peak PG ($r = 0.9$, $p < 0.001$). RV function parameters in group B became significantly worse 6 months after BPV than those after the initial 2 weeks. Conclusion Troponin correlates with the severity of PS and associates with RV dysfunction. Both troponin & RV functions improved with BPV. Recurrent elevation of troponin and impairment of RV function are associated with PV restenosis and could be set as an indication for repeated balloon dilatation of PV.

ETHICS DECLARATIONS

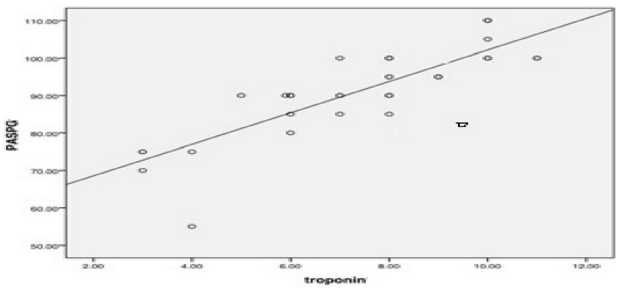
Conflict of Interest: The authors declare they do not have any conflict of interests.

Ethical Approval: Not applicable.

Consent for Publication: Not applicable.

Table 1 Comparison between patient data before and after BPV.

	Before balloon valvuloplasty	After 2 weeks	p value
E/e'	8.3 ± 1.12	3.34 ± 0.55	< 0.001 (HS)
Troponin	12.5 ± 3.4	0.21 ± 0.11	< 0.001 (HS)



079. The Use of Valeo Stents for Maintaining Ductal Patency in Infants

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Introduction The Bard Valeo peripheral vascular stents are premounted stents with an open cell design that have been utilized in children due to their low-profile balloons, which allows for minimization of sheath sizes. In this retrospective study, we sought to assess the feasibility and safety of Valeo stents in maintaining ductal patency in ductal-dependent systemic circulations. Methods: This is a retrospective cohort study performed at the University of Iowa to assess feasibility and safety of the use of Valeo stents to maintain ductal patency in ductal-dependent systemic circulation. All patients who have had a Valeo stent placed in the ductus arteriosus between 1/1/2019 and 6/1/2022 have been included. Results: Eleven patients were included in the study, with 13 individual stents being placed. Two patients had an initial stent that did not cover the pulmonary end of the duct, requiring a second stent at a later time point. Seventy three percent of our patients (n = 8) had a single-ventricle anatomy and had a Valeo stent placed as part of a hybrid approach to single-ventricle palliation. These 8 patients were made up of 7 (64%) who had HLHS, and 1 (9%) who had HRHS. Median weight and age at the time of stent placement were 3.85 kg (IQR 3.23–4.40 kg) and 13.8 days (IQR 9.9–19.8 days), respectively. The large Valeo stents (9–10 mm) were used in 54% of our interventions (n = 7), with the remaining 46% (n = 6) requiring the smaller Valeo stent (7–8 mm). Sheath size ranged from 6 to 9 Fr, with the most common being 6 Fr and 7 Fr, used in 38% of interventions (n = 5) each. Thirty one percent of interventions (n = 5) where done through direct main pulmonary artery access, 62% (n = 8) via femoral vein access, and 7% (n = 1) via femoral artery access. No complications were noted from stent placement except for 1 patient who had a self-contained vascular injury in the anterior main pulmonary artery (staining) that

did not require any intervention. There was no stent recoil and no stent fracture noted on follow-up cath. Median follow-up duration was 15.90 months (IQR 4.37–20.63 months). Ballooning of the retro grade arch through a side strut was required in 2 patients. All patients survived the procedure. Eighty two percent of patients (n = 9) survived to next surgery. **Conclusion** Patent ductus arteriosus stenting in infants is feasible and safe. Valeo stents were effective for maintaining ductal patency in our cohort with no significant side effects noted. Larger scale studies are needed to verify our findings.

ETHICS DECLARATIONS

Conflict of Interest: The authors declare they do not have any conflict of interests.

Ethical Approval: Not applicable.

Consent for Publication: Not applicable.

080. Percutaneous Coronary Intervention for Thromboembolic Acute Myocardial Infarction in a Patient with Fontan Circulation

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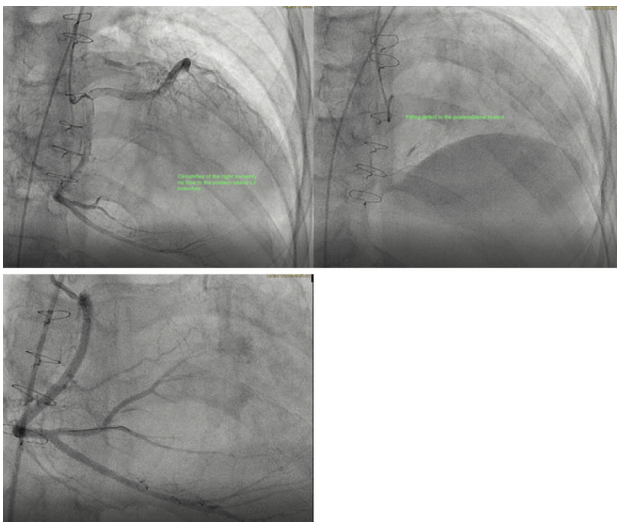
Introduction Among thromboembolic complications reported after Fontan palliation, coronary artery thromboembolic events are rare. A large majority of patients with a troponin leak in the pediatric age group have either type II myocardial infarction (MI) without coronary artery disease or non-ischemic etiology. Many patients palliated with a Fontan circulation have baseline EKG changes and systolic ventricular dysfunction which are important confounding factors when pursuing a diagnosis of acute coronary ischemia. Case Summary: A 16-year-old young woman was palliated with a fenestrated extracardiac total cavopulmonary connection for a functionally univentricular heart. Her medications included aspirin, digoxin, and enalapril. There was no prior history of arrhythmia or thromboembolic events. She presented to an outside emergency room with a two-day history of feeling unwell, and new onset shortness of breath, chest pain, and altered mental status. Shortly after presentation she suffered ventricular fibrillation; return of spontaneous circulation was achieved within 20 min of advanced cardiac life support resuscitation measures including cardiopulmonary resuscitation (CPR), defibrillation, epinephrine, and amiodarone. Her electrocardiogram (EKG) showed sinus tachycardia, ischemic changes, and left bundle branch block (LBBB) (prior EKG showed LBBB with repolarization abnormalities). She had a significant elevation of serum troponin (hs-troponin I 434, 896 pg/ml) and D-dimer. A CT scan which showed possible pulmonary embolism; she was started on intravenous heparin and transferred to our institution. She was in cardiogenic shock requiring vasoactive support and mechanical ventilation. Her echocardiogram demonstrated moderate systolic ventricular dysfunction and systemic atrioventricular valve regurgitation. Her EKG continued to show ischemia and ventricular ectopy. She underwent emergent cardiac catheterization; there was no pulmonary embolism, aortic root angiography showed left circumflex coronary (LCC) off the right coronary artery (RCA) and a separate origin of the left anterior descending (LAD) coronary artery, the Fontan fenestration was patent, and she had veno-venous collaterals. Selective coronary angiography showed no evidence of atherosclerotic disease; there was abrupt termination of what appeared to be a small posterolateral left ventricular branch arising from the distal RCA. Medical Decision Making: The patient's clinical picture was strongly suggestive of acute MI, but in stark contrast the territory supplied by the coronary artery occlusion was perceived to be small. Therefore, we consulted our adult interventional colleague who confirmed angiographic findings but estimated that the territory compromised by the occluded defect was large and compatible with clinical picture of acute MI with cardiogenic shock. We proceeded with percutaneous coronary intervention consisting of mechanical aspiration thrombectomy with adjunct balloon angioplasty. Post-intervention flow to a large myocardial territory supplied by the posterolateral left ventricular branches was restored. Residual small distal thrombus was treated with a combination of glycoprotein IIb/IIIa inhibitor (tirofiban) transitioned to direct oral anticoagulant (rivaroxaban) and a P2Y12 inhibitor (clopidogrel). The patient made a complete recovery. **Conclusion** Acute MI is uncommon in pediatrics; diagnosis can be difficult with many confounding factors and competing diagnoses. In the appropriate clinical context, selective coronary angiography (even with normal coronaries on non-selective aortography) and consultation with adult interventional colleagues is necessary for optimal patient care.

ETHICS DECLARATIONS

Conflict of Interest: The authors declare they do not have any conflict of interests.

Ethical Approval: Not applicable.

Consent for Publication: Yes.



081. Endobronchial Varices: A Rare Cause of Hemoptysis in Pulmonary Vein Stenosis. A Distinct Subset Requiring Specific Interventional Therapy

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Introduction Hemoptysis secondary to pulmonary vein stenosis (PVS) is well recognized in adults but is rare in children. The mechanism of bleeding has important implications for treatment. Case Report: An ex-22-week premature infant presented at 18 months of age with three self-limiting episodes of hemoptysis. Echocardiography showed a structurally normal heart, no forward flow in the left pulmonary artery (LPA), and no left sided pulmonary

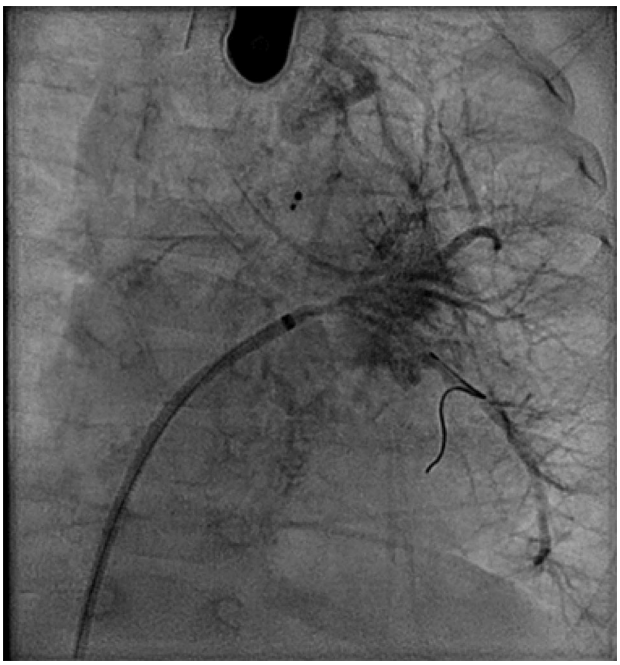
veins. A contrast enhanced computed tomogram (CT) showed left pulmonary vein atresia and a hypoplastic LPA; a prominent bronchial artery was noted without other significant systemic to pulmonary collaterals. LPA wedge angiogram demonstrated severely hypoplastic pulmonary veins with near atresia of a common pulmonary vein draining to the left atrium. There were multiple decompressing venous channels, intrapulmonary varicosities, and contrast tracking along the left bronchus consistent with left bronchial varicosities. Flexible bronchoscopy showed diffuse left bronchial hyperemia, edema, and prominent vascularity. Aortography did not show significant systemic to pulmonary collaterals. Medical Decision Making: The findings were strongly suggestive that the bleeding was secondary to endobronchial/intraparenchymal varices and not secondary to systemic-to-pulmonary collaterals. The common left pulmonary vein was successfully recanalized with balloon and stent angioplasty (single 4 × 18 mm drug-eluting stent). At the same catheterization repeat LPA wedge angiogram showed rapid clearing of contrast, and there was no contrast tracking the endobronchial wall. At her 2-month follow-up, the patient did not have any additional episodes of hemoptysis; echocardiography showed anterograde flow in the LPA, and minimal gradient across the stent in the left pulmonary veins. LPA wedge angiogram showed resolution of endobronchial and intrapulmonary varices, and interval growth of the intraparenchymal pulmonary veins. There was mild in-stent stenosis which was treated successfully with balloon angioplasty. **Conclusion** PVS causing hemoptysis in children is rare. Determining the mechanism of hemorrhage is crucial to determining treatment strategies. Arterial bleeding and embolization of systemic-pulmonary collaterals is a well-established strategy. Venous variceal bleeding may not be obvious; bronchoscopy, CT, and LPA wedge angiograms can all provide important diagnostic information. Optimal treatment is aggressive attempts relieve PVS even when atretic. Further, if PVS cannot be relieved, transcatheter functional pneumonectomy should be considered before surgical pneumonectomy.

ETHICS DECLARATIONS

Conflict of Interest: The authors declare they do not have any conflict of interests.

Ethical Approval: Not applicable.

Consent for Publication: Yes.



082. Lifesaving use of temporary balloon occlusion of an iliac artery disruption to prevent hemorrhagic shock

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A 4-year-old girl with a history of hypoplastic left heart syndrome, s/p staged SV palliation with Fontan completion. She had stent dilation of a re-coarctation using a 7mm x17mm Visi-Pro Stent. She was referred to the cardiac catheterization laboratory for redilation of her coarctation stent due to increased gradient across the arch . Access was obtained using ultrasound guidance with 4Fr sheath in the left femoral artery. A 7 French long sheath was needed to place a premounted 10 mm Visi-Pro stent across the coarctation stent which was noted to be fractured on angiography. The 4 French short sheath was exchanged for a 7 French long sheath prior to intervention. There was difficulty in advancing the 7 French long sheath over the exchange wire. This was thought to be related to scarring at the access site and for that reason the 7 French sheath was removed and then dilated using a 5 and then 7 French dilator without difficulty. The 7 French sheath was inserted again with continued difficulty in advancement. At that point, angiography was performed confirming dissection and disintegrated left common iliac artery from the level of the iliac bifurcation off the aorta to the level of the left common femoral. Patient's hemodynamics became unstable due to hemorrhagic shock with retroperitoneal hemorrhage. The following steps were done to address the hemorrhagic shock and restore iliac and femoral artery patency:

- A 5 mm Mustang balloon was advanced over the existing wire past the tip of the long 7 French sheath and was used to occlude the left common iliac artery which helped to stop the bleeding into the retroperitoneal space and stabilized hemodynamics.
- Two units of PRBCs were transfused to stabilize hemodynamics balloon.
- Protamine was reversed and platelets were administered due to history of aspirin treatment
- A Vascular surgeon was called but the surgery needed to delayed for two hours due to ongoing vascular surgery case
- Patient was eventually transferred to the OR with vascular surgery for exploration and reconstruction of the left iliac artery. A general pediatric surgeon assisted during the case due to the extensive abdominal dissection needed.
- Of note, the long sheath and a 5 mm balloon used to occlude the left iliac artery were kept in place at the end of the catheterization, during transport to the vascular surgery OR, and until exploration of the left iliac femoral artery is done. When the vascular surgeon had access to the iliac and femoral artery, the balloon was deflated and removed. The long sheath was removed with difficulty noted at the insertion site in the groin, requiring scar release by the vascular surgeon.
- Left common iliac to common femoral arterial bypass was done using a 5 mm x 13 cm cryopreserved Saphenous vein graft (CryoVein)
- A prophylactic left lower leg 4-compartment fasciotomies was performed by vascular surgery due to prolonged ischemia time (5.5hrs). All the compartment muscles looked viable.
- At the end of the procedure, Doppler confirmed triphasic flow in the left superficial femoral artery and the left profunda femoral artery. Left pedal pulses were palpable.
- F/u vascular ultrasound done at 1day and 3 months showed good flow in the left common iliac, superficial femoral, profunda femoral artery, and dorsal pedal artery.

ETHICS DECLARATIONS

Conflict of Interest: The authors declare they do not have any conflict of interests.

Ethical Approval: Not applicable.

Consent for Publication: Not applicable.

083. The Versatile Use of Visi-Pro Pre-mounted Stents in Children with Congenital Heart Disease

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Introduction The pre-mounted Visi-Pro balloon expandable stent (Medtronic) is approved for use in patients with peripheral arterial disease and biliary obstruction, but we have found the stent to be useful in treating children with congenital heart disease. There are limited reports of its use in this population, thus, we report our experience including acute outcomes and medium-term follow-up. Methods: We retrospectively identified all patients in whom a Visi-Pro stent was implanted at our institution between 1/2011 and 6/2021. A chart review was performed and relevant demographics and procedural data extracted. For any patient who underwent subsequent cardiac catheterization, these procedures were also reviewed and relevant details extracted. Results: 68 stents were placed in 52 patients. The median age of the patients at time of implantation was 5.5 months (1 day–17.9 years) and median weight was 4.6 kg (1.5–35.5). 34 (50%) stents were placed in a pulmonary artery, 25 (37%) in a right ventricle (RV) to pulmonary artery (PA) conduit, 5 (7%) across the atrial septum, and 4 (6%) in systemic or pulmonary veins. Of the pulmonary artery stents, 29 stents were placed in patients with 2 ventricle circulation and 5 were placed in patients with single-ventricle circulation. Of the RV to PA conduit stents, 21 were placed in those with a 2 ventricle circulation and 4 in patients with single-ventricle circulation. Of the 68 stents, 9 (13%) were 6 mm in diameter, 15 (22%) were 7 mm, 22 (32%) were 8 mm, 10 (15%) were 9 mm, and 12 (18%) were 10 mm in diameter. The median diameter of vascular or conduit stenosis was 3 mm (0–5.6) before intervention and improved to 7 mm (5–10) after intervention (excludes the 4 atrial septal stents). There were no instances of stent malposition. Excluding the atrial septal stents, 44 stents were evaluated during at least one follow-up catheterization. The median time from stent implantation to most recent follow-up catheterization was 24.5 mo (6–89). At most recent follow-up, 4/44 (9%) stents had evidence of unintended fracture. Of the stent fractures, 3 occurred in stents implanted in a PA; in all 3 patients, the original stent was balloon dilated to account for somatic growth and no new stents were implanted. One fracture was observed in an RV to PA conduit 18 months after implantation and additional stents were placed within the stented conduit. Excluding stents placed across the atrial septum, 28 stents were enlarged with balloon dilation at subsequent catheterizations. At subsequent dilation, the 6 and 7 mm stents were dilated to a maximum size of 14 mm, the 8 mm stents were dilated to a maximum size of 14 mm, and the 9 and 10 mm stents to a maximum size of 17 mm. At last follow-up, no stents had been intentionally fractured. Conclusions: The Visi-Pro pre-mounted stent can be used in a variety of locations and is very durable. Further study is needed to evaluate the rate at which the stents can be intentionally fractured.

ETHICS DECLARATIONS

Conflict of Interest: The authors declare they do not have any conflict of interests.

Ethical Approval: Not applicable.

Consent for Publication: Not applicable.

084. Novel Use of the Penumbra Lightning Aspiration Thrombectomy System in an Infant with Complex Congenital Heart Disease

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Vascular thrombosis is a source of severe morbidity and mortality in children with congenital heart disease. The etiology is multifactorial and can be attributed to low flow, turbulence, vascular obstruction, presence of foreign material (e.g. devices, central lines, etc.), as well as pro-thrombotic states. Standard treatment for occlusive thrombosis in pediatric patients after cardiac surgery includes pharmacological therapy, transcatheter options and surgical clot removal. Published data regarding transcatheter mechanical thrombectomy in children has been limited to small series or case reports, and there are no data to compare the efficacy and safety between the available thrombectomy device systems in children. The Penumbra Indigo system with Lightning^{TM} Intelligent Aspiration (Penumbra, Alameda, California) is designed to minimize blood loss during thrombus aspiration. It uses dual pressure sensors for real-time detection of solid clot versus liquid blood, automatically adjusts between intermittent and continuous aspiration, and provides audiovisual cues to the operator. It is currently available in 7 and 12 French catheter sizes. Here we describe the first reported use of this system in an infant who had life-threatening thrombosis after second-stage single-ventricle palliation. The patient was an infant male with asplenic heterotaxy syndrome and complex single ventricle, including pulmonary valve atresia, discontinuous pulmonary arteries supplied by bilateral arterial ducts and bilateral superior vena cavae. As a newborn he underwent pulmonary artery unifocalization and central shunt placement. At the age of 9 months and weight of 7.2 kg he underwent bilateral bidirectional Glenn anastomosis with pulmonary artery patch angioplasty. His post-operative course was notable for severe cyanosis secondary to massive thrombosis of the right superior vena cava and right pulmonary artery. He was emergently brought to the cath lab and underwent angioplasty of right-sided cavopulmonary stenosis, thrombectomy with a 6-French AngioJet system (Boston Scientific Corporation, Marlborough, MA), and local administration of tissue plasminogen activator (tPA); however, significant residual clot remained. Three days later he returned for mechanical thrombectomy from the left internal jugular vein approach. Using the 8 French Penumbra Indigo Aspiration system and Lightning Intelligent Tubing, clot in the right SVC and RPA was removed. Follow-up angiograms showed near complete resolution of the clot, and the patient tolerated the procedure well without complications. He received additional anticoagulation and tPA in the ICU, and surveillance angiogram two days later showed no residual clot. He was eventually extubated and weaned to room air. Catheter-based thrombectomy is an important tool in the treatment of children with severe thrombosis. Here we have shown the usefulness of the Indigo Lightning system to aspirate a large thrombus while minimizing blood loss in order to treat a life-threatening thrombus in an infant following high-risk bilateral bidirectional Glenn operation. Further use of the Indigo Lightning system in children with congenital heart disease may shed light on the benefits and drawbacks of this tool for our patients.

ETHICS DECLARATIONS

Conflict of Interest: The authors declare they do not have any conflict of interests.

Ethical Approval: Not applicable.

Consent for Publication: Not applicable.

085. Ductus Arteriosus Stenting Versus BTM in Congenital Heart Disease with Ductus-Dependent Pulmonary Circulation. Experience from a Brazilian Center

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Introduction Patients with ductus arteriosus (DA)-dependent pulmonary circulation are still a challenge, particularly in neonates who are ineligible for primary repair. These patients require palliative procedures, either surgically by construction of a systemic to pulmonary shunt (modified Blalock-Taussig-MTB) or percutaneously by ductus stenting. Objective: To evaluate the efficacy of ductus stenting compared to BTM surgery in patients with ductus-dependent pulmonary circulation. **Method:** Retrospective, longitudinal, single-center study. Forty-four neonates and infants diagnosed with congenital heart disease (CHD) and ductus-dependent pulmonary circulation admitted to our Hospital during the period from November/2016 to September/2021 were included. Fourteen pts (31.8%) underwent BTM surgery (Group 1) and 30 (68.2%) underwent cardiac catheterization for duct stenting (Group 2). Sex, age, mean endotracheal intubation time, mean length of hospital stay (LOS), complications and deaths were evaluated. Results: In group 1 (G1), the mean age was 38 days versus 14.5 days in group 2 (G2). There as a male predominance in both groups, being in G1 10 pts (71.5%) and in G2 16pts (53.3%). In G1, the most common diagnosis was tricuspid atresia with 5 (35.7%), followed by Tetralogy of Fallot (T4F) 4 (28.5%), pulmonary atresia with ventricular septal defect (PA with VSD) 3 (21.4%) and pulmonary atresia with intact septum (PAIVS) with 2 pts (14.3%). In G2, the most common diagnosis was PAIVS 8 pts (26.6%), followed by T4F 6 (20%), PA with VSD 4pts (13.3%), critical pulmonary valve stenosis 4 pts (13,3%) and tricuspid atresia with double outlet of the right ventricular (DORV) and critical pulmonary stenosis—2pts (6%), double inlet left ventricular inflow with PS—2 pts (6%). Other G2 diagnoses were DORV with transposition of great arteries (TGA)and PS and Ebstein's Anomaly, 1pt each. Mean ventilation time was 5 vs 4.9 days and mean LOS was 17.5 vs 12.7 days. All patients in G1 developed complications, the most common being sepsis 5 (35.7%), while in G2, 20 (66%) had no complications. Sepsis and heart failure were the most common complications in this group with 3 pts each (10% each), and post-extubation laryngitis 1 (3%). There were 6 (42.8%) deaths in G1 vs 2 (6.6%) deaths in G2. **Conclusion** In our experience, ductus stenting was successful. All patients taken for percutaneous treatment had their stent implanted. Acute severe acute complications have not been seen in this study. BTM in our institution presented high mortality and morbidity rates. Our study reinforces that ductus stenting is a safe alternative to maintain pulmonary flow.

ETHICS DECLARATIONS

Conflict of Interest: The authors declare they do not have any conflict of interests.

Ethical Approval: Not applicable.

Consent for Publication: Not applicable.

086. Myval XL for Percutaneous Pulmonary Valve Implantation (PPVI) in Native Right Ventricular Outflow Tract (RVOT) ≥ 30 mm. Can We Go Up To 35 mm?

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Introduction PPVI in native RVOT has been established as a routine technique in many centers. However, native RVOT $\geq$ 30 mm (measured by sizing balloon) remain very challenging. In the case of balloon expandable valves, it is necessary, in these dimensions, to perform prestenting and doing the valve implantation in the same procedure, or in a second deferred catheterization. Objective: To present our results in PPVI with Myval XL valve (Meril), in native RVOT (pre-stented), and to contrast the in-vitro valve overdilatation test up to 35 mm, in its clinical application. Methods and Results: 10 patients with native RVOT presenting severe pulmonary insufficiency (pulmonary regurgitant fraction 43.4% $\pm$ 5.2%) with mean RV end-diastolic volume 153.7 $\pm$ 10.3 ml/m2 were enrolled. Median age 22 years (11–49 years). All patients previously underwent RVOT prestent implantation with Andrastent XXL (43–57 mm) premounted on balloons of 30 mm (N = 2), 32 mm (N = 3) and 35 mm (N = 5). In two patients valve implantation was performed in the same procedure, and in the rest in a second procedure, 2–4 months after prestenting. Myval XL 30.5 mm (N = 4) and Myval XL 32 mm (N = 6) were successfully implanted, using 24 f (2) and 26 f (7) DrySeal valves. All cases were performed through femoral access, except 1, transhepatic access (due to superior and inferior vena cava agenesis). In cases in which the pre-stent was implanted up to 35 mm, the valve was implanted by adding 8–10 ml of extra saline, with respect to the nominal volume, to reach the target diameter of 35 mm. In no case did angiography of the control pulmonary artery show significant pulmonary regurgitation, and there were not residual gradient. In the case of transhepatic access, there was a rupture of the papillary muscle of the septal leaflet of the tricuspid valve, due to tearing of the Python introducer, which was surgically repaired 1 week after the procedure. No other significant peri-procedural complications were observed. Median follow-up time was 9 months (1–26) with good valve function without regurgitation. **Conclusion** Myval-THV implantation in pre-stented native RVOT with diameters up to 35 mm is feasible and safe, maintaining good valve competence in the medium term. Diameters larger than 32–33 mm exceed the limits of most of the new self-expanding valves, Therefore, the oversizing of the Myval XL may be a suitable alternative in selected patients. *The Python introducer, included in the implantation kit, tears easily if it undergoes a slight angulation, so other options should be sought for accesses different from the femoral vein.*

ETHICS DECLARATIONS

Conflict of Interest: The authors declare they do not have any conflict of interests.

Ethical Approval: Not applicable.

Consent for Publication: Not applicable.

087. Management of Severe Mitral Regurgitation After Failed Surgical Mitral Valve Repair

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Introduction Recurrent mitral regurgitation after surgical mitral valve repair is independently associated with worse outcomes. Redo surgery carries an increased risk of adverse events. Percutaneous mitral edge to edge repair has emerged as a valuable option in patients with severe symptomatic primary mitral regurgitation (MR) despite medical therapy or severe secondary MR with a prohibitive surgical risk. History of presenting illness: Patient is a 72-year-old female who has a past medical history of coronary artery disease status post-2-vessel coronary artery bypass graft surgery (LIMA to LAD, SVG to OM3) in 2008, chronic heart failure with reduced ejection fraction (LVEF 30–35%, LVEDD 7.3 cm) status post-CRT-D in 2019, mitral regurgitation (MR) status post-repair and annuloplasty ring placement in 2010, invasive squamous cell carcinoma status post-radiation and RUL wedge resection in 2017, atrial fibrillation, diabetes, hypertension, chronic kidney disease, chronic thrombocytopenia and multiple recent hospitalizations for decompensated heart failure presents with recurrent shortness of breath. She reports severe fatigue and shortness of breath after walking one block at a ground level or climbing one flight of stairs. Transesophageal echocardiogram showed malcoaptation of the valve leaflets resulting in severe MR and findings concerning for mitral valve ring dehiscence. There's no evidence of flail or prolapse of the mitral leaflets. Mitral valve area by planimetry is 2.0 cm^2 and mean gradient is 4 mm Hg at 70 beat per minute. Cardiac CT showed a complete mitral annuloplasty ring visualized approximately 15-16 mm above the mitral valve plane without rocking motion. Decision making: The patient's STS score is 15%. CCS 0. NYHA Class III. She was evaluated by cardiovascular surgery and deemed to be a high risk for a third operation. The etiology of mitral regurgitation is thought to be secondary to annular dilation. The decision was to proceed with transcatheter edge to edge repair using MitraClip. Procedure details: -An 8 F sheath was placed in the right femoral vein. -Transseptal puncture was carried out using RF needle in the usual fashion under fluoroscopy and TEE guidance. -A stiff wire was anchored in the left upper pulmonary vein and a 24 F Steerable guide catheter was placed in the left atrium. -The MitraClip delivery system (NTW) was advanced with great care and moderate difficulty across the mitral ring into the mitral valve under 3-dimensional TEE guidance. The clip arms were carefully opened to 120°.The A2-P2 segments of the mitral valve were captured. -The clip arms were tightened, achieving significant reduction in the MR without change in the mean gradient across mitral valve before and after clip deployment (4 mmHg and 3 mmHg, respectively) and improvement in left atrial pressure from 25/64/31 to 21/46/27. The patient was seen on follow-up and reported significant improvement in her symptoms and hasn't had any recurrent admissions since the procedure—3 months ago. **Conclusion** MitraClip is a safe and less invasive treatment option for patients with recurrent MR after failed surgical mitral valve repair. Further studies to evaluate long-term outcomes of MitraClip in a partially dehisced ring are necessary to establish the safety and efficacy of this approach.

ETHICS DECLARATIONS

Conflict of Interest: The authors declare they do not have any conflict of interests.

Ethical Approval: Not applicable.

Consent for Publication: Not applicable.

088. BeGraft Aortic Stents: A European Multi-centre Experience Reporting Acute Safety and Efficacy Outcomes for the Treatment of Vessel Stenosis in Congenital Heart Diseases

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Background and Aim: Stent implantation for the treatment of vessel stenosis in congenital heart diseases has become the preferred method of treatment. Availability of covered stents may decrease complications and may have an important role in the management of patients with complex anatomy. Aim of this study is to evaluate the feasibility and safety of the pre-mounted cobalt-chromium stent-graft covered ePTFE Aortic BeGraft in a broad spectrum of vascular lesions. Methods: This is a multicenter retrospective results analysis of 67 implanted Be Graft Aortic stents between 2016 and 2022 in four different European centers. Results: 63 patients aged 12 years (range 4–59 years), with body weight of 59.5 kg (range 14–103 kg) underwent Be Graft stent implantation. Fifty-four patients had aortic coarctation, 3 patients had conduits stenosis in a total cavopulmonary connection (TCPC), 6 patients had stenosis of pulmonary conduit and one patient was treated for a wide portocaval fistula. All the stents were implanted successfully. Median stent diameter was 16 mm (range 12–24 mm) and median length was 39 mm (range 19–49 mm). Four patients received 2 stents. Mean final long sheath size was 12 ± 3 Fr. Aortic gradient decreased from a mean of 40 ± 15 mmHg to 12 ± 6 mmHg. Three major complications occurred. During a conduit stenting procedure, the stent balloon ruptured with some difficulties in retrieval, 1 patient experienced a cerebral embolization without neurological consequences and 1 patient had a femoral artery occlusion requiring vascular surgery for reperfusion. Mean follow-up was 11 months. No late complications occurred. One patient had a stent narrowing in aortic position during follow-up that needed redilatation. Conclusions: Be-graft stent can be used safely and effectively in a wide spectrum of congenital heart diseases. Whether these good results will be stable in the long-term follow-up still needs to be investigated given its recent introduction into clinical practice.

ETHICS DECLARATIONS

Conflict of Interest: The authors declare they do not have any conflict of interests.

Ethical Approval: Not applicable.

Consent for Publication: Not applicable.

089. Impact of Pulmonary Hypertension Secondary to Congenital Heart Disease on Right Ventricular Volumes and Function Using Three Dimensional Echocardiography

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Background: Quantitative echocardiographic assessment of right ventricular (RV) function is becoming of increasing interest in cardiac

diseases that affect the right ventricle, such as congenital heart disease and acute or chronic pulmonary hypertension (PH), but is still challenging due to RV complex anatomy and structure. Aim of the Work: To study the effect of PH on the RV volumes and function using three dimensional echocardiography (3DE) and to determine the non-invasive predictors of PH in patients with PH secondary to congenital heart disease. Patients and Methods: This cross sectional study included all patients with congenital heart diseases complicated by pulmonary hypertension referred to cardiology department in Ain shams university hospital for elective hemodynamic assessment. Results: The diagnostic accuracy of 3D RV parameters for detecting hemodynamic signs of pulmonary hypertension (a composite of PVR > 7) was shown by receiver-operating characteristic curves. The parameters with the largest areas under the curve (AUC) were: 3D tenting volume (1.000) had the highest area under the curve followed by 3D-TV annulus area and lastly 3D RV EF. The best cut-off values of: 3D TV tenting volume > 4.8 (Se: 100%, Sp: 100%), 3D TV annulus area > 9.3 (SE: 100%, SP: 92.5) and 3D RV EF $\leq 42\%$ (SE = 100%, SP + 77.5%). **Conclusion** In PH patients, the quantitative assessment of global and regional RV function by 3D provided useful hemodynamic and prognostic information. Several indices can be obtained by 3D echocardiography non-invasively, to predict the PVR in congenital heart disease with PH.

Key words: Pulmonary hypertension, congenital heart disease, right ventricle, two-dimensional, three-dimensional echocardiograms.

ETHICS DECLARATIONS

Conflict of Interest: The authors declare they do not have any conflict of interests.

Ethical Approval: Available.

Consent for Publication: Accepted.

090. Learnings and outcomes from implementation of a pathway to guide neonatal patent ductus arteriosus management

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Background: Optimal management of the patent ductus arteriosus (PDA) in the premature neonate remains subject of debate. Transcatheter PDA closure (TPC) has been introduced as an effective method to address the PDA in preterm neonates as small as 700 g. While safety of TPC has been demonstrated, guidance on patient selection and procedural timing remains limited. **Objectives**: We aimed to standardize identification of PDAs in preterm infants, selection of candidates for TPC, and timing of closure through creation of a PDA management pathway (PDA-MPW). After implementation of the PDA-MPW, we aimed to retrospectively review our experience and evaluate the pathway's effects on bronchopulmonary dysplasia, mortality, and other relevant outcomes. Methods: The PDA-MPW was implemented as a quality improvement initiative. A Plan-Do-Study-Act cycle was used to iteratively improve the PDA-MPW through a multi-disciplinary committee. A retrospective study was completed to evaluate the outcomes of neonates managed on the first 18 months of the PDA-MPW (n = 116) compared to those managed pre- PDA-MPW (n = 116). Fisher's exact tests, X2, t-tests, and Mann–Whitney U tests were used to ensure equivalency and compare secondary outcomes. Variables with potential influence on BPD/death were fitted for a multivariate binomial logistic regression to explore their adjusted odds ratios (aOR). Results: 442 babies were screened on PDA-MPW from November 2018 through March 2021, and 44 underwent TPC. Over time, the average time from diagnosis of PDA to referral to TPC decreased. In the retrospective study, there was baseline equivalency in the neonates managed pre-PDA-MPW and those on the PDA-MPW. Those who underwent TPC on the PDA-MPW were smaller (1278.6 versus 2338.1 g, $p < 0.001$) and at a lower corrected gestational age (31.1 versus 37.2 weeks; $p < 0.001$) compared to those pre-PDA-MPW. Neonates managed pre-PDA-MPW were approximately 2.5 times more likely to develop moderate/severe BPD or to die compared to those on the PDA-MPW (aOR [95% CI]; 2.50 [1.09–5.69]). Conclusions: A multi-disciplinary approach has been successful in the development and implementation of a PDA management pathway for preterm neonates. This has resulted in decreased practice variation and reduced time from identification of a PDA to intervention. A retrospective review demonstrated that management on our standardized PDA-MPW was associated with improved BPD outcomes for our patients.

ETHICS DECLARATIONS

Conflict of Interest: The authors declare they do not have any conflict of interests.

Ethical Approval: Not applicable.

Consent for Publication: Not applicable.

091. Intervention Through the ECMO and Bypass Tubing: Two Cases

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Introduction Extracorporeal membrane oxygenation (ECMO) and cardiac bypass are frequently needed to support extremely sick children. We describe successful interventions through ECMO circuit tubing in 2 young children. Case 1:A 2-year-old male presented with acute respiratory failure secondary to RDS. He was placed on V-V ECMO using a 20 Fr Avalon cannula inserted in the right internal jugular vein. After a few days, the ECMO cannula migrated into the middle hepatic vein. Cannula repositioning with the classic manual manipulation has failed. A 5-Fr sheath was inserted at the inflow tube close to its connection with the cannula. A combination of a 0.035″ J-tip wire and a 4-Fr angled glide catheter were used to access the hepatic IVC and reposition the cannula by sliding it over the catheter. Of note, with the initial manipulation, air was sucked into the circuit presumably through the valve of the sheath. To prevent introducing air, all subsequent manipulations were performed with brief periods of ECMO pauses. After a successful repositioning, the tube just proximal and distal to the sheath was clamped. The tube was cut exactly at the sheath insertion site. The two ends were reconnected using a sterile ¼" to ¼" connector. After a few days, the cannula remigrated again and was successfully repositioned using the same technique. Case 2: A 4-month-old male with hypoplastic left heart syndrome underwent comprehensive stage II palliation. In the immediate post-operative period, his oxygenation and cardiac output were low. Glenn circulation was taken down and a 5 mm modified Blalock Taussig (mBT) shunt was placed from the right innominate artery (RIA). However, his saturation continued to be low. A 4-Fr sheath was inserted in the arterial tube of the bypass machine. Angiogram showed patent mBT shunt with narrowing at the RIA. It was decided to stent the innominate artery. Through the sheath in the tube, a 0.014″ grand slam wire was placed in the right subclavian artery. The 4-Fr sheath was exchanged for a 5-Fr sheath. A 5-Fr

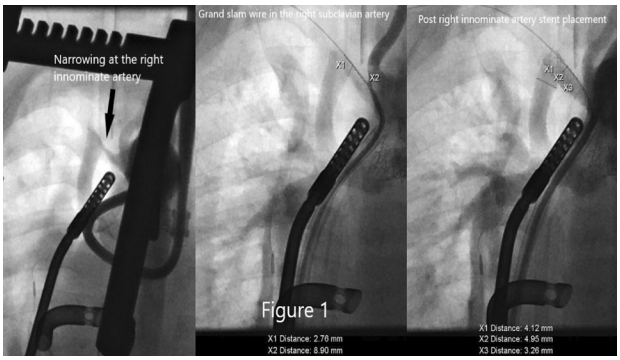
multipurpose guide catheter was tracked over the wire through which a 4 mm x 8 mm Rebel coronary stent was placed. The stent needed to jail the take-off of the mBT shunt to avoid sticking inside the aorta (Fig. 1). Similar to case 1, the sheath was removed and the two ends of the arterial tube were connected (Fig. 2). After a few days, the patient was successfully decannulated. Three weeks later, the patient has suddenly circulatory collapse requiring emergent V-A ECMO cannulation (through the right carotid and right internal jugular vein). A 5-Fr sheath was placed in the tubing of the arterial cannula. Angiogram revealed narrowing in the distal mBT shunt. Through the same sheath, the side cell of the innominate artery stent was ballooned into the mBT shunt followed by stent placement at the distal mBT shunt. He tolerated the procedure well with no complications. **Conclusion** Direct ECMO/ cardiac bypass tubing accessing allows performing different interventions without the need for the classic arterial or venous sheath placement.

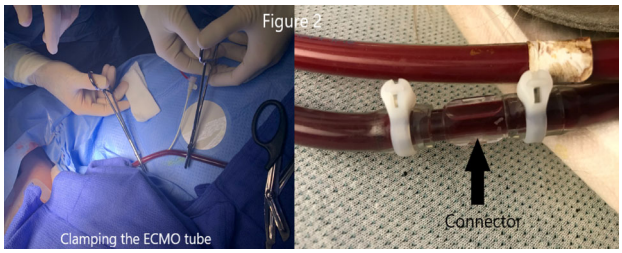
ETHICS DECLARATIONS

Conflict of Interest: The authors declare they do not have any conflict of interests.

Ethical Approval: Not applicable.

Consent for Publication: Not applicable.





092. Patent Ductus Arteriosus to Facilitate Arch Stent Placement

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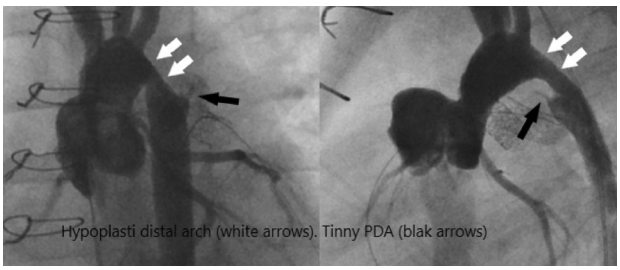
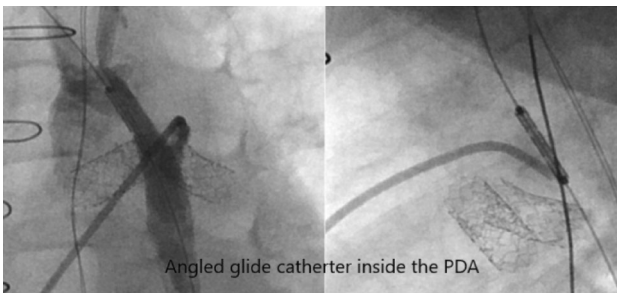
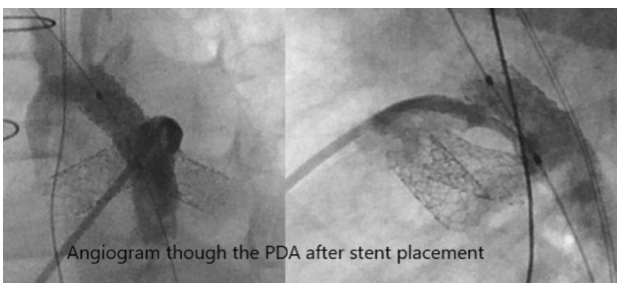
Introduction Aortic arch stent placement usually requires the use of a long arterial sheath which is well established risk for pulse loss, especially in small children. Herein, we describe a successful arch stenting through a short sheath in an infant with a coexisting small patent ductus arteriosus (PDA). Case presentation: The patient is a 2-year-old female weighing 12.8 kg with a history of Williams syndrome, supravalvar aortic and pulmonic stenoses, and hypoplastic branch pulmonary arteries, and aortic arch. After surgical repair, her branch pulmonary arteries continued to be stenotic for which she underwent bilateral stent placement. Additionally, aortic angiogram revealed significantly hypoplastic distal aortic arch (measuring 2.8 mm with a peak-to-peak gradient of 15 mmHg) and a tiny PDA. Through the 4-Fr sheath in the right femoral artery (RFA), a 0.018″ SV-5 wire was placed in the right subclavian artery. The 4 Fr sheath was upsized to a 5 Fr 11 cm prelude ideal sheath. A 4-Fr angled glide catheter was inserted in the right femoral vein sheath and advanced inside the PDA. A 6 × 12 mm Formula 418 stent was prepped and advanced over the SV-5 wire. Serial angiogram was obtained through the angled glide catheter in the PDA to guide stent positioning. The stent was deployed in the distal arch by inflating the balloon to 12 atm. Angiography demonstrated satisfactory stent position and expansion (Fig. 1). Repeat hemodynamic showed resolution of the gradient across the distal aortic arch.







Conclusion: Placing a catheter inside the PDA through a venous sheath can be used to obtain angiography to assist with arch stenting. This method allows intervening on the aortic arch through a short arterial sheath.

ETHICS DECLARATIONS

Conflict of Interest: The authors declare they do not have any conflict of interests.

Ethical Approval: Not applicable.
Consent for Publication: Not applicable.

093. Sinus Venosus Atrial Septal Defect: Deriving Metrics for an Ideal Transcatheter Device?

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Background: Transcatheter repair of superior sinus venosus atrial septal defects (SVASD) using a covered stent has been gaining popularity as an alternative to surgery. However, the technique is new and in the absence of a dedicated device there has been multiple challenges not limited to stable anchoring in the Superior Vena Cava (SVC), avoiding obstruction of pulmonary veins, differential shortening of balloon expandable stents with risk of embolization and residual shunting. We set out to derive ideal stent metrics and characteristics using advanced imaging techniques and report the results. Methods: Data of all the patients with a diagnosis of SVASD from 2012 to 2022 was extracted from our institution database. The anatomic and morphologic characteristics of the SVC, anomalous pulmonary veins' (APVs) site and drainage into the SVC, ASD location and size, and associated lesions were evaluated using computerized tomography (CT) or magnetic resonance imaging (MRI), as well as Interactive 3D visualization and 3D printing to decide amenability for transcatheter closure. We measured the diameters of the internal jugular vein (IJV) and SVC at different levels (Fig. 1) and the lengths of segments of the SVC above and below entry of the APVs. We hypothesized 3 sizes of covered self-expansile stents with uncovered anchoring flared edges and narrower middle segment would treat majority of SVASDs. Patients less than 30 kgs and 120 cms were excluded from the study to allow for potential growth and to have adequate sheath access. An ideal stent was postulated to have a covered area that will direct all pulmonary veins to the LA through an adequately sized ASD, exclude the Azygos veins and direct the innominate and internal jugular veins to the RA. Results: 39 patients with SVASD presented to our institution during the study period. 19 of them were excluded for not meeting the weight and height, not having prior CT or MRI, or anatomy not amenable for transcatheter closure. 12 patients (60%) were male, mean weight was 70.2 ± 22.3 kg, height was 167 ± 16 cm, and ASD size was 19.6 ± 7.7 mm. Depending on the length from the lower end of IJV to 2 cm below the lowest APV insertion (to assure direction of the APVs to the LA through the ASD and the margins of the ASD is covered by the stent) (Fig. 1), patients were divided into 3 groups > 90 mm, 75–90 mm and < 75 mm. Measurements of diameters and segmental length from the 3 groups as shown in Table 1. Three stent sizes 90, 75, and 65 mm (Fig. 2 and Table 2) with specified dimensions derived from our data would treat all patients meeting the inclusion criteria. **Conclusion** While 3 stent sizes with flared uncovered upper and lower segments more than 110–150% of the minimum diameter provide anchoring, the narrower middle segment of 15–16 mm can rout of the APV to the LA around without causing significant obstruction to the SVC. Developing such a covered self-expansile stent is likely to close majority of superior SVASDs.

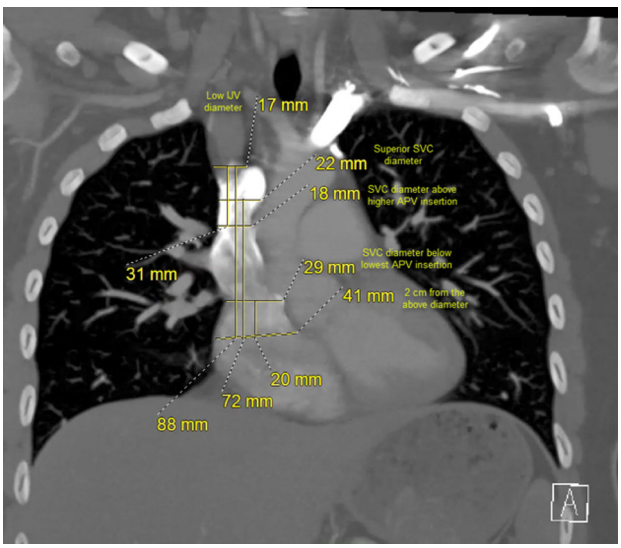

Fig. 1 MRI showing measurements used to determine the sizes of the stents. Anomalous pulmonary vein, APV; internal jugular vein, IJV; superior vena cava, SVC

Table 1 Mean and standard deviation of different measurements in the 3 patient groups. Internal jugular vein, IJV; millimeter, mm; Pulmonary vein, PV; superior vena cava, SVC

	IJV diameter (mm)	High SVC diam (mm)	High PV-SVC [C] (mm)	Low PV-SVC [D] (mm)	2 cm below D [E] (mm)	D-E (mm)	High SVC to E (mm)	IJV to E (mm)	IJV to C (mm)	C-D (mm)
Group 1: IJV-E > 90 mm										
Mean	15.0	17.8	20.0	29.8	36.8	20.0	91.6	104	44.4	38.6
Standard deviation	1.83	2.17	3.74	6.14	7.60	0.00	9.45	9.15	9.50	11.1
Group 2: IJV-E 75-90 mm										
Mean	15.2	18.7	19.5	26.6	35.5	24.2	69.3	79.9	25.3	32.2
Standard deviation	2.82	2.50	2.80	5.32	5.97	9.05	9.20	6.94	6.86	6.46
Group 3: IJV-E < 75 MM										
Mean	12.0	12.8	12.2	20.0	32.8	18.4	71.8	59.0	30.0	30.8
Standard deviation	-	1.30	1.30	2.00	4.55	2.30	20.4	-	8.60	9.74

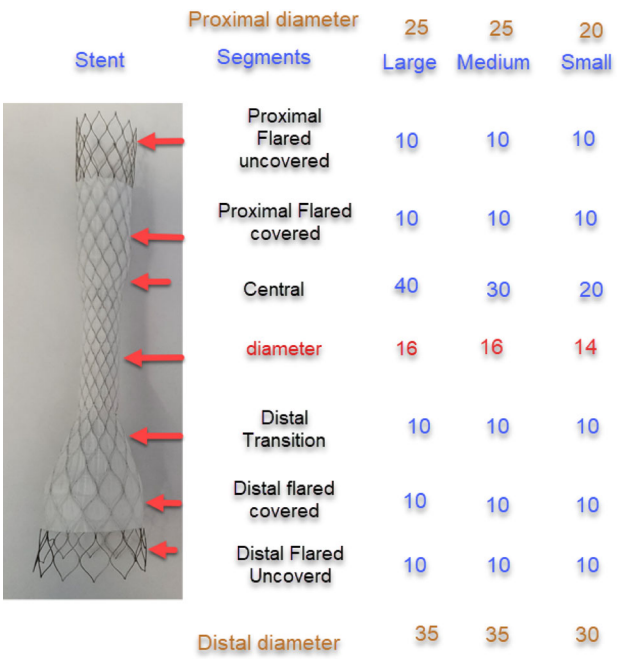

Fig. 2 Stent prototype showing different segments with bilateral distal flared uncovered segments

Table 2 Measurements of the 3 stent sizes in millimeter

	Large	Medium	Small
Proximal diameter	25	24	20
Uncovered	7.5	7.5	7.5
Covered	12.5	7.5	7.5
Central length	40	35	28
Central diameter	16	15	15
Distal transition	12.5	10	7
Covered	10	7.5	7.5
Uncovered	7.5	7.5	7.5
Distal diameter	38	35	32
Total length	90	75	65

ETHICS DECLARATIONS

Conflict of Interest: The authors declare they do not have any conflict of interests.

Ethical Approval: Not applicable.

Consent for Publication: Not applicable.

094. Atrial Flow Regulator Device in Children and in Patients with Congenital Heart Disease: An International Registry

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Background: The Atrial Flow Regulator (AFR) (Occlutech; Helsingborg, Sweden) is a double-disc device made of self-expanding Nitinol wire mesh. The device is structured around a central lumen, intended to maintain patent communication. Once deployed percutaneously, the central portion of the device stents the atrial septum leaving a preselected calibrated atrial communication. Its use has been approved in the adult population with heart failure and described for pulmonary hypertension. Only case reports have been published about its use in the pediatric population and congenital heart disease. **Aim:** Our study aims to describe the use of AFR in patients with congenital heart diseases and children with severe pulmonary hypertension or cardiomyopathy in a multicenter retrospective registry. Materials and methods: Seven centres worldwide participated in the registry. Inclusions criteria were: patients at any age with congenital heart disease or patients aged < 18 years with pulmonary hypertension or cardiomyopathy needing AFR implantation. Results: From 2019 to 2022, 29 patients underwent AFR implantation. The median age of the population was 59 months (IQR 34–204 months) and the median weight was 17,5 kg (IQR 10.5–54 kg). 24 patients had congenital heart disease, 2 patients had cardiomyopathy and 3 pulmonary hypertension. Indications for AFR implantation were: left heart failure (12pts), pulmonary hypertension (8 pts), severe desaturation in fenestrated Fontan (5 pts) and Fontan failure (4 pts). Almost all the procedures (93%) were performed under general anaesthesia. Venous access was femoral in 24 pts (83%), jugular in 2 pts (7%), transhepatic in 2 pts (7%) and subclavian in 1 pt (3%). The maximum venous sheath was 16 Fr. AFR implantation required balloon predilatation in 20 pts (69%). The implantation success rate was 100%. Two immediate AFR occlusions were registered: 1 in a patient weighing 13 kg with a Fontan failure in which a 4 mm AFR was used to create a fenestration and one in a patient weighing 19.5 kg with a fenestrated Fontan with desaturation in which a 4 mm AFR was used. In one case the clotted AFR was immediately removed and replaced with a 6 mm AFR and in the other, the clotted AFR was removed and replaced with a 6 mm AFR after one month. At a median follow-up of 1 year, no major complications occurred. 28/29 patients were alive and the only death was not related to the procedure. One 4 mm AFR was clotted 14 months after implantation and was treated with balloon angioplasty. At follow-up 13 patients improved their NYHA class, 11 patients did not change their NYHA class and only 1 patient with idiopathic pulmonary hypertension worsened his NYHA class. Conclusions: AFR implantation in patients with congenital heart diseases and children with severe pulmonary hypertension or cardiomyopathy is promising and at a short follow-up of 12 months seems to have beneficial effects. The AFR has the potential to provide benefits in terms of symptoms and survival to a variety of patients with limited treatment options and indeterminate prognosis.

ETHICS DECLARATIONS

Conflict of Interest: Konstantin Averin is proctor for Occlutech, Alban-Elouen Baruteau is consultant and proctor for Occlutech, Matthew Jones is consultant for Occlutech.

Ethical Approval: Not applicable.

Consent for Publication: Acquired.

095. Real World 5-, 7-, and 10-Year Outcomes for the Melody Valve in a Single-Center Population; Good Function for Most Hampered by a High Incidence of Endocarditis

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Introduction. The Melody valve, a stented bovine jugular vein valve, is a viable transcatheter option for patients with a dysfunctional right ventricular to pulmonary artery conduit or dysfunctional bioprosthetic valve in the pulmonary position. The 10-year follow-up for a Phase II study population was recently published but real world 5–10 year follow-up information is lacking. Methods. We retrospectively reviewed the medical records of 72 consecutive patients who underwent Melody valve implantation at our center between 2010 and 2017. Adequate follow-up information at 5 years or beyond was available for 35 patients. Valve wellness score at last follow-up was defined at excellent (1) for peak gradients < 40 mmHg and $< 1 +$ regurgitation, good (2) for gradients < 40 mmHg and $> 2 +$ regurgitation, fair (3) for gradients > 40 but < 60 or 2–3 + regurgitation, and poor (4) for any valve with gradient > 60 or regurgitation $> 3 +$. Need for intervention or surgery, incidence of infection and death were evaluated. Results. Of the 35 patients with adequate follow-up, there were 29 dysfunctional conduits and 6 dysfunctional bioprosthetic valves. Mean conduit size was 19.9 ± 2.1 mm (range 16–25 mm) and mean Melody valve size implanted was 19.7 ± 1.6 mm. Mean age at implant and at last follow-up was 14.5 ± 5.7 years and 23.2 ± 6.4 years, respectively. Doppler Peak valve gradients at 5, 7 and 10 years were 31 ± 16, 29 ± 14.7, and 44 ± 28 mmHg, respectively. Valve wellness scores of 1 (69%), 2 (11%), 3 (14%), and 4 (6%) were documented at last follow-up. Endocarditis occurred in 13 of the 35 patients (37%) at 5 ± 2.6 years post-implant; 9 of 13 (69%) required valve removal. One patient had second Melody placed, 2 have functioning valves (both with wellness scores of (1) and one required transplant following endocarditis. One patient died (2.8%) after treatment for his second bout of endocarditis on the same Melody valve (wellness score was 2 after first bout). While some suggest that smaller conduit size or higher residual gradient at implant are risks for endocarditis, we did not find that in our population. There was no difference in conduit/valve size between those who developed endocarditis (20.1 ± 2.5 mm) vs those who were endocarditis free (19.2 ± 1.6 mm), nor was there any difference in Melody valve size (20.2 ± 1.8 vs 19.3 ± 1.4 mm). The peak post-implant catheter-measured gradients also did not differ between these groups (13.6 ± 3.5 mmHg vs 12.3 ± 6.8 mmHg) Conclusions. Melody valve function, as designated by valve wellness scores, is good up to 10 years follow-up. However, the incidence of endocarditis in our population studied was, disappointingly, quite high and led to surgical valve removal and replacement in the majority of those patients. Neither conduit/valve size, melody valve size at implant nor peak post-valve catheter measured gradients were different in these groups.

ETHICS DECLARATIONS

Conflict of Interest: The authors declare they do not have any conflict of interests.

Ethical Approval: Not required.

Consent for Publication: Approved.

096. Simultaneous Three Balloon Angioplasty: A Technique to Maintain Pulmonary Vein Segmental Branch Patency

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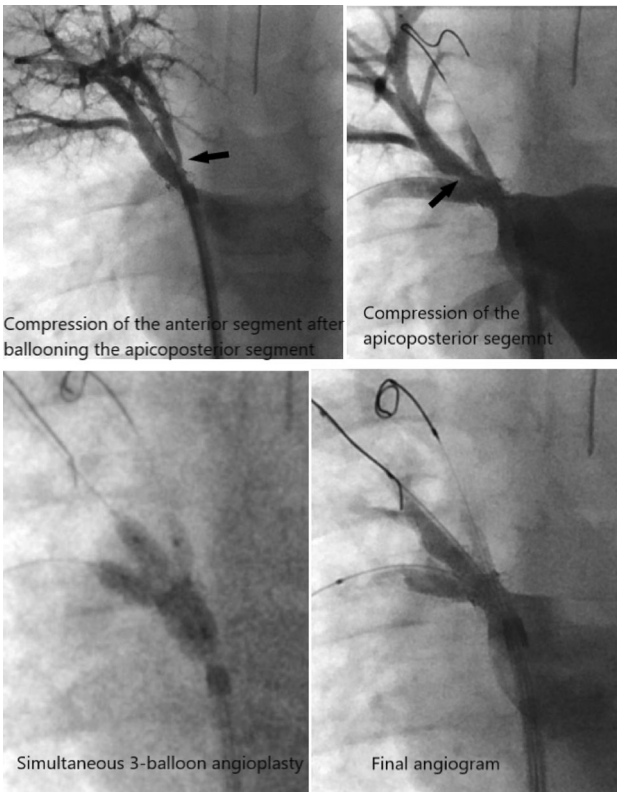
Introduction Frequent pulmonary vein balloon angioplasty is commonly needed to maintain the vein patency. When the segmental pulmonary veins are in close proximity to the stent, ballooning one segment often results in narrowing or occlusion of the other segment/s. We describe a technique to maintain the patency of all segmental veins. Case presentation: A 2-year-old male with a history of prematurity and multivessel pulmonary vein disease. He underwent stent placement in the right upper, right middle, left upper, and left lower pulmonary veins. The stent in the right upper pulmonary vein (RUPV) is extending inside the apicoposterior segmental branch traversing the take-off of the stented right middle pulmonary vein (RMPV) and the anterior segment of the RUPV. The anterior segment of the RUPV is draining through the previously ballooned side cell of the RUPV stent. Angiogram showed in-stent stenosis with narrowing at the take-off of all segments. All three segments were ballooned separately. However, ballooning resulted in compression of whatever segment which was not cannulated. Then, we decided to utilize the two-balloon technique. Through the 6-Fr 35 cm Brite tip sheath in the right femoral vein, a $0.014''$ Grand Slam wire was placed in the anterior segment and another one in the RMPV. Post-ballooning angiogram showed resolution of the stenosis in the ballooned segments. However, the apicoposterior segment got compressed. At this point, we decided to simultaneously inflate three balloons. Through the same 6-Fr sheath, a third grand slam wire was placed inside the apicoposterior segment of the RUPV. Three monorail Quantum apex balloons were prepped and inserted inside the 6-Fr sheath over the grand slam wires traversing the take-off of the three segments. We placed a 2.5×12 mm balloon across the anterior segment, a 3.5×12 mm balloon across the RMV, and another 3.5×12 mm balloon across the apicoposterior segment. All three balloons were simultaneously inflated. The monorail balloons allowed the operator to control all balloons with one hand and all wires with the other hand. Post-ballooning angiogram showed resolution of the stenosis in all three segmental branches (Fig. 1).



The same technique was used to treat the stenosis in the three segments of the left upper pulmonary vein. After 6 months, repeat cardiac catheterization showed that all RUPV and LUPV segments are patent but with mild-moderate stenosis. All segments were ballooned again using the three-balloon technique. The largest simultaneous balloons that were used inside a single 6-Fr sheath were 4 × 15 mm and two 3.5 × 15 mm monorail NC Quantum Apex balloons. **Conclusion** Simultaneous 3 balloon angioplasty is effective in maintaining the patency of pulmonary vein segmental branches. When choosing the right equipment, 3 balloons can fit together inside a single 6-Fr sheath.

ETHICS DECLARATIONS

Conflict of Interest: The authors declare they do not have any conflict of interests.

Ethical Approval: Not applicable.

Consent for Publication: Not applicable.

097. Transcatheter Stenting of Obstructed Infracardiac TAPVR in a 6-Week-old Infant Through the Venous Limb of the ECMO Circuit as Bridge to Surgery

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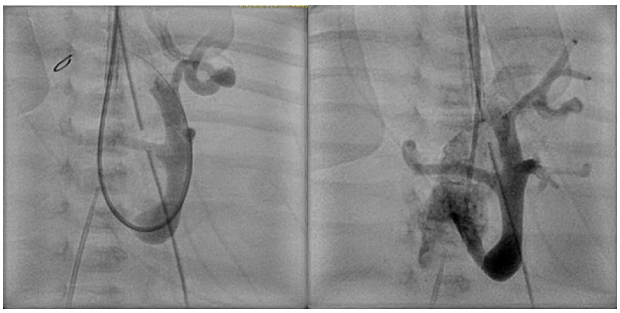
Introduction Obstructed infradiaphragmatic total anomalous pulmonary venous return (TAPVR) is a surgical emergency; some patients require ECMO support prior to surgical repair. Pre-operative transcatheter relief of obstruction is considered for patients with comorbidities (prematurity, genetic syndromes, multisystem organ failure) or high surgical risk. Case Report: A previously "well" 5-week-old female infant presented with cardiopulmonary collapse at an outside hospital. While awaiting transfer following diagnosis of obstructed infracardiac TAPVR she suffered a cardiac arrest. She was resuscitated and placed on veno-arterial extracorporeal membrane oxygenation (VA-ECMO) and transferred to our institution. She had severe pulmonary hypertension, gastrointestinal and pulmonary hemorrhage, and felt to be a poor surgical candidate. After multidisciplinary discussion, a decision was made to attempt transcatheter relief of pulmonary venous obstruction and allow organ recovery. At initially catheterization from the femoral vein, and a single left upper pulmonary vein (PV) draining to the innominate vein was stented. Unfortunately, this vein did not connect to the confluence and did not relieve obstruction. Access to the ductus venosus was not possible; umbilical venous or jugular approach could provide a better approach but were not accessible; no umbilical access in a 5-week-old, internal jugular utilized for ECMO. The solution was innovative use of the venous limb of the ECMO circuit for vascular access. The 12-Fr venous cannula in the right internal jugular vein was spliced and Y-connector was placed inline; one limb of the Y served as the ECMO cannula; the other limb of the Y was adapted with a hemostatic valve to serve as venous access for the intervention. To minimize the risk of air entrainment, the ECMO circuit was clamped whenever the hemostatic valve was accessed. A coaxial system with a microcatheter within a 4-Fr Angle Glidecath (Terumo Medical Inc., Somerset, NJ) was advanced through the ECMO cannula to the IVC. Using a 0.010″ Fathom guidewire (Boston Scientific, Natick, MA) the severely stenotic ductus venosus was cannulated. The coaxial system was advanced sequentially over the wire into the PV confluence. There was severe stenosis across the ductus venosus (27-mm mean gradient in the setting of ECMO decompression); angiography showed drainage of all except the left upper PV's draining via the severely stenotic ductus venosus. The severely stenotic DV was successfully treated with stent angioplasty using a 4 mm × 18 mm Multilink vision stent (Abbott Medical, Chicago, IL). After making a slow recovery the patient underwent a complete surgical repair, weaned from ECMO, and discharged home. At most recent follow-up (4 years of age) the patient is doing well with excellent hemodynamics (normal right heart pressures and no PV stenosis). **Discussion/Learning Objectives**: The venous and arterial limbs of the ECMO circuit can be modified for vascular access to successfully perform transcatheter interventions. When using the arterial cannula, risk of air entrainment is low but there is risk of blood loss during catheter manipulation. When using the venous cannula, there is high potential of entraining air during catheters manipulations and the circuit should be clamped while accessing the hemostatic valve.

ETHICS DECLARATIONS

Conflict of Interest: The authors declare they do not have any conflict of interests.

Ethical Approval: Not applicable.

Consent for Publication: Yes.



098. Intervening on A Stenotic Pulmonary Vein: A Rare Route

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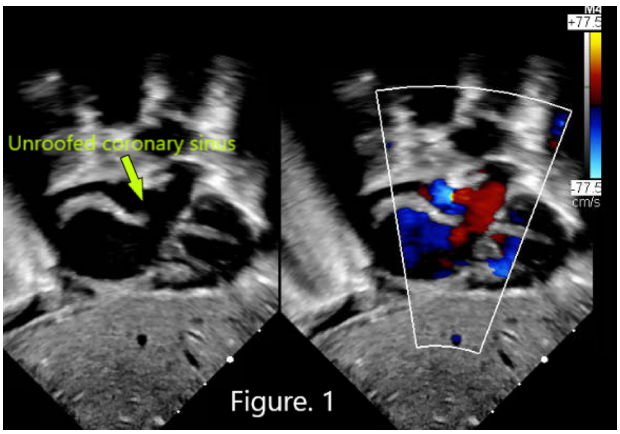
Introduction In patients with an intact atrial septum, transcatheter intervention on the pulmonary vein often requires a transseptal puncture which carries its own challenges and risks, especially in young children. We describe a rare case of intervening on the pulmonary vein through unroofed the coronary sinus. **Case presentation:** A 3-month-old male was born with truncus arteriosus, interrupted aortic arch, and persistent left superior vena cava draining into the right atrium via what was initially thought to be fully roofed coronary sinus. On day 10 of life, he underwent surgical repair. Immediately after repair, due to the severe branch pulmonary artery stenosis, stents were placed bilaterally. At 3 months of age, an echocardiogram showed increased flow velocity in the branch pulmonary arteries, dilated coronary sinus which is unroofed distally, and no atrial septal defect (Fig. 1). A 5-Fr sheath was placed in the right femoral vein (RFV) and a 20-gauge catheter was placed in the right femoral artery. Balloon angioplasty was then performed in the right and left pulmonary artery stents, along with the placement of an additional stent in the proximal left pulmonary artery. The left pulmonary artery wedge angiogram showed severe ostial stenosis of the common left pulmonary vein. We decided to attempt accessing the left pulmonary vein through the coronary sinus. A coaxial system consisting of a 5-Fr JR4 guide catheter, 4-Fr JR 2 catheter, and a 0.035" angled glide wire was inserted in the RFV sheath and used to access the coronary sinus and then cross the unroofed segment into eth the left atrium. Then, the angled glide wire was exchanged for a 0.014" Choice wire which was used to cannulate the common LPV. The JR2 catheter was then advanced over the wire into the left lower pulmonary vein. Angiograms showed severe stenosis of the common LPV just distal to the ostium. The Choice wire was exchanged for a 0.014" Asahi Grand Slam wire for stent placement. A 4 × 8 mm Synergy everolimus-eluting stent was advanced over the Grand Slam wire inside the guide catheter and centered across the stenotic portion. Angiography revealed the resolution of the stenosis (Fig. 2). Pressure measurement revealed no gradient across the stent (down from 16 mmHg at baseline). Cardiac catheterization after 4 months showed a mild degree of in-stent stenosis with significant growth of the segmental pulmonary veins. The stent was dilated using a 6 × 20 mm sterling balloon (through coronary sinus approach) (Fig. 3). **Conclusion** Unroofed coronary sinus when presents provide excellent access to facilitate pulmonary vein intervention. Its presence allows for avoiding the risky transseptal puncture, especially in young infants.

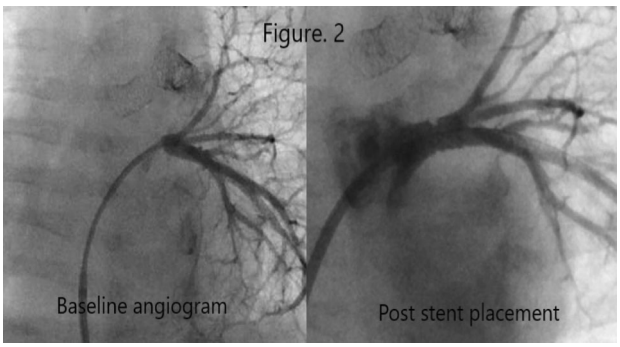
ETHICS DECLARATIONS

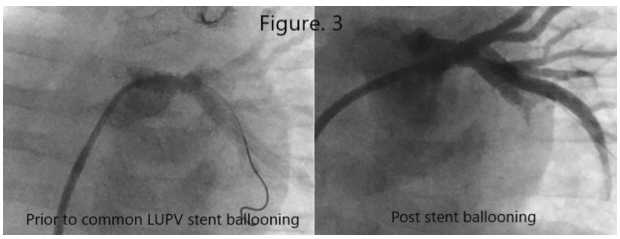
Conflict of Interest: The authors declare they do not have any conflict of interests.

Ethical Approval: Not applicable.

Consent for Publication: Not applicable.







099. Design and Evaluation of a Growth-Adaptive Pediatric Heart Valve

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Congenital heart defects (CHD) are the most common birth defect, affecting 40,000 babies born in the US annually. Valve defects, which occur in over 25% of CHD patients, often require surgery for survival. However, there are no valve designs on the market that address the small size and rapid growth of pediatric patients, in which a doubling of valve diameter occurs from infancy through age 5 years old. The goal of this work is to develop a growth-adaptive pediatric heart valve that will non-invasively double in diameter from 7 to 14 mm as the patient grows, eliminating the need for additional surgeries or interventions. The major innovations of our technology include a spring-like growth-adaptive stent that provides the expansion mechanism and a venous valve that functions at multiple diameters. To inform stent design, anatomical and tissue stiffness measurements were made at potential implantation sites (pulmonary artery, pulmonary valve annulus region) in juvenile Yucatan mini-swine (5.8–7.3 kg). These data guided the requirements for device length and target force profiles. Growth-adaptive stents were designed using nonlinear finite element analysis (FEA) to predict and fine tune performance. Stent designs were manufactured by femto-second laser cutting, followed by heat treatment and electropolishing (Resonetics, San Diego CA). Key dimensions of the stent were characterized by metrology and custom semi-automated analyses. Radial force testing was performed by Machine Solutions, Inc (Flagstaff, AZ). Stents that passed dimensional and performance quality checks were selected for implantation studies. Human femoral venous valves (CryoLife) were sutured to the growth-adaptive stents. Bench tests using a custom radial compression tool were used to assess valve function across diameters of interest. Acute studies were performed in Yucatan piglets (N = 4) to optimize implantation strategy and assess initial device function. Yucatan piglets had pulmonary artery and valve diameters in the initial size range of interest ($\sim$ 8 to 9 mm), with Young's modulus measurements of 75–85 kPa and 310–320 kPa in the elastic and fibrous regimes of stress–strain curves, respectively. A predictive numerical model informed by this data was then used to select an appropriate stent radial force for the implantation studies. Stent prototypes were successfully manufactured although some variations in key features were noted, and likely resulted in higher force profiles than predicted. However, maximum stent forces were within the acceptable limits of the model. Valves were successfully sutured to the stents and demonstrated competence on the bench at various diameters tested. Surgical implantation was performed with anchoring sutures, utilizing stent-wall apposition to achieve a seal. Implantation in the main PA was preferred. The devices were successfully constrained by the native tissue and the valve was functional. In summary, our results point to the feasibility of a growth-adaptive pediatric heart valve and current efforts are underway to evaluate performance of the device in growing piglets. Our long-term goal is to provide a solution for infants and young children with valve defects that will "grow" with them and eliminate one or more open heart surgeries.

ETHICS DECLARATIONS

Conflict of Interest: This work was supported by a DOD PRMRP grant (W81XWH-20–1-0295), a P50 grant from the FDA (P50FD004895), and NuMed for Children, Inc. Opinions, interpretations, conclusions, and recommendations are those of the authors and not necessarily endorsed by the DOD USAMRAA or the FDA.

Ethical Approval: The animal study was reviewed and approved by the Seattle Children's Research Institute IACUC and the Department of Defense Animal Care and Use Review Office (ACURO).

Consent for Publication: Not applicable.

100. Stent Compression Following CPR: Look in Two Views, Review with the Cath Doc!

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Introduction Stent angioplasty with balloon expandable stents is routine for treatment of congenital heart disease. The compressive forces during good quality cardiopulmonary resuscitation (CPR) can compress/crush stents and result in iatrogenic stent compression with reduction in cross-sectional area. Cases: 1. A 32-week premature male with Down's syndrome was born with complete atrioventricular septal defect and pulmonary vein stenosis (PVS). At 3-months he was palliated with a pulmonary artery band and PVS was treated with transcatheter drug eluting stents. His pulmonary vascular resistance remained prohibitive for complete repair. At 7-months, he suffered a hypoxic bradycardic arrest requiring 8 min of chest compressions. Multiple portable single-view chest X-rays following the CPR event did not show any stent distortion and there was no appreciable change in gradients by echocardiogram (lung perfusion scan not performed). Six-weeks later, surveillance computed tomography of the chest showed anteroposterior compression of the right upper pulmonary vein stent, the left pulmonary vein stent was not compressed. At catheterization, the lateral fluoroscopic image clearly showed stent compression of the right upper pulmonary vein and there was evidence of PVS by hemodynamic assessment. PVS was successfully treated by balloon angioplasty. Case 2. A 12-year-old patient was palliated with a fenestrated Fontan circulation for hypoplastic left heart syndrome and had stent angioplasty for left pulmonary artery (LPA) stenosis. The family had relocated to our state and established care at our institution 6-months prior to the event. The patient suffered a witnessed cardiac arrest at school and received bystander CPR with return of spontaneous circulation after a defibrillation shock from an AED. Several single-view portable chest X-rays (no chest x-rays were available from the previous institution) did not show any deformation of the LPA stent. The patient underwent placement of an epicardial implantable cardioverter defibrillator. A two-view chest x-ray was obtained. Five months after this event, the patient was referred for catheterization for transplant evaluation. At catheterization lateral fluoroscopy showed severe anteroposterior stent compression; yet there was only 1–2 mm mean gradient. Stent compression was successfully treated with reinforcing stent angioplasty with complete relief of the gradient. Retrospectively, the finding of stent compression was discernible on the lateral radiograph 5-months earlier. Results: Based on the two cases above and the published literature, all intrathoracic stents are at risk of compression during CPR. The hemodynamic effects of stent compression may be subtle in the low-pressure venous circulation. Compression may only be evident on a lateral radiograph (anteroposterior compressive forces) and therefore overlooked on single-view radiographs obtained during routine care. It is important to compare the images with prior studies and consider reviewing it with interventional team. **Conclusion** Endovascular balloon expandable stents in the thorax are at risk of compression during cardiopulmonary resuscitation. Catheterization laboratory physicians are frequently not directly involved during these events. A standardized approach may help in early identification and treatment; post-CPR obtain two orthogonal radiographic views, compare with previous studies, and review images with the interventional team.

ETHICS DECLARATIONS

Conflict of Interest: The authors declare they do not have any conflict of interests.

Ethical Approval: Not applicable.

Consent for Publication: Yes.

101. Atrial Flow Regulator Device Implantation to Improve Symptoms in a Small Child with Severe Pulmonary Hypertension

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The Occlutech Atrial Flow Regulator (AFR) is a fenestrated implantable interatrial device designed to improve symptoms in the setting of heart failure or pulmonary hypertension (PH) in adults. There has been limited reports in its use in the pediatric population. Here we describe its use in a small child with syncope related to PH. The patient is a 3-year-old with PH (ACVRL1 mutation positive) on tadalafil, ambrisentan, and amlodipine. The patient developed frequent syncopal episodes at 1 year of age and had previously undergone two balloon septostomies. His pulmonary vascular resistance (PVR) was 10.6 indexed Woods units (iWU) on initial catheterization. After each catheterization, his symptoms improved but recurred around 9 months post-procedure with spontaneous closure of the atrial septal defect on echocardiogram. On medical therapy, his PVR improved, and serial echocardiograms were consistent with mild to moderate PH. Syncope was associated with exertion, suggestive of pulmonary hypertensive crises, and could occur as frequently as weekly. A longer-term solution was desired, so Compassionate Use of the AFR was obtained. A 6 mm × 2 mm AFR was chosen. His catheterization demonstrated a PVR of 4.5 iWU. Standard transseptal puncture was performed via the right femoral vein under transesophageal echocardiogram guidance to make the defect as central as possible. Septoplasty was performed with an 8 mm Sterling balloon. The AFR was implanted without issue. Unobstructed left-to-right flow through the device fenestration was demonstrated. At 1-year follow-up, the patient has maintained good energy level and has not had any further syncopal episodes. The parents reported that occasionally with extreme exertion, he will appear tired and cyanotic, suggesting right-to-left shunting through the device to maintain cardiac output. He recovers quickly with rest. He has remained on aspirin. Despite improvement in symptoms, most recent echocardiogram demonstrated persistently elevated right ventricular pressure and PH medication dosing was increased. There is still a small left-to-right shunt through the device fenestration. The AFR can be implanted safely in the pediatric population and in select patients results in significant symptomatic improvement. It has demonstrated mid-term fenestration patency. Further experience and trials will be needed to determine optimal timing of implantation, device size selection, and long-term outcomes.

ETHICS DECLARATIONS

Conflict of Interest: The authors declare they do not have any conflict of interests.

Ethical Approval: Not applicable.

Consent for Publication: Yes.

102. Invasive Assessment of Myocardial Bridges in Children and Adolescents: Therapeutic Implications in a Single-Tertiary-Center Experience

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Background: The clinical implications of a myocardial bridge (MB) in children/adolescents and the role of invasive hemodynamic assessment is ill-defined. We aimed to evaluate invasive hemodynamics in symptomatic patients with MB to guide management. **Methods:** A total of 41 patients were referred to our center with a diagnosis of MB on CTA from 2008 to 2022. Of these, 22 symptomatic patients underwent further evaluation with myocardial functional studies under stress (exercise stress test, stress cMRI) and invasive hemodynamic studies with iFR, adenosine (aFFR), and dobutamine diastolic fractional flow reserve (dFFR) to assess hemodynamic significance. An iFR of < 0.89 or aFFR of < 0.8, and or dFFR of < 0.76 were considered significant for intervention. All studies were repeated at follow-up evaluation 3–6 months post-surgery. **Results:** A total of 22 patients were included in the study: 16 were male (73%), median age was 14 (10–21) years, and weight was 68(39–91) kg. Symptoms included aborted cardiac arrest (n = 3), exertional syncope (n = 2), typical (n = 15) and atypical angina (n = 2). Associated diagnoses included anomalous aortic origin of the coronary artery n = 5 and hypertrophic cardiomyopathy n = 3. The coronary functional evaluation with stress test was positive in 8/22 patients. An invasive hemodynamic evaluation confirmed physiologic significance in 12/22 patients: iFR 0.84 (0.77–0.87) in 8 patients, aFFR of 0.65 & 0.7 in 2 patients, and dFFR of 0.73 (0.62–0.75) in 3 patients. Treatment included medical management with beta blockers in 2 patients, and surgery was recommended in 10 patients of which 9 underwent an unroofing procedure using cardiopulmonary bypass successfully without complications. Post-surgery, all 9 patients reported improvement in symptoms and had normal functional evaluation with stress test. To date, 8 patients had follow-up invasive hemodynamic studies that were normal in 7 patients with a median iFR, and dFFR of 0.95 (0.91-0.98) and 0.93 (0.82–0.98), respectively. However, 1 patient continued to have an abnormal iFR (0.78) and dFFR (0.75). Seven of these 8 patients were cleared to participate in sports. Conclusions: An invasive hemodynamic assessment using iFR and dFFR can provide useful diagnostic information to guide therapy in children/adolescents with symptomatic MB. Most who undergo surgery normalize coronary flow, show improvement in symptoms, and return to unrestricted exercise. However, optimal cut-off values for iFR and dFFR remain to be determined in this young population.

ETHICS DECLARATIONS

Conflict of Interest: Funded by W.L. Gore and Associates. Athar M. Qureshi, MD is a consultant/proctor for W.L. Gore and Associates and Medtronic Inc. and a consultant for Edwards Lifesciences and Abiomed Inc.

Ethical Approval: IRB approved.

Consent for Publication: Yes.

103. Percutaneous Pulmonary Valve Implantation with Sapien Valve: Mid-Long-Term Results

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Introduction Percutaneous pulmonary valve implantation (PPVI) with a Sapien valve is a non-surgical option used in patients with right ventricular outflow tract (RVOT) dysfunction in recent years. However, the mid-long-term results of this valve are not yet known enough. The aim of this study is to present the mid-long-term results of Sapien valves implanted in the pulmonic position in our clinic. **Method:** Between 2014 and 2020, 144 patient underwent Sapien valve implantation. 122 of 144 patients had free regurgitation (PR) with a native large and aneurysmatic RVOT without any stenosis after TOF or valvar PS operation (Group 1). Eight had native RVOT, free PR with stenosis (Group 2). Finally 14 had conduit/bioprosthesis

dysfunction (Group 3). Echocardiographic examination for valve functions was performed in all after the procedure, at the 1st, 6th, 12th months, and annually thereafter. In addition, in group I, valve function and right ventricular volume/function were checked by performing a control MRI at the earliest one year later. **Results:** The median age and weight were 16 (7–50) years and 55 (16–110) kg, respectively. While 29 mm valve was used in 109 cases in Group I and 26 mm valve was used in 13. 20, 23, and 26 mm valves were used in Group 2 and 3. No procedure-related mortality was observed. Trace PR was found in 38 and mild PR in 9 immediately after the procedure. No PR was found in the others. Trace/mild paravalvar leak was detected in 15 cases. One case was referred to elective surgical valve repair due to the development of significant TR. In a median follow-up of 59 months (23–97 months), six of the Group I cases developed significant regurgitation within a median of 6 years (3–7 years), and all of them underwent re-PPVI. Successful balloon dilatation was performed in two cases in this group because of severe stenosis without insufficiency. One patient in group 2 required PPKI 2 years later for the same reason, while three patients in group 3 underwent balloon valvuloplasty due to severe valve stenosis. PPVI was decided upon (112 months later) due to the development of both stenosis and insufficiency with another patient in this group after balloon dilation. No more than mild regurgitation was observed in the remaining. Median pressure gradient across the valve in Group I was 20 mmHg (0–48) mmHg, while those in Group 2 and 3 were 35 mmHg (15–60) mmHg. The median RV end-diastolic volume index, end-systolic volume index, PRF and RV EF in the pre-procedural control MRIs in Group I were 161 ml/m^2 (122–266), 90 ml/m^2 (67–150), 48% (35–68), and 42% (30–55). After valve implantation, these values were 117 ml/m^2 (67–160), 66 ml/m^2 (40–106), 0% (0–60), and 42% (33–56), respectively. It was determined that RV volume indices were significantly reduced after PPVI and PR was eliminated ($p < 0.001$), while the improvement in RV EF was significant but less pronounced ($p = 0.49$). During the follow-up no endocarditis was detected. ICD was implanted in one due to resistant VT, and RF ablation was performed in another due to IART. **Conclusion** Sapien valve is effective and safe in RVOT dysfunction. In the medium-long term, the valve function is preserved in many cases. In patients with native RVOT, which constitute the majority of patients, RV volumes decrease significantly after PPVI procedure, but RV function may not show significant improvement in parallel with this. These results indicate that PPVI should be performed before RV dysfunction develops in this patient group.

ETHICS DECLARATIONS

Conflict of Interest: The authors declare they do not have any conflict of interests.

Ethical Approval: Not applicable.

Consent for Publication: Not applicable.

104. Percutaneous Pulmonary Valve Implantation with 30.5 mm and 32 mm Meril-Myval in Patients with Native and Large Right Ventricular Outflow Tract: Preliminary Results

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Introduction We report our series of PPVI with a 30.5 mm and 32 mm Myval transcatheter heart valve in patients with a large native RVOT. **Method:** Between 2020 and 2022 Meril-Myval was used in 52 patients with native RVOT with free pulmonary regurgitation and right ventricular dilatation without significant stenosis. Meril-Myval valve with a 30.5 mm or 32 mm in diameter was used in ten. Four of them had surgical valvulotomy for valvar pulmonary stenosis and six had surgical TOF repair. Balloon sizing of RVOT was performed with a 34 mm Amplatzer sizing balloon, and semi-compliant balloons were used for interrogation (with a 30 mm or 33 mm balloons, RVOT occlusion test). If the average waist diameter on sizing balloon has found to be above 32 mm, occlusion test was performed with 33 mm balloon. The size of the Z-Med/BIB balloons that the Andra Stents XXL would be mounted on was decided up to the indentation diameter that occurred during sizing, as at least 1 mm larger than the indentation diameter. If presenting with a 30 mm balloon was performed, the percutaneous pulmonary valve was implanted in the same session. However if presenting with a 33 mm or 35 mm non-compliant balloons (Z-Med balloon) was performed, the valve was implanted subsequent session. **Results:** Median age and weight were 20 years (13.8–34 years) and 52 kg (42–72 kg), respectively. Before presenting median pressure gradient between the right ventricle and pulmonary artery was 5 (0–9) mmHg. Median RVOT diameter on catheter was 31.5 mm (24.5–34.2 mm). Median indentation diameter with balloon sizing was 32.5 mm (29–35 mm). Median balloon size used for prestenting was 33 mm (30–35 mm). For prestenting 33 mm balloon used in five, 35 mm in one and 30 mm in four. Successful valve implantation was achieved in all patients; 32 mm in nine, 30.5 mm in one. Minor complications was observed in two patient, such as dislocation of stent to branch pulmonary arteries. Both of 2 patient were managed via transcatheter approach. Valvulation was performed in the same session in four and 8–16 weeks after prestenting in six. Valve function was good in all immediately after and at the last follow-up; a median of 2.5 month (2–15 month). Mild paravalvular leakage was observed in five. No reintervention required yet. **Conclusion** Myval is a bovine pericardium tri-leaflet balloon expandable valve. It is feasible and safe in patients with larger native RVOT without stenosis in adolescents and adults. Myval is currently commercially available in nine sizes; from 20 mm through 30.5 and 32 mm. Myval device is crimped directly on the balloon outside the body. The crimped valve with the delivery system is then loaded through 14Fr Python—Expandable Sheath. The 14 Fr profile is used for all Myval diameters. 30.5 mm and 32 mm Myval can be used selected patients who has large RVOT diameter with excellent results. It could be reduced the need for surgical valve replacement for majority of patients.

ETHICS DECLARATIONS

Conflict of Interest: The authors declare they do not have any conflict of interests.

Ethical Approval: Not applicable.

Consent for Publication: Not applicable.

105. Stent Implantation in Patient with Severe Coarctation of Aorta Very Close to Left Subclavian Artery

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Introduction Coarctation of the aorta (CoA) treatment approach varies according to the patient's age, weight, aortic anatomy. The relationship of the head and neck vessels originating from the aortic

arch increases the risk of developing complications during the stent implantation procedure. We aimed to present the interventional treatment strategies and results applied for the preservation of subclavian artery perfusion during stent implantation in patients with aortic coarctation, integral or very close to the left subclavian artery (LSA). Methods: The data of 326 patients who underwent stent implantation with aortic coarctation were reviewed since 2007. Three different methods were used during stent implantation, depending on the relationship between the subclavian artery and the coarctation region. Patients were divided into three groups according to the stent implantation method;Group A. Patients who underwent balloon dilation by passing between stent struts after LSA was completely jailed with a bare stent. Group B. Patients with the proximal portion of the stent extending $\leq 50\%$ of the LSA exit and the proximal portion of the stent flared towards the LSA. Group C. Patients in whom short stent was used with the LSA exit open. Demographic characteristics, echocardiography, angiocardiography findings, early and mid-term follow-up results, need for re-intervention, and complications were evaluated. Results:32 patients had CoA close to LSA were treated with stent implantation. Five patients were postoperative surgical repair, five had primary balloon angioplasty, and 22 patients were native CoA. Median age 12.1 years (5–45 years) ve median weight 43.5 (16–90 kg). Stent implantation was performed retrogradely from the femoral artery except one patient. At the initial catheterization, the mean diameter at the narrowest point of the coarctation was 5.8 mm (range 2–14), corrected for body surface area 4.6 mm/m^2 (range 1.2–8.2). Overall, the mean pressure gradient across the coarctation decreased from 42 ± 20 mmHg to 2.9 ± 3.1 mmHg ($p < 0.001$). Before stent implantation, angioplasty was performed with a non-compliant balloon using the double balloon double wire method in 5 patients with stenosis at the LSA exit site. Subclavian artery was completely jailed with AndraStent in 7 patients (Group A). The stent lengths ranged from 30 to 43 mm. Balloon dilatation was performed to the LSA with a 8–12 mm balloon by passing between the stent struts. Stent implanted in 13 patients by jailing $\leq 50\%$ of the LSA exit (Group B). We implanted 11 AndraStent, 2 Covered CP stent in group B. The stent lengths ranged from 21 to 48 mm. After stent implantation, the proximal part of the stent flared towards the LSA.A short stent was implanted in 11 patients, leaving LSA open. (Grup C). We implanted 9 bare, 2 Covered stent in group C. The stent lengths ranged from 16 to 22 mm. The median follow-up duration was 29 months (1–216). Mean echocardiographic gradient measured one day after procedure was 28.2 ± 8 mmHg and there was no the diastolic run-off.. Expected reinterventions for reCoA were performed in 3 patients. Half of the patients were still hypertensive after the procedure. There was no sign or complication of subclavian artery perfusion disorder. **Conclusion** In cases where the left subclavian artery is located within and very close to the coarctation region, it is possible to safely and effectively stent implantation without disturbing the left subclavian artery perfusion by using different techniques.

ETHICS DECLARATIONS

Conflict of Interest: The authors declare they do not have any conflict of interests.

Ethical Approval: Not applicable.

Consent for Publication: Not applicable.

106. Critical Aortic Stenosis: Different Approaches for a Very Ill Newborn

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Background: Critical aortic valve stenosis (CAS) represents an emergency, and immediate treatment is mandatory. CAS is a ductus-dependent CHD because the open ductus arteriosus supplies systemic circulation. Balloon aortic valvuloplasty (BAV) is now the first therapeutic option. To dilate the critically stenotic aortic valve, there are different approaches for best outcome. OBJECTIVE: Here, we present our mid-term results in Pediatric Cardiology Unit, Children Hospital, Mansoura University in of different approaches of percutaneous balloon aortic valve valvuloplasty (BAV) in cases of critical aortic stenosis (CAS) in the period from 2005 to 2018 to assess the safety and efficacy of transcatheter intervention for critical aortic stenosis. **Method:** Between April 2005 and June 2019, all consecutive patients with CAS treated with balloon valvuloplasty in our hospital were analyzed retrospectively. Patients were followed up from 18 months to 13 years (mean 100.8 months [8.4 years]) by clinical examination and echocardiography. **Result:** Sixty seven consecutive patients were analyzed. Their gestational age was 37.53 ± 1.37 weeks. Eleven patients (16.4%) were preterm newborn. Postnatal age was 8.5 ± 7.6 days, range 4–35 days). Weight 2.75 ± 0.43 kg. 58.5% was male and 41.5% was female. Fifty-seven of patient (85.07%) received PGE1 infusion before the procedure to maintain the ductal patency in a dose of 0.05 to 0.1 μg/kg/min. Balloon valvuloplasty was accomplished in 65 (97.01%) of 67 interventions. The procedural approaches, success, early outcome, complication rates, midterm results and aortic regurgitation were retrospectively studied. Pre-dilatation by Brio coronary balloon was used in 19 patients (28.35%) followed by TAYSHAk® mini balloon. TAYSHAk® mini balloon was used from the start in 48 patients (71.6%) with balloon annulus ratio 0.85. In nineteen patients, antegrade approach was used through the patent foramen ovale, in 21 patients, trans-femoral retrograde approach was used whereas, in 25 patients, trans-carotid approach was used. Peak-to-peak pressure gradients across the valves fell from (85.4 ± 14.0) to (24.7 ± 14.0) ($P < 0.001$). Left ventricular pressure fell from (101.4 ± 16.0) mmHg to (45.5 ± 10.5) mmHg ($P < 0.001$). Two patients had very difficult aortic valve cannulation with the wire then referred for surgical valvotomy. Two patients lost follow-up. Echocardiography on follow-up revealed a mean trans-aortic systolic gradient of < 30 mmHg, none to grade I aortic. On follow-up 6 children (9.2%) required a second balloon dilatation with good results. **Conclusion** Balloon aortic valvuloplasty is relatively safe and effective in neonatal CAS. There are different approaches for this procedure. Antegrade procedure is safe and requires shorter procedure duration. It may be associated with a lower morbidity and mortality than surgical treatment.

ETHICS DECLARATIONS

Conflict of Interest: The authors declare they do not have any conflict of interests.

Ethical Approval: Not applicable.

Consent for Publication: Not applicable.

107. Percutaneous Device Closure of Perimembranous Ventricular Septal Defects Associated with Aortic Valve Prolapsus and Aortic Regurgitation Using Different Devices

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Introduction: As compared to subpulmonic/subarterial defects, aortic valve prolapse (AVP) and aortic regurgitation (AR) is a rare complication in the follow-up of perimembranous ventricular septal defects (pVSD). In pVSD, the development of AVP and AR was reported with a rate of 10.6%, and 6.8%, respectively. Although the course of AR in perimembranous defects is less clear, studies show that accompanying AR is also progressive. Defect closure by percutaneous method is controversial in pVSD cases accompanied by AVP and AR. The percutaneous closure of pVSDs was once thought to lessen aortic insufficiency by eliminating the Venturi effect. However, data showed that percutaneous VSD closure attempts been more likely to fail in patients with AVP. Recently, the presence of AVP and AR has been accepted as a contraindication for a percutaneous approach. Nevertheless the association of septal aneurysm tissue (SAT) with AVP in perimembranous defects has been previously reported. This septal aneurysm tissue can be seen in the natural course of perimembranous VSDs and can reduce the hemodynamic diameter of the defect and decrease the amount of left–right shunt. In addition to reducing the amount of shunt, it can also act as an alternative place to deploy the device in percutaneous PM VSD closure. In our study, we report our experience on eliminating the Venturi effect by implanting a device into the aneurysmal tissue far away from the aortic valve in patients with aneurysm formation, AVP, and AR. Method:Between 2007 and 2022, in our hospital, the transcatheter device closure of a perimembranous VSD was attempted in 218 patients. Off these patients 26 had AVP, AR and septal aneurysmal tissue and have been included in this study. All patients underwent detailed cardiovascular system assessment, including physical examination, chest X-ray, electrocardiogram, and transthoracic echocardiography (TTE), prior to the procedure. The inclusion criteria for transcatheter device closure attempts were as follows: (1) patients with a significant left-to-right shunt causing left ventricular volume overload (The left ventricle end-diastolic diameter (LVDD) Z score > 2) with trivial AR, (2) patients with AVP and mild AR regardless of LVDD Z score, (3) patients who were operated for AVP and AR and had significant residual defect. Patients with a malalignment and/or subarterial VSD or patients with AVP accompanied by significant AR (moderate and severe) requiring valve reconstruction were subjected to a surgical defect closure. Those patients without a concomitant ventricular septal aneurysm were excluded. Those in whom LVDD Z Scores < 2 with trivial AR were excluded as well. Defects were measured at the end-diastolic phase. The diameter of the left ventricular (LV) opening (defined as the anatomical diameter) and the right ventricular (RV) opening (defined as the hemodynamic diameter) of the defect were measured. When multiple defects were present on aneurysms, color flow diameters were measured separately. Standard antegrade and retrograde techniques previously described in the literature were used. The hemodynamic defect on the aneurysm was closed with either an antegrade or retrograde approach. Only symmetrical double disc occluders (muscular or ADO II) were used in retrograde technique. The left disk of a double disk device was positioned in the aneurysm formation at the left side of the aneurysmal tissue and the right disk was deployed in the right ventricle at the right side of the aneurysmal tissue. An arteriovenous loop was not established when the defect was closed retrogradely. The device size was chosen based on the average of the maximum diameters of the defect measured on echocardiography and LV angiogram. A number of devices were employed for closure. The size of these devices was selected based on the average hemodynamic diameter of the aneurysm formation. The device size (waist diameter in double disk devices, proximal diameter in duct occluders) was at least 1–2 mm greater than the hemodynamic diameter of the defect. Results: The median age and weight were 9.5 years (3–22 years), 32 kg (14-69 kg), respectively. The median LV and RV diameters of the defects were 11 mm (5.5–2.5) and 5.2 mm (3.4–14 mm). More than one defect was detected in the SAT in 7 cases. The AR grade of all cases was trace or mild. In one case, the procedure was canceled because the VSA tissue was not evident. 28 devices were used in 25 cases. Muscular VSD occluder was used in 6 cases, asymmetric membranous occluder in 6 cases, PDA occluders in 1 cases, and Konar VSD occluder in one case. The median diameter of the device used was 7.1 mm (4–15 mm). ADO II and muscular device was used as the second device for the residue in the same session, since significant residual (diameter > 3 mm) remained after the first device in three cases. The rate of complete occlusion during the procedure was 56% (14/25). At a median follow-up of 58 months, AR did not progress in any of the cases. No conduction problems were encountered in any of the patients. The rate of complete occlusion was 80% (20/25) in the final echocardiographic controls during the follow-up. The amount of shunt was minimal (colored diameter < 3 mm) in the remaining five cases. Conclusion: In our study, we aimed to eliminate the Venturi effect by implanting a device into the aneurysmal tissue far away from the aortic valve in four patients with aneurysm formation, AVP, and AR. Data regarding this technique in the literature are lacking. In our cases, although the degree of AR did not decrease in these patients, AR did not progress either. For this reason, we thought that percutaneous closure could be performed in patients with AVP, AR, and aneurysm-like formations.

ETHICS DECLARATIONS

Conflict of Interest: The authors declare they do not have any conflict of interests.

Ethical Approval: Not applicable.

Consent for Publication: Not applicable.

108. Impella Device for Mechanical Support of the Systemic Circulation in a Pediatric Center

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Introduction. Management of cardiogenic shock in pediatric population is always a challenge. At present, the most common used system for mechanical support in children is the extracorporeal membrane oxygenation (ECMO), which usually require surgical implantation. Impella devices are now approved for short-term support (4–6 days depending on the device) for treatment of refractory or ongoing cardiogenic shock after AMI or following open-heart surgery. Case series have been published about Impella use in pediatric cardiogenic shock both for circulatory support and for cardiac unloading during ECMO assistance. Aim of this study is to describe our experience about the use of Impella devices in a population of adolescents and young adults mainly for cardiac unloading in association to ECMO assistance. Materials and methods This is a retrospective review of Impella device percutaneously implanted at our center from 2019 to 2022.Results In the last 3 years a total of 7 percutaneous Impella implants were performed. Median age and weight were 17 years (14–22 years) and 50 kg (range 40–70 kg). In 5 pts Impella was implanted in association to ECMO assistance in order to achieve a complete cardiac unloading, in 2 pts Impella was used alone for cardiac support. Indications to assistance were: myocarditis in 4 patients, heart failure in dilated cardiomyopathy in 2 and cardiogenic shock in congenital heart disease in 1. The last patient had a history of congenitally corrected transposition of great arteries and is one of the few cases described of Impella support in the right systemic ventricle. In 6 patients arterial femoral access was used (5 pts a 14 Fr introducer, 1 pt a 12 Fr introducer). In one patient the Impella device was implanted through a carotid access, obtained by surgical cutdown. In

6 patients a CP Impella (3.5) was used, only in one patient Impella 2.5 was implanted. During percutaneous insertion, no acute complications were encountered. Mean duration of support was 8 days (range 1 to 17 days). Indications for Impella explant were: LV function recovery in 4, LVAD implant in 2 and death in one. Impella removal was performed by manual compression of the arterial femoral access in all except one in which Impella was surgically removed with surgical reconstruction of the femoral artery. During Impella support 2 major complications were registered: 1 severe limb ischemia and the patient died for multi-organ failure and 1 bleeding from the femoral access, medically treated. Conclusions: Percutaneous implantation of the Impella system is feasible for a long period in a pediatric/young adult population. The association of Impella with ECMO for cardiac unloading allows the use of the smallest models of Impella, reducing vascular access complications. Short-term findings demonstrated an acceptable safety profile of the device for temporary circulatory support in adolescent patients presenting with refractory cardiogenic shock.

ETHICS DECLARATIONS

Conflict of Interest: The authors declare they do not have any conflict of interests.

Ethical Approval: Not applicable.

Consent for Publication: Not applicable.

109. Transcatheter repair of Scimitar Syndrome Variant with Dual Pulmonary Venous Drainage

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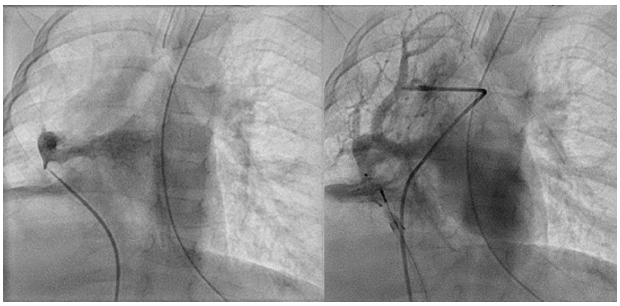
Introduction Scimitar syndrome is a rare congenital malformation characterized by partial or total anomalous pulmonary venous connection of the right lung to the inferior vena cava (IVC). There is variable hypoplasia of the right lung and right pulmonary artery, dextro-position of the heart, and systemic to pulmonary artery collaterals to the right lung. Standard treatment involves surgical rerouting the anomalous veins to the left atrium (LA); if the pulmonary veins (PVs) have dual venous drainage to both the IVC and LA a complete transcatheter strategy can be used for repair. Case Report: A 2-year-old female was referred for transcatheter closure of systemic to pulmonary collaterals in the setting of Scimitar syndrome. Intracardiac anatomy was normal except of a patent foramen ovale (PFO). Hemodynamic assessment showed Qp/Qs ratio of 1.3:1, pulmonary artery pressure 22/8 (mean 14 mmHg), with indexed pulmonary vascular resistance of 1.4 Wood units/m2. Angiography demonstrated a single systemic to pulmonary collateral from the abdominal aorta. Balloon occlusion angiogram in the Scimitar vein showed that all the right sided PVs drained anomalously via the Scimitar vein; of interest it became apparent that there was a large unobstructed connection to the left atrium. A single systemic to pulmonary collateral was demonstrated from the abdominal aorta and occluded with Medtronic Micro Vascular Plug (Medtronic, Minneapolis, MN). Medical Decision Making: Identification of previously unsuspected dual drainage of the right sided PV to both the IVC and the LA suggested the feasibility of complete transcatheter repair. To determine angiographic and hemodynamic feasibility, a second venous access was obtained, and a catheter was advanced prograde across the PFO into the connection to the LA. Test occlusion of the Scimitar vein was repeated (between the vessel draining to the LA and the IVC entrance); right PV pressure measured from the LA connection and from the wedge catheter used to perform balloon occlusion remained unchanged over 10 min. Angiography showed unobstructed drainage to the LA. The reassuring assessment allowed complete transcatheter repair our patients Scimitar syndrome; anomalous drainage to the IVC was successfully occluded with an 8-mm Amplatzer vascular plug 2 (Abbott, Chicago, IL) leaving the PVs draining to the LA. At most recent follow-up the patient is asymptomatic without evidence of PV obstruction. **Conclusion** Patients with anomalous pulmonary venous return can have dual drainage to both the systemic veins and the LA. When such patients are referred for transcatheter assessment of interventions (such as closure of systemic to pulmonary artery collaterals), balloon occlusion angiograms should be deliberately investigation. Patients with dual drainage can undergo complete transcatheter repair.

ETHICS DECLARATIONS

Conflict of Interest: The authors declare they do not have any conflict of interests.

Ethical Approval: Not applicable.

Consent for Publication: Yes.



110. 3-Year Follow-Up of a Prospective, Multicenter Study of the Amplatzer Piccolo Occluder for Percutaneous Closure of the Patent Ductus Arteriosus in Children ≥ 700 g

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Background: The Amplatzer Piccolo™ Ductal Occluder (Abbott Structural Heart, Plymouth, MN) received approval for transcatheter closure of the patent ductus arteriosus (PDA) in premature infants > 700 g from the Food and Drug Administration in 2019 after review of 6-month follow-up data from the Investigational Device Exemption (IDE) and Continued Access Protocols (CAP). This study reports the 3-year follow-up for this cohort. Methods: 200 infants (100 infants < 2 kg) were enrolled between the IDE and CAP cohorts. The results of the 6-month primary safety and efficacy endpoints were previously published. This current study reports 3-year follow-up, including 3-year echocardiographic data for the 50 patients enrolled in the IDE, as well as 3-year survival and adverse event data for the entire cohort. Results: Procedural implant success was reported in 95.5% of patients (191/200 pts) with a rate of effective ductal closure > 99% at 6 months in patients with available follow-up echocardiograms (172/173 pts). Major complications were reported in 4 patients through 6-month follow-up. Survival analysis demonstrated > 95% survival at 3 years with nine reported deaths occurring a median of 141 days post-procedure (range 14–1046 days). After review, no deaths were directly attributed to the procedure or device itself. LPA protrusion defined as LPA Doppler velocity > 2.5 m/s any time during follow-up was reported in 3

patients with persistently elevated velocities (> 2.5 m/s) at 6-months in 2/3 patients. There were no interventions for LPA protrusion at 3 years. Aortic protrusion defined as Doppler velocity > 2.5 m/s any time during follow-up was reported in 5 patients. One patient implanted at 1.2 kg required transcatheter stent implantation to resolve a clinically significant aortic protrusion 6 days following device implant. No additional patients required an intervention and in 2 patients the aortic gradient had resolved at the most recent follow-up. An increase in tricuspid valve regurgitation (TR) was observed in 5 patients all with a procedural weight < 2 kg. Two patients were noted to have moderate to severe TR post-procedure but died or withdrew from the study prior to 6-month follow-up. The remaining 3 patients had mild, moderate or severe TR that was unchanged on follow-up echocardiograms through 3 years. The patient with severe TR developed valve injury during extraction of an embolized device and developed a flail septal leaflet. No patient required intervention to repair or replace the tricuspid valve. Conclusions: This study of 3-year follow-up of the Amplatzer Piccolo™ occluder demonstrates high rates of procedural success with complete ductal closure in nearly all enrolled patients, low adverse event rates and survival > 95% at 3 years. This is a safe and effective therapy for the treatment of the hemodynamically significant PDA in premature infants. Future studies are necessary to understand the impact of transcatheter PDA closure with the Amplatzer Piccolo™ occluder on the clinical course of premature infants with a hemodynamically significant PDA.

ETHICS DECLARATIONS

Conflict of Interest: The authors declare they do not have any conflict of interests.

Ethical Approval: Not applicable.

Consent for Publication: Not applicable.

111. One-Year Outcomes in an Expanded Cohort of Harmony Transcatheter Pulmonary Valve Recipients

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Background: The Harmony transcatheter pulmonary valve (TPV) is designed to treat severe pulmonary regurgitation (PR) in the native or surgically repaired right ventricular outflow tract (RVOT). Our objective was to evaluate 1-year safety and effectiveness outcomes in patients from the Harmony Native Outflow Tract Early Feasibility Study (EFS), Harmony TPV Pivotal Study, and Continued Access Study (CAS), representing the largest cohort to date of Harmony TPV recipients. Methods: Data were pooled from the EFS, Pivotal Study, and CAS. Eligible patients had severe PR by echocardiography or PR fraction ≥ 30% by cardiac magnetic resonance imaging and a clinical indication for pulmonary valve replacement. Patients received the 22-mm (TPV22) or a 25-mm device based on anatomical suitability. Nineteen patients received an early iteration of the 25-mm valve (clinical TPV25) that was later found to have less predictable deployment and was therefore discontinued. A modified version (mTPV25) was subsequently developed and became commercially available. The primary safety endpoint was freedom from procedure- or device-related mortality at 30 days. Efficacy was assessed as freedom from PR, stenosis, and interventions (≥ moderate PR, mean RVOT gradient > 40 mmHg, device-related RVOT reoperation, and catheter reintervention) through 1 year. Adverse events were adjudicated by a Clinical Events Committee. At the time of this analysis, all patients had completed ≥ 1 year follow-up. Results: Forty-two patients received TPV22 valves and 45 received mTPV25 valves. Patients in the TPV22 and mTPV25 groups had a median age of 25.5 and 29.0 years, respectively; mean body weight of 70.7 and 80.9 kg, respectively; and an original diagnosis of Tetralogy of Fallot of 95.2% and 77.8%, respectively. At 1 year there were no deaths in any group (TPV22, mTPV25, clinical TPV25). In patients with the commercially available TPV22 and mTPV25 devices, 95.1% of TPV22 and 89.7% of mTPV25 patients were free from PR, stenosis, and interventions. In the TPV22 group, 97.5% of patients had none/trace PR and 97.5% had none/trace paravalvular leak at 1 year. Similar 1-year rates were observed with the mTPV25 device (97.4% none/trace PR and 97.4% none/trace paravalvular leak). There was no severe PR or paravalvular leak in either group at 1 year. Patients with the discontinued clinical TPV25 device are being similarly followed. Conclusions: Harmony TPV patients in this expanded analysis cohort had favorable clinical and hemodynamic outcomes, confirming previous results and demonstrating continued device safety and effectiveness across studies and valve types at 1 year.

ETHICS DECLARATIONS

Conflict of Interest: This study was funded by Medtronic (Minneapolis, MN). Dr Asnes serves as a consultant for Medtronic. The authors requested data from the sponsor who has full access to the Harmony Pivotal Trial database. The raw data and statistical codes are owned by the sponsor of the Harmony Pivotal Trial and will not be shared for purposes of reproducing the results or replicating the procedure.

Ethical Approval: The study protocol was approved by the Institutional Review Board at each participating site. The study was conducted in accordance with Good Clinical Practice guidelines and the Declaration of Helsinki.

Consent for Publication: All patients provided written, informed consent.

112. Applications of Steerable Microcatheter in Paediatric Interventions

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We are presenting our practical experience in using Swift NINJA® Steerable Microcatheter (Merit Medical 1600 West Merit Parkway, South Jordan UT 84095 USA) in paediatric interventions. Swift-NINJA, is a straight tip catheter that articulates up to 180 degrees in opposing directions to rapidly select the most challenging vascular ostium. The catheter which has FDA approval is used for complex

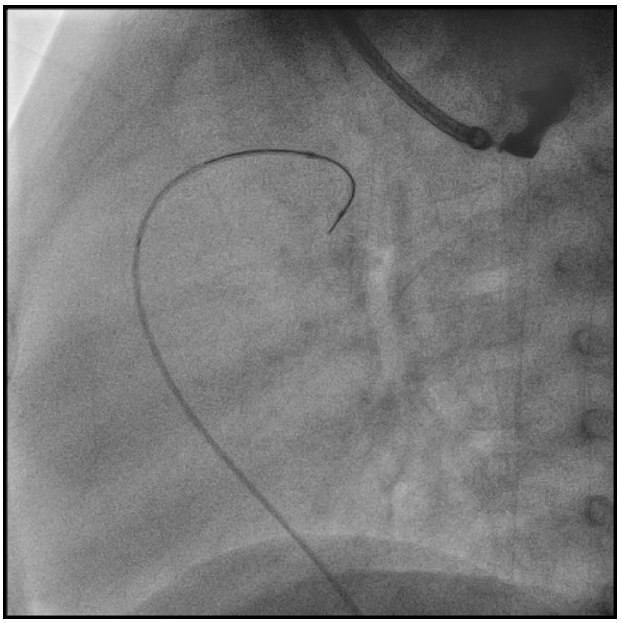
Neurovascular intervention. We applied this catheter in complex branch pulmonary arteries stenosis in the context of pulmonary atresia/VSD/MAPCAs, post-unifocalization. We also used it to cross challenging severely stenotic Aortic valves, in the context of severe Aortic stenosis during transcatheter Aortic valve ballooning. The steerable soft tip microcatheter was extremely useful in reaching acutely curved or angled vessels. This catheter can be telescopically advanced through a 4F glide catheter, and a soft coronary wire can go through it to give more support. After accessing the vessel, or crossing the valve, we can slide over the glide catheter, and take the Ninja swift out. Obtaining a good road map angiogram, prior to using the microcatheter is important to plan the procedure. Our experience with 6 patients with the varoius diagnoses including PA/VSD/MAPCAs, severe AS, Abernathy malformation, 2 cases of single ventricle underwent (Pulmonary flow regulator implantation), vertical DA stent crossing proved beneficial. Crossing the Aortic valve was less time-consuming. In PA/VSD patients, we managed to access all the small branches. However, it takes time but less effort to do those procedures, as expected. The bleeding from the dead space between the microcatheter and the glide catheter was not significant, but it is something to consider for long procedures and small patients.

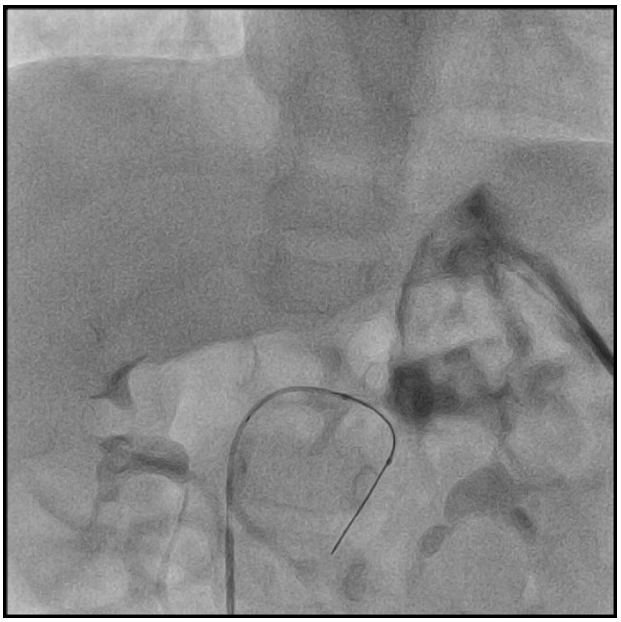
ETHICS DECLARATIONS

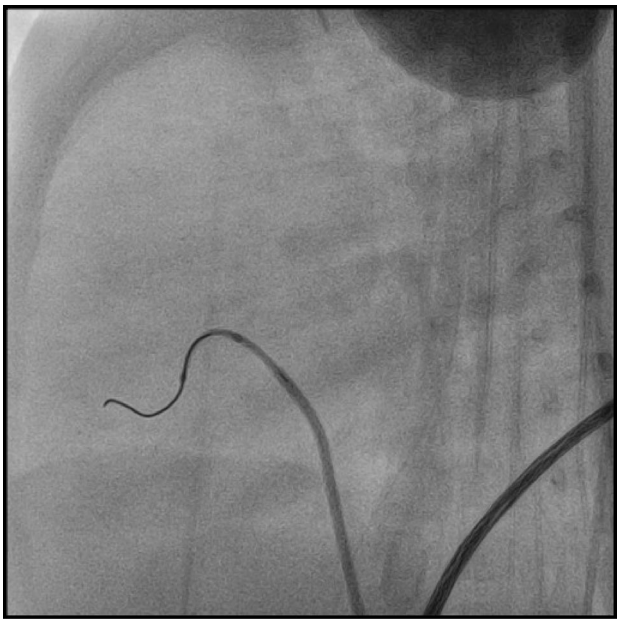
Conflict of Interest: The authors declare they do not have any conflict of interests.

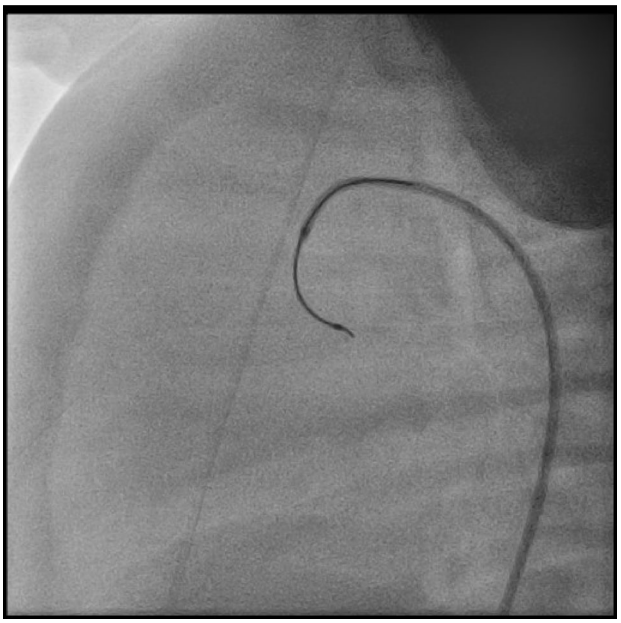
Ethical Approval: Not applicable.

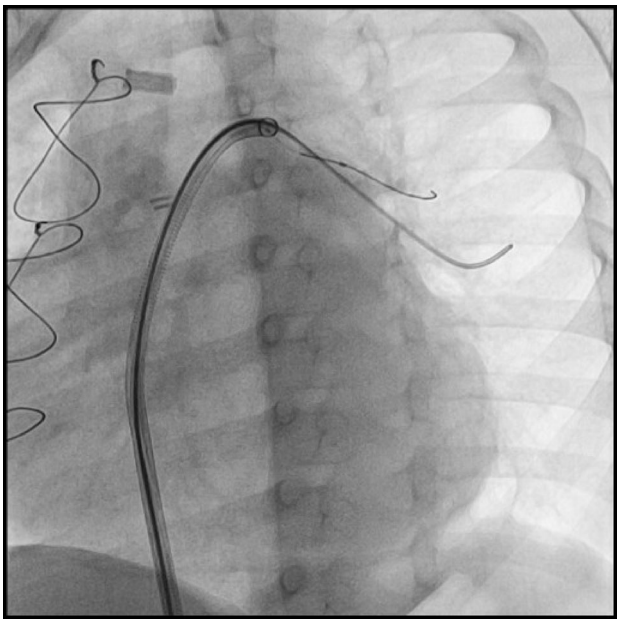
Consent for Publication: Not applicable.











113. Percutaneous Treatment of Thoracic Duct Outlet Stenosis for Patients with Disorders of Lymphatic Perfusion

Mudit Gupta[1], Danish Vaiyani[2], Aaron DeWitt[2], Emmanuelle Favilla[2], Erin Pinto[2], Lauren Biroc[2], Christopher Smith[2], Yoav Dori[2]

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Background: Disrupted lymphatic drainage from the thoracic duct into the central venous system can lead to disorders of lymphatic perfusion including chylothorax, plastic bronchitis and protein-losing enteropathy. We report findings of abnormal lymphatic flow secondary to thoracic duct outlet stenosis, demonstrated both by magnetic resonance and direct contrast lymphangiogram, and results of subsequent intervention. Methods: Single-center retrospective case series of seven patients who underwent thoracic duct outlet balloon angioplasty for chylous effusions from 2015 to 2021. Exclusions included patients who had previously undergone surgical intervention upon the thoracic duct or thoracic duct dilation for purposes other than treatment of outlet stenosis (e.g. introduction of sheaths). All patients underwent bilateral inguinal intranodal and periportal hepatic access for lymphangiogram. Six of seven patients also had mesenteric lymphatic access for imaging. Results: Five of seven patients (71%) had congenital heart disease, four with single-ventricle physiology. All patients had lymphatic effusions, five (71%) with chylothorax, three (43%) with ascites and one (14%) with chylopericardium. Three (43%) patients had chylous effusions in multiple compartments. Transabdominal antegrade thoracic duct access was obtained and direct contrast lymphangiography demonstrated thoracic duct outlet stenosis in all patients. Median pressure gradient from thoracic duct to innominate vein was 8 mmHg (IQR 2.5–13.5 mmHg). Following balloon angioplasty, median pressure gradient was 0 mmHg (IQR 0–2 mmHg). Five of seven patients (71%) also had selective embolization of collateral lymphatic networks in the thorax or abdomen. Six of seven patients (86%) had decrease of chylous effusions during the same hospitalization. One patient required pericardiocentesis for non-chylous pericardial effusion three weeks after the lymphatic intervention. All seven patients had subjective symptomatic improvement related to effusions at last follow-up (median 215 days (IQR 97–323 days)). None of the patients in this series have required repeat lymphatic intervention to date. Conclusions: We demonstrate significant pathophysiologic sequelae of thoracic duct outlet obstruction: lymphatic effusions in multiple compartments. Balloon dilation angioplasty is a durable treatment that can reduce thoracic duct-innominate vein pressure gradients and subsequently decrease effusions in these patients.

ETHICS DECLARATIONS

Conflict of Interest: The authors declare they do not have any conflict of interests.

Ethical Approval: Not applicable.

Consent for Publication: Not applicable.

114. Percutaneous Closure of Atrial Septal Defects in Patients Less Than 10 kg

Alejandro Rodriguez Ogando[1], Cesar Abelleira Pardeiro[2], Fernando Ballesteros Tejerizo[1], Enrique Balbacid Domingo[2], Federico Gutierrez Larraya[2], Jose Luis Zunzunegui Martinez[1]

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Background and Objective: Atrial septal defects (ASD) accounts for 10–15% of congenital heart disease. Its percutaneous closure is effective and safe, traditionally recommended in > 15 kg. Our objective is to describe our experience in percutaneous closure of ASD in < 10 kg, the characteristics of our patients, the procedure, complications and results. Methods: Retrospective descriptive study of all patients < 10 kg in whom percutaneous ASD closure was performed. Secondary subanalysis was performed, comparing the data in two subgroups of ≤ 8 kg and > 8 kg. Results: Fifty-one patients were included, 37.3% male, median weight 8.2 (2.8–10) kg, age 13.9 (0.8–32.8) months, and ASD size measured by transesophageal echocardiography of 9.63 (5–19) mm. 80.3% had comorbidity (associated heart disease, syndrome, others) and 13.7% were premature newborns. The main reason for closure was heart failure and failure to thrive (84.3%). In the procedure, an Amplatzer Septal Occluder (72%), Cocoon (14%) or Occlutech (14%) device was used, with an average size of 11(6–25) mm, with a conventional technique (91.7%), assisted with balloon (4.2%) or loop catheter (4.2%). ASD-Size/Weight Ratio: 1.3 (0.7–2.1), Device/ASD-Size: 1.1. 90.2% (46/51) were successfully closed, with 5 cases that failed the attempt due to inadequate borders (4/51) or multiple defects (1/51). Fluoroscopy time of 18.28(1.4–59) minutes, and total procedure of 76.6 (11–144) minutes. Complications occurred in 11.8% (6/51, and 1/51 major complication) of the patients. There were no desd related to the procedure. After subdividing according to weight, N = 25 was obtained for ≤ 8 kg and N = 26 for > 8 kg. There were no differences in extracardiac comorbidity, Device/ASD-size ratio, success rate, complications, or fluoroscopy or total procedure times. In the ≤ 8 kg subgroup, a greater amount of associated heart disease (44% vs 11.5%, p = 0.009) and a higher ASD-size/Weight ratio (1.47 ± 0.34 mm/kg vs 1.14 ± 0.27 mm/kg, p = 0.0001) were observed, and Device-size/weight ratio (1.65 ± 0.35 mm/kg vs 1.24 ± 0.37 mm/kg, p = 0.0001). CONCLUSIONS: Percutaneous ASD closure in < 10 kg in selected cases can be performed successfully and safely, including the subgroup of ≤ 8 kg.

ETHICS DECLARATIONS

Conflict of Interest: The authors declare they do not have any conflict of interests.

Ethical Approval: Not applicable.

Consent for Publication: Not applicable.

115. Percutaneous Pulmonary Valve Placement in Pediatric Patients with One and a Half Ventricular Physiology

Domarco Manrique Alejandro, Jose Igancio Camuña Correa, Alejandro Rodríguez Ogando, Fernando Ballesteros Tejerizo, Jose Luis Zunzunegui Martinez

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Background and Aim: The percutaneous pulmonary valve placement (PPVP) procedure in pediatric patients in whom the right ventricular outflow tract (RVOT) is stenotic or insufficient, primarily or secondary to surgical correction, has been postulated as the technique of choice in many patients. A group of patients who benefit from this valve placement is made up of those with one and a half ventricular physiology, in whom their underlying heart disease determines the need to establish a superior cavopulmonary bypass (Glenn surgery), and subsequently a flow between the right ventricle and pulmonary vascular arteries by repair of the native outflow tract or implantation of a conduit between the right ventricle and the pulmonary artery. We present our experience with eight pediatric patients with this physiology who underwent PPVP. Five of these patients had pulmonary atresia with intact septum and a sixth patient had atrioventricular canal. Methods: Retrospective case series including all reports of PPVP in patients with one and a half ventricle physiology. The data was collected from a computerized database of a tertiary hospital. The implant was performed by pediatric hemodynamicists, with follow-up in consultations before and after it by pediatric cardiologists. Results: The mean weight at the time of the placement was 28 kg (range 16–86 kg). In all of them, a systemic-pulmonary fistula and/or ductal stent had been performed in the neonatal period. In 87.5% (7/8) correction with enlargement of the RVOT with a transannular patch had been performed. All the patients were in functional class I–II prior to valve replacement. Mean oxygen saturation before the procedure was 77% (range 73–100%). The right ventricular ejection fraction measured by cardiac magnetic resonance imaging was 47.6% (range 40–61%). Echocardiography revealed a significant pressure gradient in the RVOT in none of the patients, with mild tricuspid regurgitation in 50% (4/8) of patients and moderate-severe in 25% (2/8). The electrocardiogram showed a QRS £120 ms in all of them, with fragmentation in 50% (4/8). A Melody percutaneous prosthesis was placed in 7/8, and in 1 patient a Myval XL 32 mm, with no periprocedural complications. In six of the 7 patients with Melody-valve im plantation, a 22-mm Melody prosthesis was implanted, and a 18-mm prosthesis in the remaining patient. Anterograde implantation was performed in five of the eight patients, in the remaining three patients, retrograde implantation was performed from jugular venous access through the Glenn system. In subsequent clinical controls, all patients remained in NYHA functional class I, with good right ventricular function and mild tricuspid regurgitation in 80%, presenting improvement of moderate-severe to moderate regurgitation in two of them. The mean oxygen saturation after the procedure was 90% (range 80–98%). No significant electrocardiographic changes were observed. To date, none of the patients has required intervention on the implanted valve. Conclusions: Percutaneous placement of pulmonary valve prostheses in pediatric patients with one and a half ventricular physiology could be a reasonable option as an alternative to surgery, although medium and long-term studies are necessary.

ETHICS DECLARATIONS

Conflict of Interest: The authors declare they do not have any conflict of interests.

Ethical Approval: Not applicable.

Consent for Publication: Not applicable.

116. Percutaneous Transhepatic Periportal Embolization of Hepato-duodenallymphatic Fistulae as a Treatment for Protein-Losing Enteropathy After Fontan

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Aims & background: To determine early and medium-term results of selective embolization of hepato-duodenal lymph vessels in Fontan

patients with protein-losing enteropathy (PLE). Methods: Retrospective, observational review of all Fontan patients with PLE where transhepatic lymphatic embolization was performed. Intralymphatic position of a 22G Chiba needle was confirmed by contrast injection. Occlusion of hepato-duodenal lymphatics was achieved by injection of Lipiodol/n-butyl cyanoacrylate (Histoacryl®). Results: 18 patients with proven PLE were treated at a median age of 15.2 (range 3.6–38.8) years. Fontan palliation was performed at 3.7 (range: 1.4–10.0) years; clinical PLE started 3.5 (range: 0.2–15.8) years later. Procedural complications consisted of: portal thrombus (n = 4), abdominal discomfort in all for 24 up to 48 h, transient cholangitis (n = 1), and caustic duodenal bleeding/melena (n = 1). In 44% of patients (8/18), a lasting improvement in clinical PLE was obtained after one to four embolizations after a median follow-up period of 1.9 (IQR 0.8; 2.9) years. In these, serum albumin improved significantly from a median of 23.6 (range: 20–34) g/l to a median of 38.0 (range: 32.0–43.0)g/l [p = 0.003]. Conclusions: Embolization of hepatico-duodenal lymphatics is a promising technique for patients with PLE. However, in 56%, embolization did not result in clinical improvement; the presumed leaks could not be identified and will require additional diagnostic and therapeutic abilities. More extensive series with longer follow-ups are needed to identify patients who will benefit from this treatment.

ETHICS DECLARATIONS

Conflict of Interest: The authors declare they do not have any conflict of interests.

Ethical Approval: Obtained from ethics committee University Hospitals Leuven.

Consent for Publication: patients were informed through the medical record system.

117. Stent Expansion of Restrictive Fontan Conduits to Nominal Diameter and Beyond

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Background: Mechanical factors may cause bottlenecks in a Fontan circuit. Extracardiac conduits (ECC) are placed at a young age, but the materials do not allow growth. Restriction in ECC dimensions may deteriorate the function of the circuit. Aims: This study aimed to evaluate the feasibility and safety of stent expansion of an ECC to the nominal dimension at the time of implant and, if possible, beyond nominal. Methods: Retrospective, single-center observational review of all ECC Fontan patients who received a stent to expand a previously placed surgical conduit. Results: A total of 44 restrictive conduits were stented over a 14 year study period a median of 11.8 (IQR: 9.1, 13.8) years after ECC placement. Cross-sectional areas were a median of 30% (IQR: 21, 42) smaller than the original placed ECC; there was no gradient in 23/44 patients, and 21/44 a minimal gradient of 1.3 ± 0.5 (range 1–3 mmHg). All conduits could be enlarged with a significant ($p < 0.0001$) increase in diameter from 13.6 ± 1.8 to 19.2 ± 1.2 mm, corresponding to a median cross-sectional area increase of 171% (IQR: 153, 220). In three patients where the conduits were not contracted, expansion of between 127 to 165% was obtained. There were no conduit ruptures and only one minor complication. Conclusions: Extracardiac conduits in some Fontan patients become smaller than nominal over time, usually without overt symptoms. The dimensions of ECC's can be safely and significantly increased to nominal or even beyond employing stenting. It allows adjustment of ECC dimensions to compensate for somatic growth.

ETHICS DECLARATIONS

Conflict of Interest: The authors declare they do not have any conflict of interests.

Ethical Approval: obtained from ethics committee University Hospitals Leuven.

Consent for Publication: patients were informed through the medical record system.

118. "Champagne Glass Sign": The Door to Retrograde Transvenous Thoracic Duct Cannulation Technique for Lymphatic Evaluation and Interventions

Surendranath Veeram Reddy, Stephen Clark, Abhay Divekar, Yousef Arar, Thomas Zellers, Luis Zabala, Gary Markee, Tarique Hussain, Sheena Pimpalwar

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Introduction Currently, the most widely accepted technique for accessing the thoracic duct and central lymphatics is via a percutaneous prograde transabdominal approach. While ultimately effective in most cases, this technique has a steep-learning curve and the potential for important complications including inflammatory response, hemorrhage, sepsis, etc. and many interventional cardiologists have avoided adopting it. Herein, we describe a novel relatively safe technique for retrograde transvenous thoracic duct cannulation that is both reproducible and useful for lymphangiography as well as a host of lymphatic interventional procedures. Methods: All patients undergoing diagnostic or interventional lymphatic procedures where retrograde transvenous thoracic duct access was attempted from May 2018- April 2022 were reviewed. All patients undergo magnetic resonance imaging of the lymphatic system prior to intervention either utilizing a staged approach on separate dates or via a single-anesthesia event. This involves both static T2W lymphangiography as well as dynamic contrast-enhanced MR lymphangiography (DCMRL). Balloon occlusion left innominate vein angiogram consistently identified a triangular-shaped notch that opacifies within the venous angle (between the internal jugular and subclavian vein). This notch corresponds to a valve guarding the main entrance to the thoracic duct. Given its appearance, we have termed this angiographic structure the "champagne glass sign" (Figure). Technical success was determined by ability to obtain transvenous distal wire and catheter position in the thoracic duct. Clinical outcomes including lymphatic symptom resolution, complications etc. were reviewed. Results: Retrograde transvenous thoracic duct cannulation was attempted in 17 patients (age 9 months to 24 years). Technical success with expressed intent to access the thoracic duct was accomplished in 15/17 (88%) patients. Interventions included selective lymphatic and/or thoracic duct embolization, balloon and/or stent angioplasty of the thoracic duct. Of the 2 patients where retrograde access was unsuccessful, one patient (9 months old) underwent a thoracic duct interruption procedure via the transabdominal approach. Other patient (8 yrs. old) transabdominal access was not performed as symptoms resolved. There was a trend towards increased success after the learning curve, as we were successfully able to cannulate the thoracic duct in 12 of the last 12 procedures (100%). Conclusions: We present a novel, reproducible, minimally invasive technique for accessing the thoracic duct for diagnostic and interventional lymphatic procedures. Retrograde transvenous thoracic duct access alleviates the need for the

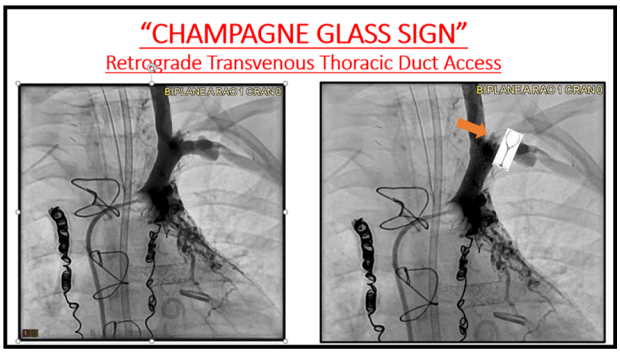
more traditional but perilous transabdominal approach while preserving the ability to perform the full host of potential interventions described in the literature. This technique is safe and effective, and its intuitive similarities with traditional catheterization techniques may usher in a new era of lymphatic exploration and interventions among a broader audience of interventionists.

ETHICS DECLARATIONS

Conflict of Interest: The authors declare they do not have any conflict of interests.

Ethical Approval: Not applicable.

Consent for Publication: Not applicable.



119. Left Ventricle to Coronary Artery Fistula in Hypoplastic Left Heart Syndrome

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Introduction Coronary artery fistula is a rare congenital cardiac anomaly connecting a coronary artery to a cardiac chamber. Right ventricle to coronary artery fistula is associated with pulmonary atresia with intact ventricular septum however, a left ventricle to coronary artery (LV-CA) fistula is extremely rare in the setting of aortic atresia and hypoplastic left ventricle. We report a case of LV-CA fistula with severe systemic right ventricular dysfunction and interventional management. Case presentation and discussion: A 25-year-old male with HLHS, (mitral and aortic atresia) with intact ventricular septum had staged repair, ending in a total cavopulmonary anastomosis. He was found to have severe right ventricular systolic dysfunction attributed to cardiomyopathy with moderate tricuspid regurgitation (NYHA III). A Coronary fistula was suspected by echocardiogram and confirmed on cardiac computed tomography (CT). The left main and circumflex coronary arteries had 2 fistulous connections to the rudimentary LV (Fig. 1). The patient was taken to the catheterization laboratory where the LV-CA fistulae were confirmed with the neck of the bigger fistula measuring 4.8 mm and the body up to 11.8 mm (Fig. 2). The larger fistula was occluded with 2 standard Penumbra coils (12 × 60 and 12 × 40) and the smaller one was occluded with a 4 × 4 Vortex coil. Repeat angiography showed complete occlusion of the fistulae with good right and left coronary perfusion (Fig. 3). The patient was seen one months after the procedure when he reported clinical improvement of his symptoms with improvement of RV function with stable tricuspid regurgitation. Fontan patients can have low cardiac output and limited exercise tolerance, however sudden clinical deterioration should warrant comprehensive investigation. In single-ventricle patients with Damus-Kaye-Stansel (DKS) anastomosis, on this setting, a coronary fistula can compromise flow to the contralateral system. Our patient had new-onset exertional symptoms that led to discovery of dilated left coronary arteries and 2 fistulae and warranted their closure. Conclusions: LV-CA fistulae seen in HLHS patients, can cause coronary steal from the right coronary affecting the single systemic ventricle in patient with DKS anastomosis. Patients with suspected acquired cardiomyopathy in this setting needs accurate imaging to exclude coronary artery disease including coronary fistulae.

ETHICS DECLARATIONS

Conflict of Interest: The authors declare they do not have any conflict of interests.

Ethical Approval: Not applicable.

Consent for Publication: Not applicable.

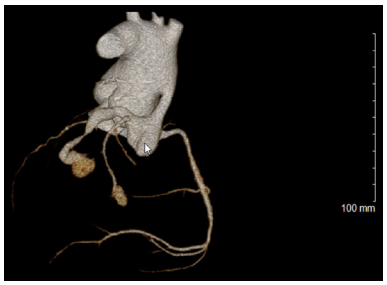

Fig. 1 Computed tomography 3D reconstruction showing right and left coronary arteries taking of the native aorta with the 2 fistulae connected to the left circumflex artery

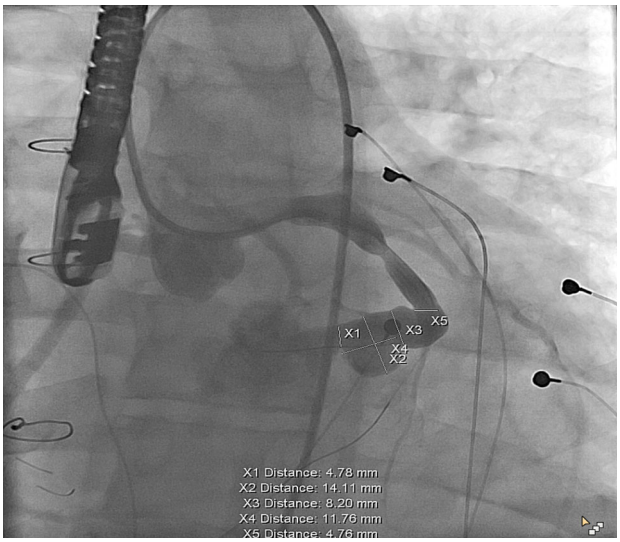

Fig. 2 Angiography of the bigger fistula: neck of the fistula measuring 4.8 mm and the diameter of the body up to 11.8 mm

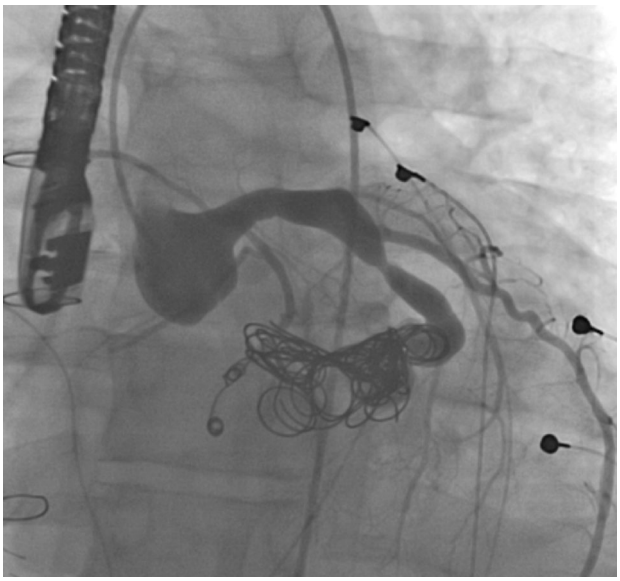

Fig. 3 Repeat angiography showed complete occlusion of the fistula

120. Percutaneous Coronary Intervention in Pediatric and Adolescent Patients: A Single-Center Experience

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Objectives: To investigate the feasibility, procedural techniques, safety, and overall potential of percutaneous coronary angioplasty and stent implantation in pediatric and adolescent patients with coronary obstructions. Methods: Single-center retrospective review including all patients under 18 years old who underwent percutaneous coronary intervention (PCI) during a period of 17 years. Results: Between 2004 and 2021, 18 patients underwent 22 PCI procedures, including percutaneous coronary balloon angioplasty alone in 2 and coronary stent implantation in 20. Median age was 6 years (13 days–17 years), and median weight was 22 kg (3,3–90). Indications for intervention included postoperative acute coronary syndrome in seven cases (38%), in the setting of arterial switch (3), Ross (3), and anomalous coronary (1) surgical procedures; severe coronary allograft vasculopathy in heart transplant recipients in five cases (27%); late severe ostial stenosis post-arterial switch operation in four cases (22%); and acute coronary syndrome associated with Kawasaki or Williams syndromes in two cases (11.1%). Balloon angioplasty alone resulted in optimal resolution of coronary stenosis in 2 patients under 2 months of age. Successful stent placement with excellent revascularization was achieved in all cases, with an average internal diameter of 2.7 mm (ranging from 2.25 to 3.5 mm). Eight patients (44%) were in ECMO support during the procedure; four of them died in ICU postintervention period. There was another late death in a heart transplanted patient (overall survival of 72%). Average follow-up period in survivors was 5.2 years (2 months–16 years). Three patients were noted to have angiographic evidence of severe in-stent restenosis at 10-, 11- and 53-months post-deployment, respectively; all of them were successfully percutaneously treated. Conclusions: In our experience PCI is a feasible and safe option in pediatric and adolescent patients with coronary stenosis, and it can be used in a wide range of anatomical conditions and revascularization indications. It remains technically challenging because of the specific anatomical setting and the lack of dedicated material for PCI in small children. Short-term benefits of the technique can be critical in certain cases. A close follow-up is mandatory to detect patients with recurrent lesions. Further studies are warranted to determine the durability of this interventions.

ETHICS DECLARATIONS

Conflict of Interest: The authors declare they do not have any conflict of interests.

Ethical Approval: Not applicable.

Consent for Publication: Not applicable.

121. Percutaneous Atrial Septal Defect Closure in a 5-Month-old Patient Weighing 7 kg with Persistent Pulmonary Hypertension. A Case Report

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Percutaneous transcatheter closure is the treatment of choice for secundum atrial septal defects due to its effectiveness and low rate of complications. Current guidelines recommend intervention after 2 years of age or in children weighing more than 15 kg; Subsequently, concerns have been raised about adverse events of this procedure in smaller children. This case report describes a 5-month-old child with Cantú syndrome which was complicated by persistent pulmonary hypertension leading to a controversial and challenging transcatheter ASD closure with a body weight of 7 kg. The percutaneous closure was successfully performed with good clinical outcomes. Current echocardiography shows a pulmonary arterial systolic pressure of 29 mmHg.

ETHICS DECLARATIONS

Conflict of Interest: The authors declare they do not have any conflict of interests.

Ethical Approval: Not applicable.

Consent for Publication: Not applicable.

122. Building Capacity for Congenital Heart Patient-Centered Outcomes Research in Under-Represented Minorities

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Background: In congenital heart disease, racial and ethnic disparities impact mortality, especially among Blacks and Hispanics in Texas and surrounding regions, however meaningful engagement in ACHD, especially interventional patient-centered outcomes research (PCOR) and comparative effectiveness research (CER) has been limited by socioeconomic, cultural, and geographic factors. We employed a

patient-driven peer-to-peer approach to recruit and engage racial minority ACHD patients and family members with the capacity to act as equal research partners to identify, participate in, develop, lead, and disseminate transcatheter intervention PCOR and CER. **Method:** In addition to the study team, four expert PCORI funded-consultants provided strategies and training on stakeholder recruitment and engagement for targeting minorities and underserved communities. The following strategies were employed: 1) engaging through faith-based organizations like churches, synagogues, and mosques 2) working with Houston Methodist Primary Care Providers (PCP) group to identify ACHD patients 3) recruiting through the project's Online Portal and participants' Video Blogs to appeal to stakeholders 4) using social media for mainstream outreach. Results: Eighteen total ACHD collaborative members were successfully recruited. Six ACHD patient advocates were recruited as Steering Committee Members (SCM) of the stakeholder collaborative (STK), however, two SCMs resigned from their positions due to family reasons and time commitments. One member was replaced by previously interviewed candidates and another was promoted from our lay STKs. Other applicants remain involved in a non-decision maker capacity as in-waiting STK members. Social media outreach and our online portal proved to be the most efficient recruitment and engagement strategies. On average, we received three new candidate applications after every social media post. Eleven stakeholders were recruited through social media. One stakeholder was recruited through the PCP network. Two churches promoted our flier in their newsletter but we did not receive any applications. Onsite recruiting from faith-based organizations was not feasible due to the ongoing global health crisis from COVID-19. Discussion: Addressing racial disparities in congenital heart and interventional cardiology is challenging and requires a patient-centered approach to research. Despite the COVID-19 pandemic, we successfully built an 18-member ACHD patient collaborative of underrepresented minorities, employing a peer-to-peer strategy through a multi-faceted approach. Social media was the most successful approach especially in the absence of in-person gatherings, however, despite financial compensation for involvement, attrition due to personal reasons occurred. Current efforts are directed toward training the ACHD patient collaborative in basic research methods to serve as equal partners in patient-centered outcomes and comparative effectiveness research.

ETHICS DECLARATIONS

Conflict of Interest: The authors declare they do not have any conflict of interests.

Ethical Approval: Not applicable.

Consent for Publication: Not applicable.

123. Percutaneous Pulmonary Valve Implantation in Native Right Ventricular Outflow Tract with Myval Transcatheter Heart Valve

Alejandro Rodríguez Ogando[1], Felix Coserria Sanchez[2], Eduardo Molina Navarro[3], Pablo Avanzas Fernandez[4], Fernando Ballesteros Tejerizo[1], Jose Luis Zunzunegui Martinez[1]

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Background: Pulmonary percutaneous valve implantation (PPVI) is feasible with satisfactory mid-term results in patients with native right ventricular outflow tract (RVOT) and has been increasingly used instead of surgically implantable pulmonary valves. Creating a stable landing zone with a diameter less than the largest commercially available valve (previously available 29 mm and currently available 32 mm) is crucial for technical success of the procedure, limiting the number of suitable candidates for PPVI. Objective: The aim of this study is to present our results and feasibility of PPVI with Myval transcatheter heart valve in a large native RVOT (pre-stented). Methods and Results: 10 patients with native RVOT presenting with severe pulmonary regurgitation (48% ± 3.1% pulmonary regurgitant fraction) with mean RV end-diastolic volume 167.7 ± 12.4 ml/m2 were recruited. Median age of 22 years (11–49 years). All patients were pre-stented with: Andra-stent XXL mounted on 28 mm balloon(N = 1), 30 mm balloon (N = 1), 32 mm balloon (N = 3), and 35 mm balloon (N = 5). Two patients underwent valve implantation in the same procedure (Myval XL 32 mm), and the rest of them, with a range of 2–4 months after pre-stenting, PPVI were successfully implanted with Myval THV of 28 mm (N = 1), 30.5 mm (N = 1), and 32 mm (N = 6). All cases were performed through femoral access, Except in 1 in which transhepatic access was performed due to the absence of superior and inferior vena cava. In all cases in which pre-stent were implanted up to 35 mm, the valve was deployed at the target area by adding 8 ml extra-volume for the nominal balloon configuration (40 ml) to reach 35 mm. Pulmonary artery angiogram showed no significant pulmonary regurgitation and three-dimensional transesophageal echocardiography showed good valve coaptation. No significant periprocedural complications were noted in any patient, except in the case of transhepatic access, that there was a rupture of the papillary muscle of the septal leaflet of the tricuspid valve, due to tearing of the Python introducer. Median follow-up time was 9 months (1–26). There was no adverse event associated with the valve. **Conclusion** The implantation of Myval-THV in pre-stented native RVOT with diameters up to 35 mm is feasible and safe, maintaining good valve competence in the medium term.

ETHICS DECLARATIONS

Conflict of Interest: The authors declare they do not have any conflict of interests.

Ethical Approval: Not applicable.

Consent for Publication: Not applicable.

124. The Effect of Sapien 3 Over-dilation or Under-dilation on Valve Function in the Pulmonic Position

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Introduction Sapien 3 (S3) valves are commonly over-dilated when used for transcatheter pulmonary valve replacement (TCPVR) in native right ventricular outflow tract (RVOT) patients, and sometimes under-dilated when used in conduit patients. The S3 has not been tested outside of nominal implant diameters. This study attempts to provide follow-up on valve function for both over- and under- inflated pulmonary Sapien 3 valves up to 5 years post-implantation. Methods: This single-center study retrospectively reviewed all patients who underwent S3 TCPVR from 9/2015–11/2021. All S3 valves were retrospectively measured at their proximal, middle, and distal diameters from post-implantation angiograms. The patients' most recent echocardiograms were analyzed and PR and obstruction was quantified. Chi-squared and Fisher's exact tests were used to compare categorical data, and the T-test was used to compare variable data. Results: There were 163 S3 valves implanted over a 6-year period. Sixty percent were male and 60% had Tetralogy of Fallot. The mean

weight was 70 kg (median 68 kg), and average age 33 ± 16 years. Approximately 40% of patients had native or patched RVOTs, and 60% had bioprosthetic valves or conduits. About 14% of S3 valves in native RVOTs, and 16% of S3 valves in bioprosthetic RVOTs, were overinflated to ≥ + 1 mm above nominal. Neither group of overinflated S3 valves had a significant difference in PR compared to S3 valves in the nominal and underinflated range ($p > 0.1$). Similarly, 49% of S3 valves in bioprosthetic RVOTs, and 32% of S3 valves in native RVOTs were underinflated to ≤ -1 mm versus nominal. The S3 valves underinflated in bioprosthetic RVOTs did not reach a statistically significant difference compared to nominal inflation and overinflation with regards to obstruction ($p = 0.09$) or PR ($p > 0.1$). In many cases, even with aggressive overinflation (nominal + 4 mL or more) of S3 valves in both native and bioprosthetic landing zones, the angiographic diameter of the valves did not measure above their nominal diameter. **Conclusion** In a single-center experience, neither over- nor under-dilation of Sapien 3 valves was significantly associated with valve dysfunction up to five years from implantation. Overinflated S3 valves did not appear to be associated with an increase in pulmonary regurgitation.

ETHICS DECLARATIONS

Conflict of Interest: The authors declare they do not have any conflict of interests.

Ethical Approval: Not applicable.

Consent for Publication: Not applicable.

125. Aortic Root Dilation Associated with Cryptogenic Stroke Risk in Patients with Patent Foramen Ovale

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[1]Houston Methodist Hospital, Houston, USA. [2]DeBakey Cardiology Associates, Houston Methodist Hospital, Houston, USA

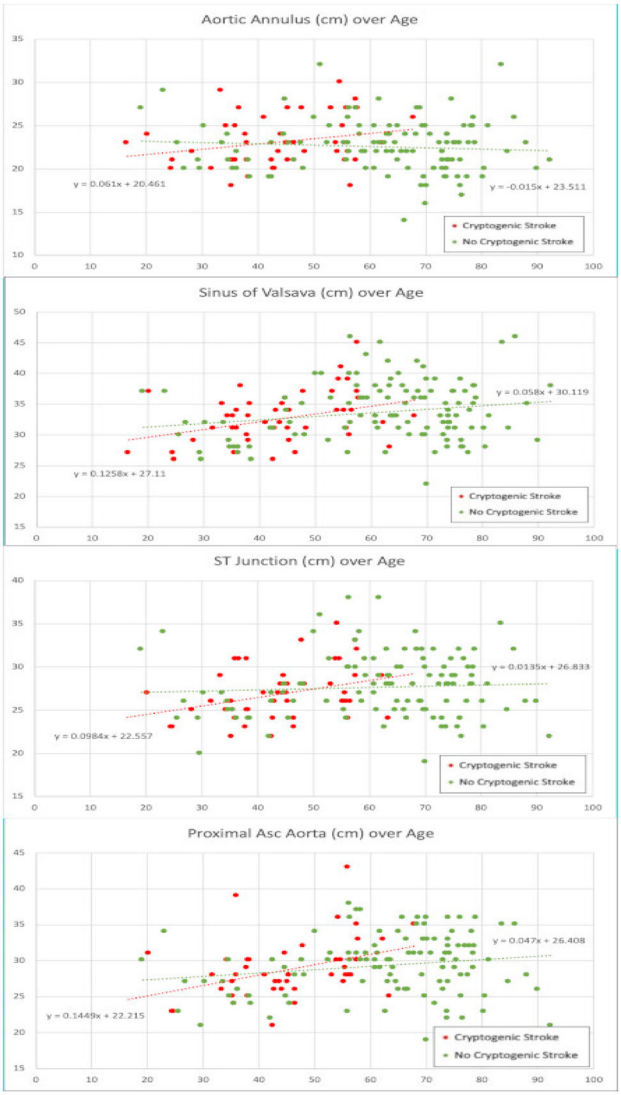
Introduction Aortic root dilation has been associated with increased cryptogenic stroke (CS) risk in patients with patent foramen ovale (PFO). Our study aim is to evaluate differences in aortic root dimension between groups with and without CS in patient cohort all with PFO. Methods: All patients in our hospital system with PFO reported on transesophageal echocardiogram from January 2015 – March 2020 were identified. After review of echo images, 222 patients were identified as having PFO based on positive bubble contrast study and intra-atrial shunting on color doppler. Dimensions at the aortic annulus (AA), sinus of Valsalva (SoV), sinotubular junction (STJ) and proximal ascending aorta (PAA) were measured in standardized TEE views. 47 of the patients had CS. Results: The CS group (N = 47) had different baseline demographics from the no CS group (N = 175). The CS group was significantly younger (45.4 ± 11.46 in CS vs 63.54 ± 15.36 in no CS) as well as more predominantly female (35% Male in CS vs 54% in no CS). There was no significant difference in the total mean aortic root dimensions for the two groups. Dimensions were analyzed over age, and linear regression relationships between CS and no CS groups were compared using analysis of covariance (ANCOVA). The slopes of linear regression relationships were higher is CS vs no CS group with statistical trend toward significant difference (AA $P < 0.06$, SoV $P < 0.27$, STJ $P < 0.09$, PAA $P < 0.25$). For subgroup of just female patients, there is significant difference in slopes of linear regression (AA $P < 0.01$, SoV $P < 0.02$, STJ $P < 0.03$, PAA $P < 0.01$). **Conclusion** This study suggests an increase to age related aortic dilation in CS vs no CS patients with PFO, especially in female patients. The limited population study shows trend towards statistical significance. Further study with larger patient population in patients with and without PFO are needed to further establish relation between PFO, CS and aortic root dimensions.

ETHICS DECLARATIONS

Conflict of Interest: The authors declare they do not have any conflict of interests.

Ethical Approval: Not applicable.

Consent for Publication: Yes.



126. Use of Virtual Reality in Case Preparation for Catheter Intervention in Congenitally Corrected Transposition of the Great Arteries: A Case Series

Katie Reynolds, Jenny Zablah

Children's Hospital Colorado, Aurora, USA

Introduction Virtual reality (VR) is becoming an innovative method for understanding 3-dimensional (3D) relationships of complex congenital heart anatomy in pediatric cardiology. VR allows for the user to interact directly with a model of the patient's complex cardiac anatomy by integrating previously obtained cross-sectional imaging.

VR is a valuable tool in pre-procedural planning in interventional cardiology in patients with complex anatomy and can aid in reducing procedural times. We present the use of VR in pre-procedural planning in patients with congenitally corrected transposition of the great arteries (ccTGA) who required pulmonary venous baffle interventions. Case 1: BG is 12-year-old female with ccTGA status post-double-switch operation at 11 months of age. BG underwent catheterization for pulmonary venous baffle stenting at 2 years of age in 2012. Many attempts were made to obtain proper positioning for a transeptal puncture in order to perform stenting of the pulmonary venous baffle with a Palmaz Genesis 1910 stent. Total fluoroscopy time was 63.7 min. BG returned at 12 years of age in 2022 with recurrent pulmonary venous baffle stent obstruction. CTA was obtained and used to create a VR model for pre-procedural understanding of the complex spatial relationships of the systemic and pulmonary venous baffles. With access in the right femoral vein and with aid of TEE and VesselNav, the pulmonary venous baffle was accessed without an issue from the systemic venous baffle using a Nykanen RF. Balloon angioplasty with a 14 mm Atlas was performed in the pulmonary venous baffle stent. Total procedural time was 72 min and total fluoroscopy time was 21.9 min which is notably shorter than the previous catheter intervention without VR. Case 2: AW is a 21-month-old male with ccTGA status post-double-switch procedure performed at 10 months of age who was found to have a pulmonary venous baffle obstruction. CTA data was used to create a VR model to assist in pre-procedural understanding of the spatial relationship between the systemic and pulmonary venous baffles. After this assessment, it was deemed possible to intervene without interacting with surrounding structures. With access in the right femoral vein, the pulmonary venous baffle was accessed without an issue from the systemic venous baffle from the IVC using a Nykanen RF wire and under TEE and VesselNav guidance. Two Valeo biliary stents were placed at the area of pulmonary venous baffle stenosis with angiographic improvement. Additionally, a balloon angioplasty was performed on the SVC and previously placed RPA stent. The total procedure time was 178 min and total fluoroscopy time was 50.4 min. **Conclusion** In our experience, the use of VR in pre-procedural planning helps to improve the interventionalist's understanding of the patient's complex congenital cardiac anatomy while also reducing procedural times.

ETHICS DECLARATIONS

Conflict of Interest: The authors declare they do not have any conflict of interests.

Ethical Approval: Not applicable.

Consent for Publication: Not applicable.

127. Patent Ductus Arteriosus Closure Using Different Generations of Amplatzer Devices, Experience in CEDIMAT, Dominican Republic

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Patent ductus arteriosus (PDA) is a vascular communication between the left pulmonary artery (LPA) with the descending aorta just after the origin of the left subclavian artery. It is an essential fetal structure that closes spontaneously in about 90% of infants during the first 48 h of life. Persistent patency of the ductus arteriosus beyond few weeks is considered abnormal (1) Transcatheter PDA closure is proposed as a direct substitute for surgical and is the standard of care in most cases and has become the treatment of choice for most PDAs in preterm, term infants, children and adults. Techniques have evolved and the transcatheter approach to PDA closure is now feasible and safe with current devices. Since the first transcatheter PDA closure by Portsmann et al. in 1967 (2,) there have been many significant developments in the devices used to close a PDA. (3) Objectives: The aim of this study is to share our experience of transcatheter device closure of PDA and evaluate the safety and efficacy of transcatheter using different generations of Amplatzer devices in pediatric patients, at short-term follow-up. Methods: We describe our initial clinical experience in percutaneous closure of PDA using Amplatzer devices. A retrospective analysis of 45 children referred for transcatheter PDA closure between November 2020 to May 2022 was done. Patients < 18 years were screened for a PDA. Device size was selected according to the size and morphology of the PDA, right and left heart catheterization was performed, and hemodynamic data were obtained in some cases at the time of implant. The diameter of LPA and descending aorta, and the presence of any pre- existing pressure gradients across the LPA or aortic arch were assessed at baseline and post-implant. Results: A total of 45 patients were enrolled. 24 females, the median age was 4.3 years, mean weight 20.6 kg. 29 Patient presented isolated PDA, 3 patients had PFO, 3 had small Perimembranous ventricular septal defect. 69% did not had extracardiac anomalies, 11% had Down's Syndrome. 31 Patients (69%) were symptomatic. The median implant time was 1:35 min. Median fluoroscopy time was 15.8 min. A retrograde (aortic) approach was used in 69% of procedures. Vascular Plug (AVP) was used in 3 patients, Amplatzer duct occluder (ADO) in 12 patients, ADO II in 8 patients, ADO II (AS) Additional Sizes in 19 patients, Piccolo in 3 patients, successful implantation was achieved and angiographic occlusion in 44 patients (98%). There was 1 embolization. None of the patients were referred for surgery. Transthoracic echocardiography 24 h after implantation confirmed total occlusion in 41 cases (91%), 1 had residual shunt and 2 had mild stenosis of the branches. **Conclusion** Small to large PDAs can be effectively and safely closed using Amplatzer devices with excellent results. Further studies are required to establish long-term results in a larger patient population.

ETHICS DECLARATIONS

Conflict of Interest: The authors declare they do not have any conflict of interests.

Ethical Approval: Not applicable.

Consent for Publication: Not applicable.

128. Mid-term Outcomes of Secundum Atrial Septal Defect Closure with the new GORE Cardioform ASD Occluder- Results for the Combined Pivotal and Continued Access Cohorts in the GORE ASSURED Clinical Trial

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Background: The GORE Cardioform ASD Occluder (W. L. GORE & Associates, Flagstaff, AZ) is a recently approved device for closure

of secundum atrial septal defects (ASD). The purpose of this study is to report the mid-term results of the combined pivotal and continued access cohorts of the GORE ASSURED clinical trial. Methods: This was a prospective, multicenter, single-arm clinical trial comparing the GORE Cardioform ASD Occluder with existing benchmark data from other U.S. FDA approved devices. The study cohort included patients from 22 centers enrolled from 3/2017 to 7/2019. The primary end points were 6- month closure success after device implantation (complete closure or insignificant residual shunt) and 6- month composite clinical success (technical, safety and 6-month closure success). Secondary endpoints evaluated included safety outcomes, arrhythmias, and device wire frame fracture (WFF) at 6 months. Results: A total of 569 patients age 18.5 ± 18.5 years with a mean weight of 44.1 ± 29.3 kg underwent attempted secundum ASD closure. The mean stop flow ASD diameter was 17.6 ± 5.3 mm. The primary endpoint of closure success was met in 100% of patients (428 patients with complete data). The primary endpoint of composite clinical success (485 patients with complete data) was met in 86.2% of patients (technical failure in 8.9%, 30-day serious adverse event in 4.1% and device event in 3.5% of patients). No patient experienced a cardiac erosion. Clinically significant new arrhythmias were observed in 23/569 (4.0%) of patients. WFF was noted in 138/433 (31.9%) of patients completing a 6-month fluoroscopy, (19.4%, 18%, 29.9%, 75.9% and 60% of patients with 27 mm, 32 mm, 37 mm, 44 mm and 48 mm devices, respectively). No clinical sequelae were observed in any patient with WFF. Device-related serious adverse events were similar in patients with and without WFF [1/138 (0.7%) versus 7/295 (2.4%), p = 0.45]. Conclusions: In this largest congenital ASD device trial to date, the GORE Cardioform ASD Occluder was found to have favorable results compared to other available U.S. FDA approved devices. Due to its unique features, size range and safety profile, the GORE Cardioform ASD Occluder expands the options for secundum ASD closure.

ETHICS DECLARATIONS

Conflict of Interest: Funded by W.L. Gore and Associates. Athar M. Qureshi, MD is a consultant/proctor for W.L. Gore and Associates and Medtronic Inc. and a consultant for Edwards Lifesciences and Abiomed Inc.

Ethical Approval: IRB approved.

Consent for Publication: Yes.

129. Novel Implantation of Amplatzer Piccolo Occluder: A Case Series Report

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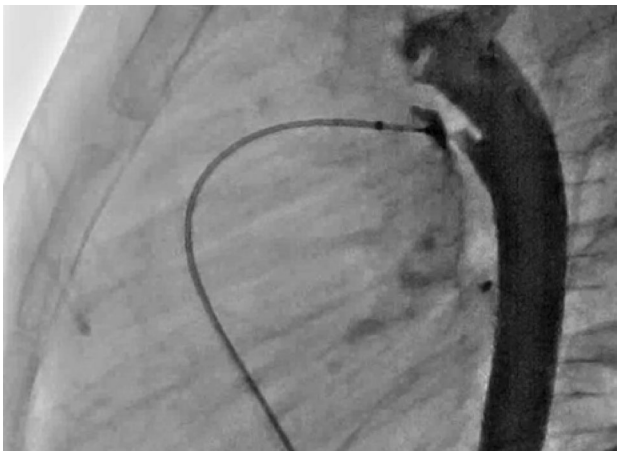
The features of the Amplatzer Piccolo Occluder (APO) are favorable for treatment of the hemodynamically significant PDA in premature and small infants. Recent studies have shown that the APO is both safe and effective. In patients weighing < 2 kg, the device is designed to be implanted entirely within the length of the PDA. In this series, we report a "spanning" implantation technique employed in older and larger patients, whereby the aortic and central discs are located within the ductal ampulla and/or PDA, and the pulmonary artery disc is pulled into the pulmonary artery (PA) so that it is flush with the inner surface of the vessel wall. Implantation was performed via an antegrade approach, and both angiography and transthoracic echocardiography (TTE) were used for imaging guidance. Indications for closure in these 7 patients included: respiratory insufficiency due to chronic lung disease; PDA murmur; and failure to thrive. There was no evidence of flow obstruction in the aorta and PAs on angiography and TTE performed pre-discharge, nor was there evidence of residual PDA flow. The PDAs in this series tended to be small and were not amenable to closure with other common devices (e.g. Amplatzer Duct Occluder 1). Historically a "free hand" coil occlusion technique would have been implemented to close similar PDAs. The spanning technique described here allows successful treatment of this subset of PDAs and affords more control during delivery compared with a free hand technique. Furthermore, as use of the APO increases, the spanning technique is a safe, straightforward, and effective substitute for free hand coil occlusion, particularly as familiarity with the latter approach wanes.

ETHICS DECLARATIONS

Conflict of Interest: The authors declare they do not have any conflict of interests.

Ethical Approval: Not applicable.

Consent for Publication: Not applicable.



Caption: Lateral projection, aortogram with APO on delivery cable. Residual contrast flow through PDA outlines posterior wall of main PA.

130. Prep for Congenital Heart Liver Transplant; the Importance of Aortopulmonary Collateral Embolization

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Abstract

The prevalence of adult congenital heart disease (ACHD) is increasing in the United States because of improved survival into adulthood. The unique physiology of ACHD commonly leads to multiorgan failure, requiring multiorgan transplant. Although surgical techniques and perioperative management have improved transplant outcomes for ACHD patients, some of these patients are nonetheless deemed prohibitively high risk and declined for transplantation due to concern for operative bleeding from extensive aortopulmonary and chest wall collaterals and co-existing liver dysfunction. Uncontrolled bleeding was recognized early in the congenital transplant experience as an important cause of mortality in the intra-operative and peri-operative period. Elimination of collaterals prior to heart transplant is a safe, well-tolerated procedure in ACHD patients, and appears to decrease collateral bleeding during transplant operation. Case: A 47 y.

o. male with history of D-loop transposition of the great arteries status post-atrial switch (Mustard) operation at 9 months of age. Referred for consideration of heart and liver transplantation in the setting of systemic right ventricular failure, pulmonary venous baffle obstruction, and liver cirrhosis due to cardiac congestion. This was despite IVC baffle obstruction stenting and pulmonary venous baffle stenting. Initial catheterization in April 2019 showed residual pulmonary venous baffle obstruction with a gradient of 8–9 mmHg, as well as significantly elevated systemic RVEDP 28 mmHg. Notably his subpulmonic RV pressures were 63/25 and his PA pressures were measured at 60/32, RPW 37, TPG 10. Diagnostic angiography in 2020 demonstrated a large pulmonary AVM originating from the medial/anterior branch of left basal trunk and marked competitive filling suggestive of pulmonary collaterals. The superior segmental branches also demonstrated competitive filling. Patient was accepted for transplant pending embolization of the AVM and aortopulmonary collaterals. Procedure: Patient underwent 7 separate procedures over 13 months for successful occlusion of left pulmonary AVM and embolization of numerous APCs to reduce the risk of mediastinal bleeding in the setting of planned multiorgan transplant. Equipment included: 6-French 70 cm Flexor Sheath, 6-French Guide Catheters: MPA, AL 0.75, IM, and JR4; 4-French Catheters: Glide MPA, IM, JR4, and Mikkelsen; Wires: 0.035 Wholley, 0.035 tip deflecting, and Fathom 0.018; Microcatheters: Cantata 2.5, Cantata 2.9, and Lantern; Coils/Plugs/Spheres: 8 mm Amplatzer Vascular Plug 2, 700micron & 900 micron Embozene particles, Penumbra POD coil, Ruby LP coils, Ruby soft coils, Ruby coils, packing coils, and MVP vascular plugs. Follow-Up: Patient underwent successful heart and liver transplant in November 2021. Post-transplant, he had no issues with APC bleeding, pulmonary venous return obstruction, or hypoxia related to resolving pulmonary AVM.

ETHICS DECLARATIONS

Conflict of Interest: The authors declare they do not have any conflict of interests.

Ethical Approval: IRB approval.

Consent for Publication: Yes.

131. Transcatheter Venous Rehabilitation in Patients with Chronic Renal Disease

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Background: Pediatric patients with chronic renal disease on hemodialysis may develop venous occlusion specifically of the superior vena cava secondary to multiple factors including chronic indwelling hemodialysis catheters. Patients with chronic renal disease often require long term and repeated placement of hemodialysis catheters, thus rehabilitation of the superior vena cava in this patient population is essential. Objective: We describe the short-term results of venous rehabilitation in patients with venous occlusion with insitu hemodialysis catheters. Methods and results: There were 5 procedures done in 4 patients with chronic renal disease on hemodialysis who presented with superior vena cava syndrome. Ultrasound documented complete obstruction of the superior vena cava around the hemodialysis catheter. The patients ranged in age from 11 to 22 years (median 16 yrs). The etiology of the chronic renal disease in these patients are unique to each patient. All patients had developed graft failure following deceased donor kidney transplantation and required hemodialysis. The hemodialysis catheter was placed across the SVC through the right or left subclavian vein and the catheter was tunneled under the skin. The procedure was done in conjunction with pediatric surgery who freed the subcutaneous cuff from the surrounding tissue. A wire was advanced from the hemodialysis catheter to the right atrium and the hemodialysis catheter was pulled back to the subclavian vein. A snare catheter was advanced from the femoral vein to the right atrium where the wire was snared and exteriorized through the femoral vein forming a "rail". An appropriate sized sheath was advanced to the SVC over the wire and angiograms were done to assess the vessel obstruction. The superior vena cava was preemptively dilated with a high pressure balloon catheter followed by stent placement. There were a total of 7 stents placed which were a combination of the CP stent (NuMED Inc, Hopkinton, New York, USA) and the Palmaz XL stent(Cordis Corp, Cardinal Health Company, Milpitas, Ca) In three patients two overlapping stents were placed and in one patient a single stent was placed across the stenotic site. There was immediate angiographic evidence of vessel patency. When indicated the hemodialysis catheter was replaced over the wire "rail", tunneled under the skin and secured. One patient with innominate vein obstruction noted on angiography underwent rehabilitation of the vessel in addition to the superior vena cava. One patient had graft failure after SVC rehabilitation and required reintervention with successful hemodialysis catheter placement. **Conclusion** Our experience suggests that patients with chronic renal disease requiring long-term hemodialysis who develop SVC syndrome derive relief from transcatheter venous rehabilitation. Furthermore, transcatheter venous rehabilitation provides a durable vascular access solution in a patient population who is at a high risk for vascular compromise. These patients are likely to need repeated dialysis catheter placement, further underscoring the importance of maintaining adequate vascular patency.

ETHICS DECLARATIONS

Conflict of Interest: The authors declare they do not have any conflict of interests.

Ethical Approval: Not applicable.

Consent for Publication: Not applicable.

132. Ductal Stenting in Pulmonary Atresia as the Early Palliative Procedure of Choice: A Cohort at 2600 m Above Sea Level

Camila Castro-Paez[1], Catalina Vargas-Acevedo[2], Diana Herrera[1], Karen Moreno-Medina[2], Juan Carlos Briceño[1], Alberto García[2]

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Objective: Pulmonary atresia (PA) is a complex congenital heart defect with single-source ductal-dependent pulmonary blood flow (PBF), usually with a tortuous ductus arteriosus (DA) and a critical health condition, thus an early palliative procedure is necessary. Ductal stenting (DS) has been used as an alternative to surgical palliation (Modified Blalock-Taussig-Thomas shunt). The ductal morphology makes the angiographic approach of the DA a challenge. We sought to describe the clinical characteristics of children with pulmonary atresia who underwent DS as the first early palliative procedure. Methods: We analyzed a historical cohort of children younger than three months with echocardiographic diagnosis of PA, treated at Fundación Cardioinfantil- LaCardio (a reference cardiovascular center in Bogotá, Colombia—a city located at 2600 m asl) with a ductal stenting as their first intervention. Demographic, echocardiographic, clinical, and angiographic variables were described using non-parametric statistics due to the nature of the data. Angiographic images were retrieved to describe ductal morphology

according to Qureshi et al. The exclusion criteria for DS included sepsis or active infection, weight under two kg or other severe congenital diseases (complex genetic syndromes such as trisomy 13 or 18). Ductal morphology was not considered an exclusion criterion for DS. Results: During the study period there were a total of 61 eligible patients, of which 37.7% were female. PA with intact ventricular septum was found in 59% of cases, PA with ventricular septal defect in 19.7% of cases and PA with complex intracardiac anatomy (other associated defects) in 21.3% of cases. There was a median age at intervention of 13 days (IQR 4.5–20.5) and a median weight at intervention of 3 kg (2.5–3.2). Median preprocedural oxygen saturation was 85% (IQR 80–90%) with a postprocedural increase to a median of 90% (IQR 87–95%), considered normal at Bogotá's altitude. Prostaglandin infusion was maintained during the entire procedure and early postoperative care. Ductal morphology was classified as type I in 35.2% of cases, type II in 46.3% and type III in 18.5%. Median angle between the DA and the descending aorta was 49.9° (IQR 15.7°-130.2°), with a median diameter at the narrowest part of the DA at 3.5 mm (IQR 2.0–5.0 mm), and the median length of the DA was 14.1 mm (IQR 6.0–32.2 mm). Median in hospital stay after the procedure was 21 days (IQR 14–30). The procedure was successfully completed in 83.6% of cases. Unsuccessful cases were: four intraprocedural fatalities, two failed attempts to deliver the stent into the DA, and four early reinterventions (defined as the need for another procedure in the first 30 days). Conclusions: Worldwide DS has become a reasonable alternative to surgical palliation for children with PA, and in our center, it has become the procedure of choice for this patient population despite their critical condition and difficult ductal morphology (tortuosity and aortic origin). We consider DS a less invasive procedure to secure early PBF without surgery and with adequate postoperative oxygen saturations and hemodynamics for the patient to reach a next stage or definitive surgical repair.

ETHICS DECLARATIONS

Conflict of Interest: This project was funded by Colombia's Ministry of Science, Technology and Education (Minciencias), Fundación Cardioinfantil and Universidad de los Andes, under the title InnCarddio: innovation in the treatment of congenital heart diseases inspired by clinical and hemodynamic observations, RC 821–2017. All data was obtained from institutional electronic records. Ethical Approval: This project was presented and approved by the institutional ethics committee.

Consent for Publication: Since it is a retrospective cohort no consent was needed.

133. ¿Is Percutaneous Reconstruction of the Aortic Arch Possible in Infants? With Regard to a Case

Ana M. Aristizabal[1,2], Jaiber Gutiérrez[1,2], Walter Mosquera[1,2]

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Female patient, product of term twin pregnancy, with diagnosis of congenital heart disease type coarctation of the aorta and aortic isthmus hypoplasia (Fig. 1) with muscular ventricular septal defect. At two months of life, the patient underwent cardiac catheterization to assess the possibility of angioplasty and interventricular septal defect closure. Angioplasty was performed with a Genesis Blue 5 × 24 stent in the coarctation zone, with "hourglass" image for which an attempt was made to dilate the narrow area with a coronary balloon and a new Genesis Blue 5 × 15 stent was place, without being able to perform angioplasty in the entire affected area (Fig. 2), with significant blood pressure gradient in extremities. Three days later, the patient was taken to a new interventional procedure using multiple balloons, an Angio Sculpt 3X1.5 and a Euphora 5 × 2 balloon, which were dilated up to 22 and 14 atmospheres, respectively, on repeated occasions, without achieving the desired response. Finally, a Mustang 6X2 balloon was placed and dilated several times, achieving significant improvement in pulsatility and 50% decrease in gradient and improvement in left ventricular systolic-diastolic function. The case was discussed in a cardiosurgical meeting and decision was made to defer closure of the interventricular septal defect and perform pulmonary artery banding to control pulmonary hyperflow. The procedure was carried out two days later, without complications. The clinical evolution showed poor weight gain and swallowing disorder, requiring gastrostomy. Four months later, with echocardiographic evidence of significant gradient in descending aorta and Doppler showing diastolic prolongation, it was decided to perform a new interventional procedure. A Mustang 6 × 4 balloon was placed and dilated up to 22 atmospheres, without observing complete improvement of stent waisting. The Mustang was removed and a Conquest 6 × 4 balloon was fitted and dilated up to 25 atmospheres, observing full waist resolution (Fig. 3). The balloon was removed and a new angiography was performed, which demonstrated mild neointimal hyperplasia in stents, significant improvement of the lumen of the aorta, with 7-mmHg pressure gradient between ascending and descending aorta, and significant improvement of pulsatility, without evidence of aneurysms or dissections. Echocardiogram showed decreased residual gradient, with improved left ventricular function. Currently, the patient is in good condition, with height and weight gain, asymptomatic, without clinical extremity blood pressure gradient. We are waiting for programming to perform surgical closure of interventricular septal defect. We consider this to be a case of great interest, given that it paves the way for interventionist management in patients with coarctation of the aorta and hypoplasia of the aortic arch. Reports should continue to have sufficient evidence available to support this type of management.

ETHICS DECLARATIONS

Conflict of Interest: The authors declare they do not have any conflict of interests.

Ethical Approval: Approved.

Consent for Publication: Given.

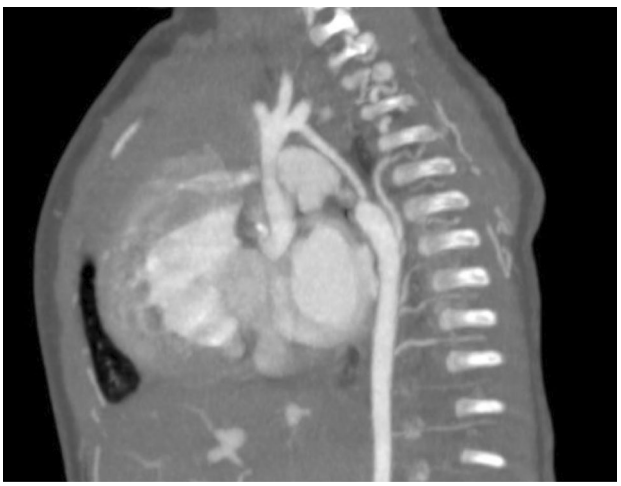

Fig. 1 Computed tomography angiography showed coarctation of the aorta and aortic isthmus hypoplasia.

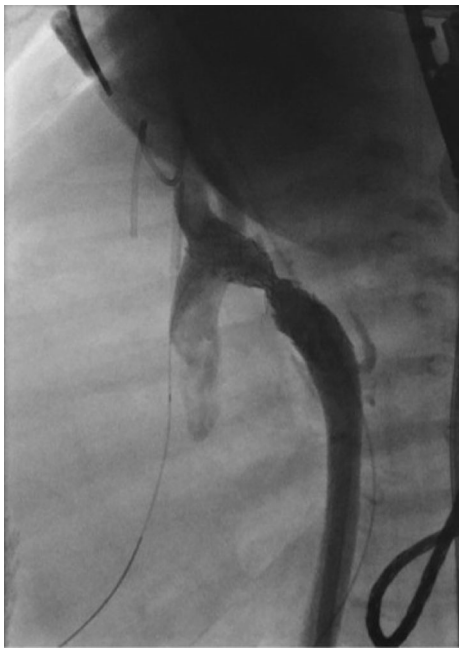

Fig. 2 Stent angioplasty of uncorrected coarctation, hourglass image

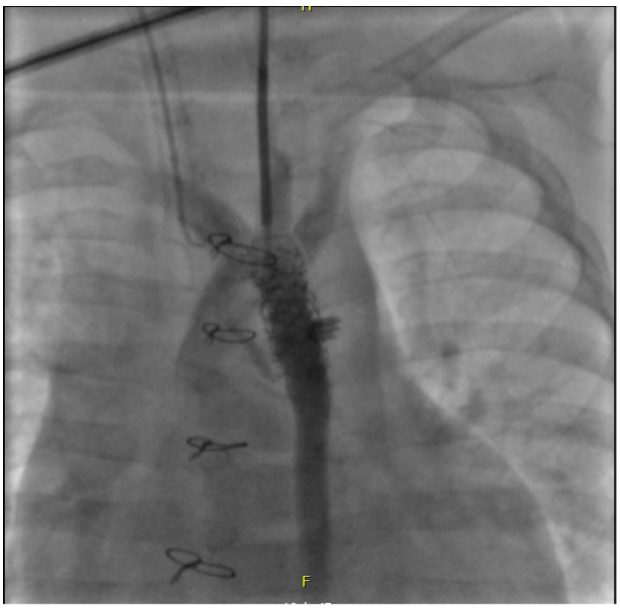

Fig. 3 Stent angioplasty of successful coarctation

134. Suture Assisted Technique for Gore Cardioform ASD Occluder Delivery Sheath Deflection to Facilitate Closure of Large or Complex Secundum Atrial Septal Defects

Lindsay Eilers[1], Richard Krasuski[2], John Serfas[2], Tacy Downing[3], Allen Ligon[4], Manish Bansal[1], Srinath Gowda[1], Gary Stapleton[1], Athar Qureshi[1]

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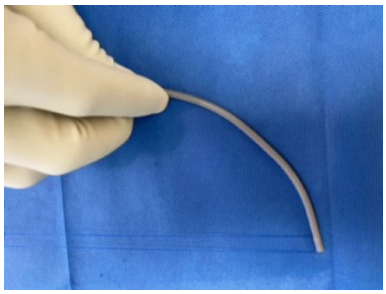
Objectives: To describe a new deployment technique of the Gore Cardioform ASD Occluder (W. L. Gore and Associates, Flagstaff, AZ) for large atrial septal defects (ASDs) with deficient rims, or with complex anatomy. **Background**: The Gore Cardioform ASD Occluder is approved for closure of secundum ASDs from 8 to 35 mm. In large defects or complex anatomy with multiple deficient rims there can be significant challenges aligning the device parallel to the atrial septum. Methods: A retrospective study was conducted on the use of a suture to facilitate closure of challenging secundum ASDs in the cardiac catheterization laboratory from 09/2021 to 06/2022 at Texas Children's Hospital, Children's Hospital of Atlanta, Children's National Medical Center, and Duke University. A long Prolene, Vicryl, Polypropylene, or Silk suture was looped through the wire port of the Gore Cardioform ASD Occluder delivery sheath with both ends of the suture remaining outside the patient (Figure). During device deployment, tension was placed on the suture to deflect the Gore Cardioform ASD delivery sheath and align the device parallel with the atrial septum. Results: To date, 16 patients have undergone attempted ASD closure using suture deflection of the Gore Cardioform ASD Occluder [median age 7.6 (IQR 4.6, 17.1) years, weight 36.8 (IQR 16.9, 54.3) kg, and BSA 1.19 (IQR 0.70, 1.53)]. All patients had deficient retro-aortic rims and four patients had multiple deficient rims. Median procedure time was 109 (IQR 61, 149) minutes and median radiation dose was 528 (IQR 79, 3904) cYg*cm^2. The suture technique was typically used to deliver large devices (> 32 mm). Device implantation was successful in 14/16 (88%) patients (two unsuccessful implants in very large defects with multiple deficient rims). There were no major adverse events. In patients where the defect was successfully closed echocardiogram following the procedure demonstrated no more than a trivial residual shunt. Conclusions: Suture assisted deployment of the Gore Cardioform ASD Occluder device is a useful technique for device alignment in select patients with large secundum ASDs or ASDs with deficient rims.

ETHICS DECLARATIONS

Conflict of Interest: Funded by W.L. Gore and Associates. Athar M. Qureshi, MD is a consultant/proctor for W.L. Gore and Associates and Medtronic Inc. and a consultant for Edwards Lifesciences and Abiomed Inc.

Ethical Approval: IRB approved.

Consent for Publication: Yes.



135. Service Line for Transcatheter Device Closure of the Neonatal Patent Ductus Arteriosus: Program Infrastructure Correlates with Increased Procedural Referrals and Efficacy

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Children's Healthcare of Atlanta—Emory, Atlanta, USA

Background: Transcatheter device closure (TDC) of the patent ductus arteriosus (PDA) in the premature neonate has represented a growing trend due to new device availability. However, altering referral and treatment patterns of the neonatology community has experienced a slower trend. Further, most programs are performing neonatal TDC-PDA the cardiac catheterization laboratory and struggle with ensuring procedural efficacy and safety within this medically fragile population. In October 2021, we developed a comprehensive neonatal TDC-PDA closure program within our institution to address the multidisciplinary needs of these patients. Methods: Summative programmatic and process (quality) measure outline of a multidisciplinary approach to TDC-PDA in preemies, with the focus being establishment of a service line. This encompasses streamlining referrals via an interdisciplinary review team and generating checklist-pathways for all team members that encompass pre-, intra-, and post-procedural care. Descriptive statistics summarize neonatal TDC-PDA outcomes in the 8 months preceding program establishment (February 2021 to September 2021) compared to the 8 months after foundation (October 2021 to May 2022). Results: Clinical and echocardiographic criteria for neonatal TDC-PDA referral were generated and disseminated to neonatologists and cardiologists throughout the state of Georgia via an email listserv created for centralized referral. Neonatal TDC-PDA referrals have increased exponentially since program inception (n = 32) relative to the comparative study period preceding (n = 5) (Fig. 1). Moreover, there has been an increase in patients referred weighing less than 1 kg (n = 16 with weight range 510–950 g versus n = 1 with weight 790 g) who now represent the primary patient subset of procedures performed. All referred patients underwent successful TDC-PDA, except for one patient prior to program formation (March 2021) due to intra-procedural clinical instability; the patient ultimately underwent surgical ligation. Creation of procedural checklist-pathways have resulted in higher staff "care ratings" surrounding the care of TDC-PDA patients—average care rating being 2 versus 5 pre- and post, respectively (scale to 5). Additionally, procedural checklists have resulted in decreased catheterization lab "out of isolette" time for TDC-PDA patients from a mean of 88 min (pre) to 56 min (post). Major procedural complications experienced since program inception include a flail Tricuspid leaflet in a 910-g infant who now 6 months post-procedure has no residual PDA and stable mild-moderate tricuspid regurgitation without clinical sequelae. Another patient required snaring of embolized device then new PDA device placement without complication. Conclusions: Building a service line and streamlining referral can result in a significant increase in institutional TDC-PDA in premature neonates. A multidisciplinary team and approach to these challenging patients is critical to ensure the efficacy and safety of this procedural experience.

ETHICS DECLARATIONS

Conflict of Interest: The authors declare they do not have any conflict of interests.

Ethical Approval: Not applicable.

Consent for Publication: Not applicable.

136. Safety and Efficacy of the Micro Vascular Plug (MVP) for Closure of Patent Ductus Arteriosus in Premature Infants at a Single High Volume Center

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Background: Transcatheter patent ductus arteriosus (PDA) closure in premature infants is becoming more routine at high volume pediatric interventional centers. The Amplatzer Piccolo Occluder, "Piccolo" (Abbot, Santa Clara, CA) is the only device approved by the FDA specifically for the indication. However, other centers have reported success in utilizing a small number of other devices, including the Microvascular Plug, "MVP" (Medtronic, Minneapolis, MN). We report safety and efficacy data for transcatheter PDA closure in premature infants when utilizing the MVP device. Methods: Retrospective review of all ex-premature infants who underwent transcatheter PDA closure at a single center (04/2018–05/2022, n = 102). Cases which utilized the MVP were included for the analysis (n = 72). Basic descriptive statistics were performed using R version 4.0.2 (R Foundation for Statistical Computing, Vienna, Austria). Results: Seventy-two ex-premature infants underwent transcatheter PDA closure using the MVP. Mean gestational age of the cohort was 24.1 + 1.6 weeks (range, 22–33); mean weight at the time of procedure was 1.2 + 0.3 kg (range, 0.7–2.0; 82% were < 1.5 kg); mean age at the time of procedure was 46 + 15 days (range, 20–94); mean PDA diameter was 2.9 + 0.7 mm (range,1.3–4.9). There were no mortalities within 30 days of the procedure. There were no known significant vascular injuries. There was one major AE (need for repeat catheterization for an aortic arch obstruction; 1.4%). There were 2 other minor AEs (2.8%; small pericardial effusion not requiring insertion of pericardial drain, n = 1; and instance of device malposition with uneventful retrieval and replacement of an additional device within the same catheterization, n = 1). The mean post-procedure left pulmonary artery peak gradient was 7.9 + 6.0 mmHg; the mean aortic peak gradient was 2.4 + 5.5 mmHg. There is a mean total follow-up time of 2.4 + 1.2 years (range, 0.3–4.2). Conclusions: Transcatheter PDA closure was performed safely in 72 premature infants using the MVP device. The safety profile, including number of major and minor adverse events, is in line with (and actually lower than) the average reported in a recent meta-analysis of PDA closure in infants who weigh < 1.5 kg*. Some experienced operators at this institution prefer the MVP device due to its flexibility and the ability to deliver through a microcatheter. Further study is warranted. (*Percutaneous Closure of Patent Ductus Arteriosus in Infants 1.5 kg or Less: A Meta-Analysis. Bischoff, Adrianne Rahde et al. The Journal of Pediatrics, Volume 230, 84–92.e14).

ETHICS DECLARATIONS

Conflict of Interest: The authors declare they do not have any conflict of interests.

Ethical Approval: Not applicable.

Consent for Publication: Not applicable.

137. Embolization of Massive Veno-Venous Collateral in Adult with Fontan.

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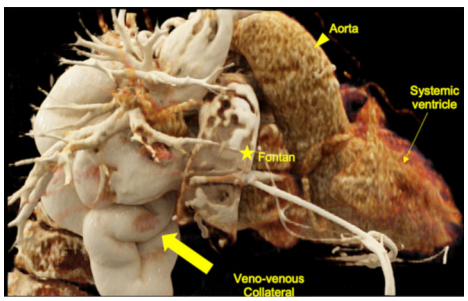
Introduction Veno-venous collaterals after Fontan operation can lead to significant chronic systemic arterial hypoxemia. We present case of adult patient with Fontan and large veno-venous collateral requiring embolization. Case: Our patient is a 32yo man with history of tricuspid atresia s/p classical atrio-pulmonary Fontan at age 3 followed by conversion to extracardiac conduit and MAZE procedure for atrial fibrillation at age 12. He presented with severe hypoxia with O2 saturation in mid 70%s that prompted further workup. Cardiac catheterization and CTA chest demonstrated a massive 2 cm tortuous venovenous collaterals coming from left innominate vein and forming pseudochamber returning to the common atrium. During catheterization, he was found to have significant impairment of hemodynamics due to AV dyssynchrony related to failure to capture of epicardial pacemaker lead. As a result, hybrid approach with surgical ligation of veno-venous collateral to the right pulmonary vein as well as epicardial pacemaker replacement prior to staged transcatheter occlusion of collaterals was planned. During transcatheter procedure, left innominate vein venography demonstrated multiple venovenous collaterals including 3 most prominent. The first one originates from large superior thoracic vein, that gives rise to superiorly directed venovenous collateral and another inferiorly directed venovenous collateral. The inferiorly directed collateral was first embolized using Medtronic MVP 3Q 12 mm microvascular plug. The superiorly directed collateral was then embolized using MVP 3Q 12 mm microvascular plug. The largest collateral was embolized last using two MVP 3Q 9 mm microvascular plugs with the second plug positioned at the ostium. Post-embolization angiography demonstrated complete cessation of flow to each collateral. **Conclusion** Our case demonstrates a successful joint surgical and percutaneous approach to embolization of large collateral vessel. Repeat CTA chest 3 months post-op shows successful occlusion of previous massive venovenous collaterals He continues to have symptoms of dyspnea on exertion, and O_2 saturation remains in 80%s. This is likely related to post-surgery complication including elevated right hemidiaphragm. He is pending further pulmonary workup.

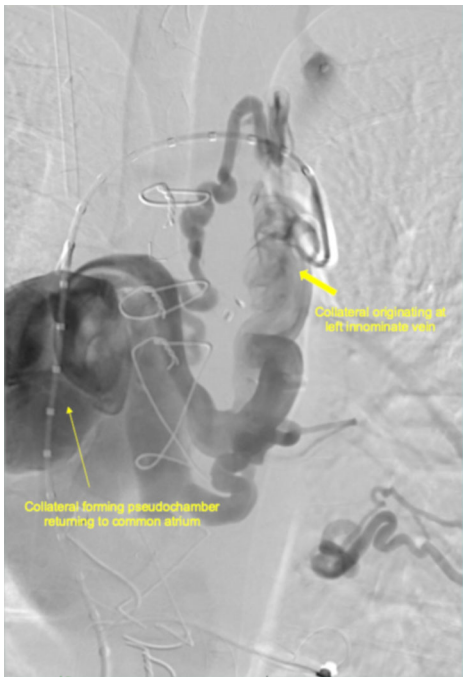
ETHICS DECLARATIONS

Conflict of Interest: The authors declare they do not have any conflict of interests.

Ethical Approval: Not applicable.

Consent for Publication: Yes.





138. Rapid Atrial Septal Defect Creation Technique Utilizing Radiofrequency Wire-Guide Catheter Transseptal Puncture in Pediatric Patients with Complex Anatomy

Natalie Craik[1,2], Eilers Lindsay[1,2], Gary Stapleton[1,2], Srinath Gowda[1,2], Manish Bansal[1,2], Asra Khan[1,2], Melissa Webb[1,2], Athar Qureshi[1,2]

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Objective: To describe a specialized technique for transseptal puncture in pediatric patients using radiofrequency (RF) energy. **Background**: Transseptal puncture in pediatric cardiac catheterization is used to obtain access to the left atrium in patients with intact atrial septum. Traditionally, this has been performed with a transseptal needle. However, the needle is stiff with a curve that is not always suitable in smaller patients or those with complex anatomy. The RF wire technique for transseptal access can be used in pediatric patients requiring a more efficient technique to create atrial septal defects (ASDs). At our institution, this technique has largely replaced transseptal needle puncture in small patients with complex anatomy. Methods: A retrospective study was conducted on the use of RF wire-assisted transseptal puncture in the cardiac catheterization laboratory from 11/27/2019 – 6/13/2022 at Texas Children's Hospital/ Baylor College of Medicine. A 0.024″ Nykanen RF perforating wire (Baylis Medical) was advanced through a Protrak microcatheter (Baylis Medical) and positioned abutting the atrial septum through a short 5 Fr JR 4 guide catheter (Cordis). Both fluoroscopic and transthoracic echocardiographic guidance were used to confirm position. A current was applied for a period of 2–3 s allowing the microcatheter to be advanced across the atrial septum. The perforating wire was exchanged for a 0.014″ wire and balloon angioplasty of the atrial septum with a 4 mm Emerge balloon (Boston Scientific) was subsequently performed, allowing the guide catheter to be easily advanced into the left atrium as the balloon is being simultaneously

deflated. ASD creation with larger balloons or stenting was then performed with appropriate wire/catheter exchanges. Results: Thirteen patients have undergone RF wire-assisted transseptal access. The median age was 0.83 years (IQR 0.4–3.5), weight was 7.7 kg (IQR 4.3–13.4), BSA was 0.38 (IQR 0.25–0.58), and radiation expose measured by dose area was 176 cGY*cm2 (IQR 101–424). The mean procedure time was 209 min (SD 90) and fluoroscopy time was 80.1 min (SD 34). The most common procedure for which we utilized this technique was ASD creation intervention for pulmonary vein stenosis (n = 11) followed by ASD creation/stenting in hypoplastic left heart syndrome with intact atrial septum (n = 2). One patient required CPR due to a pulmonary hypertension crisis and another required transfusion with no additional reported complications, including atrial perforations or effusions. Conclusions: Transseptal puncture and ASD creation utilizing the RF wire and guide catheter technique may provide improved control, efficiency, and safety in small patients with complex anatomy.

ETHICS DECLARATIONS

Conflict of Interest: Funded by W.L. Gore and Associates. Athar M. Qureshi, MD is a consultant/proctor for W.L. Gore and Associates and Medtronic Inc. and a consultant for Edwards Lifesciences and Abiomed Inc.

Ethical Approval: IRB approved.

Consent for Publication: Yes.

139. Long-Term Outcomes Following Intervention in Children with Functional Single Ventricle and Pulmonary Vein Stenosis: A Single-Tertiary-Center Experience

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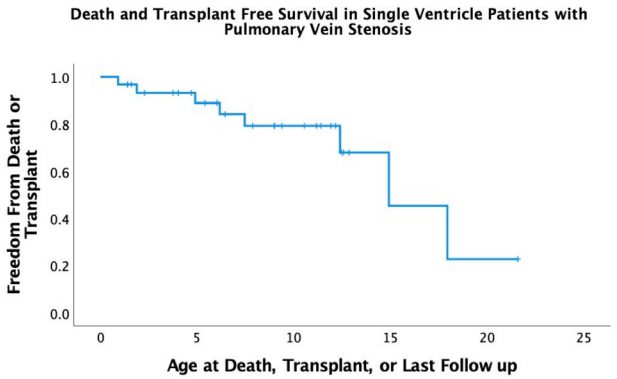

Background: Overall survival and staged single-ventricle (SV) palliation of children with functional single ventricle and pulmonary vein stenosis (PVS) are felt to be poor and challenging due to group heterogenicity, association with heterotaxy, cardiac and extracardiac anomalies. Our aim was to evaluate medium and long-term outcomes of PVS following surgical and transcatheter intervention from our center. Methods: Our database was reviewed from June 1990 to June 2022 for patients with SV who had surgical or transcatheter intervention for PVS. A retrospective review of demographics, cardiac diagnosis, surgical and transcatheter PVS interventions, success rate, complications, most recent surgical palliation and outcomes were performed. Transplant/death free survival was obtained using Kaplan Meier curve and risk factors associated with poor outcomes (including death, transplant, and failing Glenn) were evaluated. Results: A total of 32 patients were included in study, 17 patients (53.1%) were female. Twenty-nine patients were term (90.6%). Heterotaxy and genetic abnormality were noted in 17 (53%) and 5 patients (15.6%), respectively. Associated cardiac diagnosis included; unbalanced AVSD n = 14 (43.8%), HLHS n = 6 (18.8%) and CCTGA n = 5 (15.6%). Of note, 22 cases (68.8%) were diagnosed with anomalous pulmonary venous return (APVR). Pulmonary vein (PV) disease was unilateral in 18 patients (56.3%). Fourteen patients (43.8%) had stenosis of 3 or more veins at the baseline, 9 patients (28.1%) had 2 PV and 9 patients (28.1%) had one PV disease. There were 47 surgical interventions performed in 27 patients with the median of one procedure per patient IQR (1–2). 29 patients (90.6%) had 130 transcatheter interventions for PVS with median of 3 interventions per patient, IQR (1–6). Interventions include angioplasty, stent angioplasty, and recanalization. Success rate in transcatheter interventions was (81.8%-89.4). On last follow-up, median age was 8.9 years (IQR 4.1–12.1) and median of lost PV was 1, IQR (0–2). The staged palliation included BDG in 8 patients (25%) and Fontan in 11 patients (34.4%). Five patients (15.6%) had failing Glenn physiology, six patients (18.9%) had died, and 2 patients (6.3%) had transplant during follow-up period. Using logistic regression, unilateral PV disease was associated with poor outcomes (p = 0.021). Two or more PV disease approached significance (p = 0.057). However, on multivariate analysis, neither were significant. Heterotaxy, genetic diagnosis, TAPVR, congenital versus post-surgical PVS, and the age at first PVS intervention were not associated with poor outcomes. Overall death and transplant free survival of SV patients with PVS was 95% at one year of age, 83% at 8 years of age, and 60% at 10 years of age. Death and transplant free survival was 83% and 75% at 5 years and 10 years after the first PVS intervention. Conclusions: Staged palliation in SV patients with PVS remain challenging with ~ 60% reaching Glenn and Fontan palliation at medium term. However, the long-term outcomes remain guarded. Unilateral PV disease and 2 or more PV disease are likely associated with poor outcomes. A designated PV program, hybrid surgical and transcatheter techniques with medications and team approach may improve future outcomes in these patients.

ETHICS DECLARATIONS

Conflict of Interest: Funded by W.L. Gore and Associates. Athar M. Qureshi, MD is a consultant/proctor for W.L. Gore and Associates and Medtronic Inc. and a consultant for Edwards Lifesciences and Abiomed Inc.

Ethical Approval: IRB approved.

Consent for Publication: Yes.

140. Percutaneous Catheter Directed Thrombolysis in Small Complex Congenital Patients

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Arterial and venous thrombosis is a common complication in patients with complex congenital heart disease. Systemic thrombolysis has concomitant risks. Most recently, catheter directed thrombolysis has been used in the treatment of pulmonary embolism and has shown to have decreased mortality, shorter hospital length of stay and lower bleeding and transfusion rates. We report two unique cases of local

catheter-based delivery of tissue plasminogen activator (tPA) for localized vessel thrombosis in very small single-ventricle patients. A 4-month-old male, 5.3 kg, with left dominant unbalanced AV canal with multilevel right ventricular outflow tract (RVOT) obstruction, bilateral Superior Vena Cavae (SVCs) without bridging vein. Initially, he underwent a modified left 3.5 mm Blalock Taussig Thomas shunt for cyanosis and eventually underwent translocation of the left SVC (LSVC) to right SVC (RSVC), right sided bidirectional Glenn and main pulmonary artery banding. Post-operatively, he had chronic and recurrent chylous effusions requiring prolonged chest tubes, total parenteral nutrition and octreotide infusion without resolution. He was subsequently taken to the cardiac catheterization lab that showed normal Glenn pressures, patent Glenn anastomosis with stenotic LPA that was balloon dilated with no residual gradient. He was noted to have an occlusive thrombus in LSVC despite being on adequate anticoagulation with enoxaparin and aspirin. The LSVC was recanalized and a 4Fr/90 cm UniFuse catheter (Angiodynamics, Latham, NY) was positioned in the LSVC and secured for continuous tPA infusion. After 48 h of tPA continuous infusion, repeat angiograms showed significant improvement in the LSVC clot burden. There was some residual stenosis at the LSVC/left subclavian junction which improved after balloon angioplasty. He also underwent MPA occlusion. Following these interventions, chest tube output decreased and chest tubes were removed 10 days post-intervention. He was eventually discharged home. The second patient was a 5-month-old, 5.4 kg boy with {S,L,L} double inlet left ventricle, right AV valve atresia, unobstructed subaortic VSD and significant valvar and subvalvar pulmonary stenosis. He was initially palliated with a PDA stent and ultimately had bidirectional Glenn. His postoperative course was also complicated by chylous pleural effusions and was found to have occlusive thrombus of the left pulmonary artery and innominate vein. He was taken to the cardiac catheterization laboratory. His left basilic vein was accessed and a 0.014″ Fielder wire (Asahi Intecc USA, Inc., Irvine, CA) was able to be manipulated across the thrombus and successfully recanalized the left innominate vein and left pulmonary artery. A 4Fr/90 cm UniFuse catheter was also placed via the left basilic vein for continuous tPA infusion in the similar fashion. With significant decrease in thrombus burden, balloon angioplasty of the left innominate vein as well as pulmonary artery were then subsequently performed. Despite successful recanalization, unfortunately he had a prolonged hospital course complicated by duodenal perforation, hemoperitoneum and eventually succumbed to decompensated septic shock. We describe an interesting and unique percutaneous technique of continuous catheter-based local infusion of tPA for vessel thrombi which can be used particularly in small complex patients that have failed systemic anticoagulation.

ETHICS DECLARATIONS

Conflict of Interest: The authors declare they do not have any conflict of interests.

Ethical Approval: Not applicable.

Consent for Publication: Not applicable.

141. Replacement of Melody Valve Jugular Vein Tissue with a PET Covering

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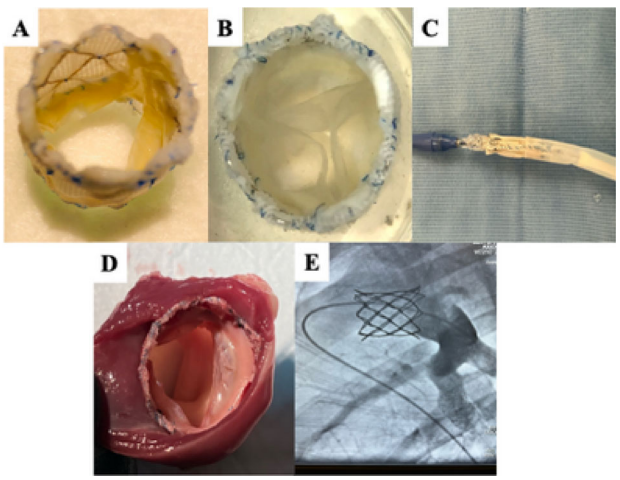
Background: Between 2014 and 2020, patients with a polytetrafluoroethylene pre-stent trended toward significantly reduced IE incidence ($p = 0.095$) after Melody valve implantation. It was hypothesized that endocarditis following device implant could be secondary to the valve's bovine jugular vein (BJV) covering. We attempted to replace the BJV surface of Melody valves with a polyethylene terephthalate (PET) covering while preserving valvular function. Methods: The BJV coverings of two Melody valves were carefully removed, in order to not disturb the tissue architecture supporting the valve leaflets. The tissue was replaced with PET, which was sutured to the stents. Size 6/0 blue prolene thread and size 3/0 black silk thread were used for the first and second valves, respectively. These modified devices were implanted into the pulmonic position of two mini-pigs. The valves were delivered via the right femoral vein, using a 22 mm Ensemble system over a Lunderquist wire. Angiograms were then performed, and the Melody valves were explanted. Results: The two modified Melody valves were successfully implanted into 9-month-old mini-pigs with no acute regurgitation on angiogram. Gross pathology post-implant showed well-seated valves with normal leaflet function. Figure 1A and B exhibit the modified Melody valves pre-implant with open and closed leaflets. Figure 1C illustrates the device crimped onto the Ensemble system. Figure 1D pictures the explanted Melody valve with the right ventricular side facing upwards. Figure 1E is an angiogram demonstrating the absence of regurgitation acutely.



Conclusions: The Melody valve's BJV covering can be successfully replaced with PET, and this device can be implanted with good acute valvular function. Longer-term data and more testing are needed to determine this modification's clinical relevance.

ETHICS DECLARATIONS

Conflict of Interest: Daniel Levi–Paid consultant for Medtronic.

Ethical Approval: Not applicable.

Consent for Publication: Not applicable.

142. Thrombotic Ischemic Event in a Patient with Hypoplastic Left Heart Syndrome and Single-Ventricle Physiology

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Introduction This case study reviews the diagnosis and management of a thrombotic coronary ischemic event in a patient with hypoplastic left heart syndrome. Case Presentation: Patient is a developmentally appropriate 17-year-old male with HLHS status post-fenestrated Fontan who was initially admitted with a brain abscess, but developed

ectopic atrial tachycardia. This rhythm started after he was transferred to the ICU following attempted needle aspiration of his abscess. He complained of chest pain after developing the arrhythmia and an echocardiogram was completed demonstrating severely depressed systolic function. A troponin was also drawn and elevated (43 ng/mL) at that time. He became hemodynamically unstable acutely and was cardioverted after which his rhythm was sinus with visible p waves and a decreased heart rate. Repeat troponin the next morning was further elevated (66 ng/mL). Given these labs and the knowledge that he had a period of hypotension following anesthesia induction for his neurosurgical case, arrhythmia requiring cardioversion, and newly severely depressed function on echocardiogram, there was concern for a coronary ischemic event. He was taken for urgent cardiac catheterization to evaluate for cardiac ischemia. After access was obtained and sheaths were placed, a 5F pigtail catheter was utilized to perform hemodynamic measurements. An angiogram in the aortic root was then performed. With this angiogram he became acutely hypotensive and bradycardic. Chest compressions were performed and his epinephrine infusion was increased to 0.1 mcg/kg/min. Return of spontaneous circulation was achieved, and he was alert after approximately three minutes of compressions. Further review of the angiogram after patient stabilization demonstrated a filling defect in the left anterior descending coronary artery and a filling defect in the aortic root that moved into the os of the right coronary artery during the angiogram. After discussion with adult interventional cardiology the decision was made to transfer him to their cardiac catheterization lab for further intervention. Upon arrival in the adult cardiac catheterization lab, coronary angiography showed patent co-dominant right coronary artery with large clot in the proximal left anterior descending (LAD) and proximal left circumflex (LCx) arteries. An Impella device was placed and Impella-supported percutaneous coronary interventions (PCI) performed. In the proximal LAD aspiration thrombectomy followed by two drug eluting stents was completed, and then in the proximal LCx aspiration thrombectomy followed by drug eluting stent placement in the distal LCx. Following four days of Impella and ECMO support his Impella was removed with plans to wean ECMO more slowly as his heart function recovers. **Conclusion** This was a critically ill patient with HLHS status post-Fontan procedure who developed thrombotic coronary ischemia requiring Impella-assisted percutaneous coronary intervention. He was transitioned off the Impella onto solely ECMO support and is weaning his ECMO flow in preparation for transplant evaluation. His course has since been complicated by acute kidney failure necessitating CRRT in addition to ECMO.

ETHICS DECLARATIONS

Conflict of Interest: The authors declare they do not have any conflict of interests.

Ethical Approval: Not applicable.

Consent for Publication: Consent obtained from family.

143. Mechanisms of Coronary Ischemia Associated with Homograft Failure After the Ross Operation

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A 41-year-old woman presented with crescendo exertional chest pressure three years after a Ross operation (with a 27 mm homograft in the pulmonary position) for bicuspid aortic valve stenosis. On exam, she was euvolemic and had a harsh 3/6 systolic ejection murmur at the left upper sternal border. Echocardiogram showed normal biventricular function with a well-functioning neo-aortic valve, and stenosis of the homograft in the pulmonic position, with mean gradient 38 mmHg and RVSP estimated at 80 mmHg. A cardiac CT scan confirmed a long segment of narrowing of the homograft, measuring 8 × 18 mm in narrowest dimension, with diffuse thickening of the wall, in particular in the lesser curvature near the epicardium. No coronary stenoses were noted; the LAD was 3.5 mm away from the distal end of the conduit. Cardiac catheterization showed a 19 mmHg peak-peak gradient across the diffusely stenosed RV to PA conduit (under anesthesia), normal filling pressures. Coronary angiography showed normal epicardial coronaries except for a focal hazy stenosis in the mid LAD (Fig. 1). This area was interrogated with DFR (diastolic hyperemia-free ratio) and was found to be non-ischemic at 0.96 (normal 0.9–1.0; Fig. 2). Intravascular ultrasound however showed extrinsic compression as well as focal atherosclerosis in that site. Balloon angioplasty of the homograft and test coronary compression was done with a 22 mm True balloon (Fig. 1), and demonstrated compression of the mid LAD. The procedure was therefore aborted, as implantation of a 23 mm valve at least was the intended outcome, given the patient's size and low surgical risk. Re-operation for replacement of the RV-PA homograft is planned. This case demonstrates development of atherosclerosis at a site of extrinsic compression of the coronary near a stenotic RV-PA homograft, with inflammation as a likely mechanism of failure based on imaging. Pulmonary homograft dysfunction has been described in 10–20% of patients after the Ross procedure, in particular in younger patients, and is thought to be due to inflammation and a possible immune reaction. The inflammation see on cross-sectional imaging in our patient appears to have led to coronary compression; turbulent flow at that location of the coronary may have contributed to the development of atherosclerosis. Multimodality imaging including coronary physiology and intracoronary imaging allowed for precise evaluation.

ETHICS DECLARATIONS

Conflict of Interest: The authors declare they do not have any conflict of interests.

Ethical Approval: Not applicable.

Consent for Publication: Not applicable.

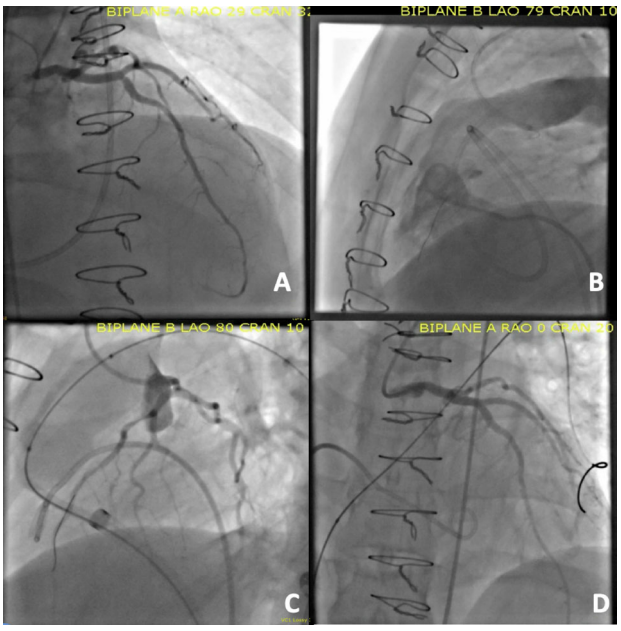

Fig. 1 (A) Baseline left coronary angiogram, showing focal LAD moderate stenosis after take-off of large diagonal branch. (B) RV-PA angiogram showing stenosed conduit, in close proximity distally to

the LAD. (C) Balloon inflation in the homograft, with simultaneous left coronary selective angiogram, showing further LAD compression. (D) Final left coronary angiogram, showing resolution of the compression

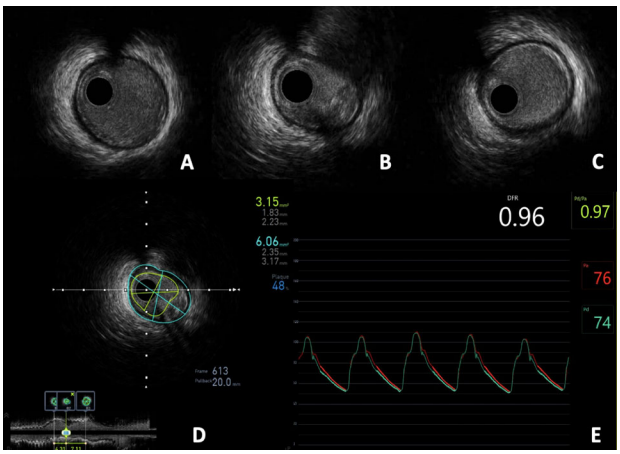

Fig. 2 Intravascular ultrasound of the LAD showing a extrinsic compression as well as a focal mid vessel stenosis (B), without significant atherosclerosis distally (A) or proximally (C). DFR (diastolic hyperemia-free ratio) of the LAD stenosis, showing no significant hemodynamic obstruction at rest

144. Transcatheter Pulmonary Valve Replacement

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Introduction Congenital Heart Defects (CHDs) involving the RVOT often require multiple surgeries to restore its function in aims to improve quality of life. An alternative to subsequent surgeries is a transcatheter pulmonary valve replacement (TPVR). Early mortality (< 30 days) in surgical PVR has been reported around 2.4%, with accumulative mortality of 0.5% per year. A 3-year single-center registry to compare outcomes with those reported with SPVR was made. Methods and Results: Patients with corrected CHDs with RVOT disfunction confirmed by cardiac magnetic resonance imaging who underwent transcatheter pulmonary valve replacement at our center were included in this registry. Baseline characteristics including demographics, diagnosis, indication of TPVR, functional class, right ventricular morphology and function were recorded, as well as procedural outcomes and follow-up. A total of 25 patients were included [14 with Melody (M) and 11 with Edwards Sapien 3 (ES3)] with no statistical difference between groups in age [M 14(8–30) and ES3 18(9–36), p = 0.28], women 28% in both groups [p = 0.94], QRS duration [M 157 + 28 and ES3 153 + 30 ms, p = 0.76], medium gradient [M 29 + 27 and ES3 31 + 15, p = 0.71], RV telediastolic volume [M 132 + 59 and ES3 160 + 24, p = 0.19], RVEF [M 38(17–49) and 45(15–54)]; and statistical difference between groups in prosthesic size [M 20(16–22) and ES3 26(23–29), p = 0.001] and native RVOT [M 5(36%) and ES3 10(91%), p = 0.01]. Immediate post-implant gradient was [M: 9(1–31) and ES3: 4(2–15), p = 0.29]. Two patients were lost after 18 months of follow-up. The overall mean follow-up was 365 (30–1513) days. No deaths were reported at 30-day follow-up, in fact, no patients have died during follow-up. No arrythmias have been documented in any group. No thrombosis nor endocarditis have been reported. All patients improved to and remained in NYHA class I after intervention. **Conclusion** In this single-center registry, patients treated with any of the TPVR reported no complications no complications at discharge, at 30-day, 1-year and 3-year follow-up. Prothesis selection based on RVOT size or type (native, conduit or ViV) did not impact procedure success.

ETHICS DECLARATIONS

Conflict of Interest: The authors declare they do not have any conflict of interests.

Ethical Approval: Not applicable.

Consent for Publication: Not applicable.

145. Multipurpose Use of Embolic Protection Baskets in Pediatric Interventions for Congenital Heart Disease: A Case Series

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Introduction Embolic protection baskets are used routinely for high-risk procedures in adults but this is not typical in pediatrics as thromboembolic sequela is not a commonly encountered entity. However, there are instances, particularly in patients with congenital heart disease undergoing interventions, in which there is a significant risk of thromboembolic complications. Our institution has utilized cerebral embolic protection devices in various catheterization and hybrid interventions. Patient 1: A 14-year-old girl presented with occlusive left lower extremity arterial thrombus and echocardiogram showing a mobile left atrial appendage mass concerning for myxoma. Due to high intraoperative embolization risk, decision was to place carotid embolic protection devices. Prior to sternotomy, a 6Fr sheath was placed in the left femoral artery and a 4Fr angled glide catheter was advanced into the bilateral carotid arteries for angiography. An 0.014″ Ironman guidewire was advanced over which SpiderFX embolic protection devices were advanced and deployed (6 mm in right carotid and 5 mm in left carotid). The surgical resection was uneventful after which the carotid baskets were retrieved. Patient 2: A 14-year-old male underwent Ross procedure and required post-operative ECMO support. He developed layering thrombus in the left ventricle so desire was to protect his cerebral vasculature prior to decannulation from ECMO. A 6Fr sheath was placed in the left femoral artery and catheters were advanced to the carotid arteries and left vertebral artery. A 0.014″ XS wire was advanced and 7 mm SpiderFX embolic protection devices were deployed. Following decannulation, the carotid baskets were retrieved without difficulty. The vertebral artery basket was unable to be captured and angiogram showed complete occlusion of the vessel below the basket with thrombus. A 6Fr multipurpose catheter was advanced and clot was aspirated making the basket more mobile to be moved into the descending aorta and then captured. There was no thrombus visualized in the basket and repeat angiography did not show any further thrombus. Patient 3: A 5yo with unbalanced, right-dominant atrioventricular septal defect, left atrioventricular valve atresia and aortic atresia underwent fenestrated extracardiac Fontan and left pulmonary

artery stenting. He has required two cath lab procedures that were high risk for thrombus embolization including recreation and stenting of his Fontan fenestration and recanalation of his LPA stent. For each procedure, arterial access was obtained in the left femoral artery and angiography was performed in the bilateral carotids and left vertebral artery after which SpiderFX embolic protection devices were deployed (6 mm in the carotids, 5 mm in the vertebral). In both cases there was debris in at least 1 of the 3 baskets upon retrieval. Discussion: These cases represent unique utilization of embolic protection baskets in congenital heart disease for both hybrid and interventional procedures. Many patients with congenital heart disease have residual right to left shunting lesions which put them at higher risk of embolic events during interventional procedures. Additionally, high-risk surgical procedures with potential for embolism on the left side of the heart could benefit from hybrid cerebral vasculature protection.

ETHICS DECLARATIONS

Conflict of Interest: The authors declare they do not have any conflict of interests.

Ethical Approval: Not applicable.

Consent for Publication: Yes.

146. Evaluating Serial Changes in Right Ventricular Outflow Tract Gradient Prior to Endocarditis After Transcatheter Pulmonary Valve Replacement

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Introduction Studies of infective endocarditis (IE) following transcatheter pulmonary valve replacement (TPVR) suggest that a residual RVOT gradient > 15 mmHg is a risk factor for IE. No studies have evaluated serial changes in echocardiograms in patients who develop IE following TPVR. This study aims to evaluate changes in echo-derived RVOT gradients over time in patients who ultimately develop IE. **Method:** Retrospective, single-center, cohort study of all TPVR cases between 2009 and 2021. Echocardiographic parameters (Doppler-derived variables including peak instantaneous gradient, mean gradient, and the presence and severity of pulmonary insufficiency) of patients who developed IE were analyzed. Patients were stratified by invasive residual RVOT gradient: ≥ 15 mmHg or < 15 mmHg. **Result:** During the study period, 219 patients underwent successful TPVR. Twenty-six patients (11.8%) developed IE, a median of 35.5 months (range 12–101 months) from implant. These patients were stratified based on high, mean 20.6 mmHg, (n = 14) or low invasive, mean 8.5 mmHg gradient (n = 12) immediately following TPVR. Demographics were similar between groups with exception of younger age at implant for those with a residual gradient > 15 mmHg. By definition, peak and mean Doppler gradients were different at discharge ($p < 0.001$). However, there was no difference between groups in RVOT gradient immediately prior to or at the time of IE diagnosis. Those patients with a high initial residual gradient did not experience a change in gradient over time while patients with a low invasive RVOT gradient had a significant increase in peak and mean Doppler gradient prior to IE diagnosis. **Conclusion** Residual TPV gradient is a well-described risk factor for IE. No studies of TPV-associated IE have tracked serial changes in RVOT gradient over time. Within a cohort of patients diagnosed with IE, those patients with a higher invasive RVOT gradient demonstrated no significant increase in gradient over time prior to IE diagnosis. Patients who started with low invasive gradients but went on to develop IE demonstrated a significant increase in RVOT gradient over time prior to infection. Evaluating serial changes in RVOT gradient and developing threshold gradients at which the IE risk begins to increase would be a helpful tool in further risk stratifying patients following TPVR. The next step with this cohort will be to compare with non-IE patients and develop threshold values to further categorize IE risk in patients post-TPVR.

Table 1 IE demographic and diagnostic variables

	PG < 15 (n = 12)		PG > 15 (n = 14)		p
	12		14		
Age, yrs	29		16		0.009
Weight, kg	70		63.5		0.570
Male	7	58%	12.00	86%	0.117
Time to IE (mean,%)	45		41.83		0.834
Underlying Cardiac Diagnosis					
Tetralogy of Fallot	5	42%	5	36%	
Truncus	0	0%	0	0%	
TGA/DORV	3	25%	4	29%	
Ross Procedure	3	25%	5	36%	
Pulmonary atresia, intact ventricular septum	1	8%	0	0%	
Genetic/ Immunosuppression	0	0%	1	7%	
Prior History of Endocarditis	2	17%	1	7%	
RV-PA conduit size, mm	22.5		21.4		0.407
RVOT type					
Homograft	4	33%	9	64%	
Bioprosthetic valve/conduit	6	50%	2	14%	
Contegra	2	17%	3	21%	
Procedure Characteristics					
Valve size, mm	22		22		0.787
Post-cath RVOT gradient, mmHg	8.5		20.6		< 0.001
Pre stent, non-covered	1	8%	3	21%	
Covered stent	0	0%	2	14%	
Echocardiogram Parameters					
Discharge PG, mmHg	23.56		41.27		< 0.001
Discharge MG, mmHg	10.2		22		< 0.001
Discharge PI (> / = moderate)	0	0%	0	0%	
Pre-IE diagnosis PG	35.6		43.0		0.215
Pre-IE diagnosis MG	17		24.3		0.271
Pre-IE PI (> / = moderate)	1	8%	1	7%	
IE Diagnosis PG	48.58		53.68		0.466
IE Diagnosis MG	28.2		28		0.968
IE Diagnosis PI (> / = moderate)	1	8%	2	14%	

RVOT right ventricular outflow tract, *PI* pulmonary insufficiency, *IE* Infective endocarditis, *PG* peak gradient, *MG* mean gradient

ETHICS DECLARATIONS

Conflict of Interest: The authors declare they do not have any conflict of interests.

Ethical Approval: Not applicable.

Consent for Publication: Not applicable.

147. Transcatheter Closure of Perimembranous Ventricular Septal Defects with the Amplatzer Vascular Plug II: Acute and Mid-term Results

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Transcatheter closure of ventricular septal defects (VSDs) is well established with a variety of Amplatzer devices. When a suitable ventricular septal aneurysm (VSA) is present an approach to device closure is to seat the device within the VSA, avoiding impingement upon the conduction system. Outcomes of this approach using Amplatzer Vascular Plug II (AVP II) devices are not adequately characterized. Medical records were reviewed for patients with perimembranous VSDs closed with AVP II devices at UCSF Benioff Children's Hospital from 2012 to 2022. Twenty-seven patients were identified. Four of these had multiple devices placed in a single VSA. Age ranged from 7 months to 65 years (median 8.25 years). Weight ranged from 5.7 to 106 kg (median 28 kg). Technical success was defined by device placement in the intended position by echocardiography and angiography with minimal residual shunt, and was achieved in all patients. AVP II size ranged from 6 to 16 mm. The most common device used was the 12 mm AVP II (11 patients). Twenty devices were placed with a retrograde wire course via the femoral artery with the wire stabilized in the RV or pulmonary artery (PA). Seven had an arteriovenous wire loop to facilitate crossing the defect, three had a device successfully placed antegrade [AE1] along this loop. A fourth device placed antegrade embolized and the VSD was successfully closed from a retrograde approach along the same loop. Four of the seven patients with an arteriovenous wire loop had procedures at the beginning of our review period, from 2012–2013. All AVP IIs were positioned with the distal disk in the RV, the middle disk in the aneurysm and the proximal disk either inside or at the entrance of the aneurysm. Placement in all but two was guided by transesophageal echocardiography, transthoracic echocardiography was used in these two small patients. Average Qp:Qs decreased from 1.6 to 1.06 after VSD closure. Immediately after device placement, 15 had no residual flow, 11 had trace residual, 1 had small residual flow through another VSD. Three devices embolized, two to the right PA and one to the right atrium. All were successfully retrieved and VSDs were closed with a larger AVP II. There were no serious complications, and no vascular occlusions. Clinical follow-up was available for 19 patients with an average follow-up of 2.4 years. Seven patients had a new or increased conduction delay noted on EKG post-procedure. Six were followed locally, one resolved by post-operative day 1, one by 1 month and remaining four persisted to an average follow-up of 3.7 years; there was no high-grade block and none required intervention. One patient with multiple genetic defects died of an unrelated pneumonia 2 years later. Perimembranous VSDs can be closed with AVP II devices using a modified VSA approach. The smaller profile of the AVPII device has facilitated our use of a retrograde approach without a though and through wire course, when possible. Technique modification and further experience may yield improved outcomes, but continued evaluation is warranted.

ETHICS DECLARATIONS

Conflict of Interest: The authors declare they do not have any conflict of interests.

Ethical Approval: Not applicable.

Consent for Publication: Not applicable.

148. Ability to Dilate Supported Contegra Conduits for Transcatheter Pulmonary Valve Replacement

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Background: Failed right ventricle to pulmonary artery conduits are often dilated beyond their original diameter for transcatheter pulmonary valve replacement (TCPVR). Supported Contegra bovine jugular vein conduits have two polyester covered polypropylene rings above and below the valve. Dilation of unsupported Contegra conduits beyond their original diameter is well described. Whether or not supported Contegra conduits can be over-dilated remains unknown. We describe expansion characteristics of supported Contegra conduits based on bench testing and a series of patients who underwent TCPVR. Methods: Bench testing was carried out on a 14 mm supported Contegra conduit. The conduit was serially dilated with 16, 18, and 20 mm balloons at pressures of 18–20 ATM. The conduit diameter was measured with the 20 mm balloon at 18 ATM. A retrospective chart review was performed of patients with a supported Contegra conduit who underwent TCPVR with the intention of dilating the conduit beyond the original diameter from 12/2020 through 6/2022. The original, minimum, and final conduit diameters; balloon sizes; type and number of pre-stents; and valves implanted were collected. Data are provided as median (range). Results: Bench testing demonstrated that the rings of the 14 mm supported Contegra conduit could be stretched to an outer diameter of 21 mm (Fig. 1). The rings did not fracture. Five patients with a supported Contegra conduit underwent TCPVR with the intention of dilating the conduit beyond the original diameter. The median age and weight were 11.8 years (9.8–14.8) and 42.9 kg (33.0–48.0). Patient and procedural characteristics are shown in Table 1. In 4 patients (80%), the final conduit diameter was larger than the original size. The difference between the final conduit diameter and original diameter ranged from -1.1 to 3.7 mm. The final diameter was 95 to 131% of the original conduit diameter. There were 2 complications in 2 patients. In patient #1 there was a pinhole balloon rupture during pre-stent implantation. In patient #2 a distal pulmonary artery wire injury with pulmonary hemorrhage was noted after pre-stent implantation. This was managed conservatively, and valve implantation was performed 22 days later. There were no uncontained conduit injuries or other complications. Conclusions: In this small single-center series, supported Contegra conduits can be dilated and stented several millimeters beyond their original diameter. High pressure balloons and multiple pre-stents may be needed to maintain a larger diameter.

ETHICS DECLARATIONS

Conflict of Interest: The authors declare they do not have any conflict of interests.

Ethical Approval: Not applicable.

Consent for Publication: Not applicable.

Figure 1

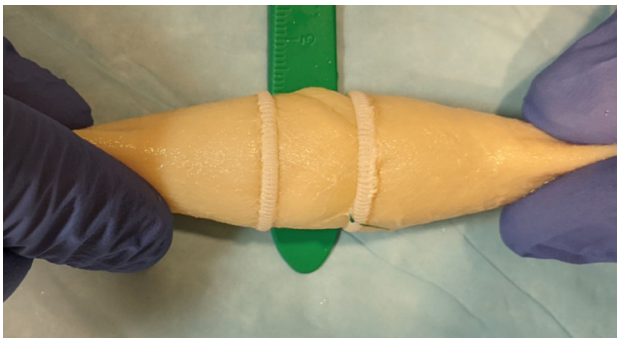

Table 1

Patient	Diagnosis	Conduit size (mm)	Minimum conduit diameter (mm)	Largest balloon size (mm)	Pre-stent type	Number of pre-stents	Valve Type	Final diameter (mm)
1	IAA/ VSD	14	10.6	20	Palmaz 4010	2	Melody	17.7
2	TOF	16	14.9	22	Palmaz 3110	2	Melody	21
3	TOF	18	9.2	23	3.9 cm covered CP stent	1	Sapien 3	18.9
4	Truncus	18	10.8	23	Palmaz 4010	1	Sapien 3	20.3
5	DORV	20	7.3	23	Palmaz 4010	2	Sapien 3	18.9

149. Initial Experience with Andrastent in Children and Adults with Congenital Heart Disease

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Background: Major vessel stenosis are currently succesfully treated with stent implantation. The balloon expandable cobalt-cromium stents (AndraStents L, XL; Andramed, Germany) with semiopen designed cells, nude and covered and low profile have been introduced into clinical practice as a low profile stent alternative. Objective: We present two center experience with AndraStent implantation in different congenital heart diseases in children and adults. Methods: Between May 2017 and May 2022, vessel stenosis of varied localizations were treated. Andra Stents L and XL nude and covered of 17,26,30 and 39 mm in length were used. The hemodynamics and measured data were collected and clinical mid-term follow-up were analyzed. Results: From May 2017 to May 2022, 85 nude and covered Andrastents L and XL were implanted in 77 patient. The median age and weight were 20,4 years (1–34 years) and 56 kg (range 8–65 kg) respectively. The stent was implanted into the left or right pulmonary arteries (n = 54), Bidirectional Cavopulmonary Anastomosis (n = 1), Pulmonary Trunk (n = 4)and pulmonary homograft (n = 5), Aortic Coarctation (n = 26). All implantations were successfully performed. The diameter of the vessel stenosis increased significantly from a median of 5,8 mm(2,7–11 mm) to 13,6 mm (10–18 mm). There was a 50% decrease of systolic right ventricle pressure in pulmonary arteries dilatation patients and gradient absence pos implantation in aortic coarctation and Bidirectional Cavopulmonary anastomosis patients. There were two major arterial access complication necessitating vascular surgery. At mid term of 60-month follow-up, 3 aortic patient required redilatation because of growing up mismatch and neointimal proliferation. Pulmonary artery redilatation was needed in 5 implanted stent. Conclusions: Our initial results show that Andra Stents are a very good option in the treatment of different vascular stenosis and present a valuable alternative for pulmonary, aortic and any other affected vessel to the available large stents. The mid-term follow-up shows good results and low re stenosis incidence.

ETHICS DECLARATIONS

Conflict of Interest: The authors declare they do not have any conflict of interests.

Ethical Approval: Not applicable.

Consent for Publication: Not applicable.

150. Venus P-Valve for Percutaneous Pulmonary Valve Replacement: Experience in Argentina and Chile, and Mid-Term Follow-Up

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We report a clinical experience with the Venus P valve for percutaneous pulmonary valve replacement (PPVR) in Argentina and Chile, emphasizing the mid-term follow-up results. Between march 2016 and December 2019, we successfully implanted 29 Venus P-valves in 29 selected patients (17 female) with severe PR and indication for PVR. Median age of 23 years (range 12–45 years) and mean weight of 60,4 kg (40–93). The primary diagnosis was tetralogy of Fallot in 28 patients. Successful implantation rate was 100%. All the procedures were performed through a femoral venous access but one with a severe MPA dilatation who underwent MPA surgical plicature and perventricular access for the Venus P delivery. The most common implanted valve diameter was 30 mm in 9 patients, then 28 and 32 mm with 6 patients each, 28 mm in 6 patients, and 26 and 36 mm in 2 patients each. There was no mortality related to the procedure. Infolding was observed in 2 patients immediately after the valve deployment and resolved with a conventional angioplasty balloon. Fever was observed in 5 patients after the procedure and was self limited. One patient presented a transient AV block during the first day post-procedure and another patient presented VT 18 days after the procedure that was resolved with anti arrhythmic drugs with no recurrence. One patient needed a surgical tricuspid replacement for severe tricuspid regurgitation maintaining the Venus P valve which is properly functioning. Stent frame fracture was observed in 2 patients in the proximal end, being this not progressive and not resulting in valve disfunction during the follow-up. MRI evaluation in 13 patients mean 15.7 months after the procedure demonstrated decrease in

RVEDV index from 147.8 (98–193) to 95.5 ml/m2 (74–117) and decrease of regurgitation fraction from mean 48.3% (29–74) to 3.3% (0–14). Evaluation with transthoracic echocardiography in 16 patients with a mean follow-up of 37.1 months (12–76) has demonstrated a mean gradient across the valve of 16,8 mm Hg (10–25) and no regurgitation in 7 patients, trivial in 5 and mild in 4 patients. No valve endocarditis has been observed so far and no valve explantation or interventions on the valve has been necessary. Our experience shows that Venus P-valve can be safely and effectively implanted in a reproducible procedure for dilated right ventricular outflow tracts. Mid-term follow-up demonstrates Venus P maintains its functionality with no severe complications observed and no interventions needed on the valve.

ETHICS DECLARATIONS

Conflict of Interest: The authors declare they do not have any conflict of interests.

Ethical Approval: Not applicable.

Consent for Publication: Not applicable.

151. Recanalization of Complete Occlusion of Fontan Conduit via Cardiac Catheterization

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Introduction This case study reviews a cardiac catheterization for a patient with a Fontan conduit that was found to be obstructed with clot. Case Presentation: Patient is a 6-year-old female with a univentricular heart with side-by-side great vessels and severe PS status post-left BT shunt, bidirectional Glenn, and extracardiac, fenestrated Fontan. She was admitted with rhino/enterovirus, respiratory failure, and hepatomegaly. Initial cardiac catheterization revealed elevated pulmonary vascular resistance, elevated Glenn and Fontan pressures (26 mmHg), and LPA stenosis, for which she underwent LPA balloon angioplasty. Multiple veno-venous collaterals and spontaneous closure of the fenestration were also noted. Post-cardiac catheterization she developed acute kidney failure and she was placed on intermittent hemodialysis with the dialysis catheter placed in her Glenn shunt. She was taken for repeat cardiac catheterization to evaluate transplant candidacy and possibly intervene on any branch pulmonary artery stenoses or embolize collaterals. Upon entering the SVC using a 0.035 angled glidewire, a hand injection was performed showing complete occlusion of the Fontan conduit. A hand injection from the right lower extremity PICC line confirmed this finding. After multiple attempts, the thrombosis was crossed with a 4F MPA and the 0.014" Pilot wire. An attempt was made to advance an infusion catheter for directed tPA into the thrombosed conduit, but was unable to pass. A 3.5 mm × 2 cm Sterling balloon catheter was prepped, positioned within the thrombus, and inflated to create a channel for the infusion catheter. The balloon catheter was removed, and the infusion catheter was advanced to the thrombus. A hand injection confirmed flow of contrast through the channel to the IVC and hepatic veins. Following 48 h of directed tPA, she re-presented for cardiac catheterization to evaluate thrombolytic progress and stent the Fontan conduit. With the help of CT surgery, her dialysis catheter was removed from her L IJ over a 0.035″ Wholey wire and replaced with a sheath. A 4F angled glide catheter was then used to exchange the Wholey wire for a 0.035″ Amplatzer super-stiff wire which was advanced into the IVC. An 18 mm × 4 cm CP covered stent was advanced through the sheath, the sheath was withdrawn, and the inner and outer balloons were inflated deploying the stent. The sheath was advanced over the balloon into the IVC and a hand angiogram was performed which verified good stent positioning. A 18 mm × 2 cm Atlas Gold balloon was advanced over the wire and dilations were performed in the proximal and distal conduit before the balloon was removed. A series of angiograms were then completed in the IVC, the right renal vein, and the SVC demonstrated improved flow through the conduit. **Conclusion** This was a critically ill patient whose pre-transplantation cardiac catheterization demonstrated complete occlusion of her Fontan conduit. The conduit was successfully recanalized using directed tPA and stenting. The patient improved clinically and was able to discharge home on aspirin 10 days following her repeat cardiac catheterization. She will be followed with repeat catheterization 6 weeks from discharge.

ETHICS DECLARATIONS

Conflict of Interest: The authors declare they do not have any conflict of interests.

Ethical Approval: Not applicable.

Consent for Publication: Not applicable.

152. Five Year Results of the Nit-Occlud PDA Post-Approval Trial

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Introduction The FDA granted PMA approval for the Nit-Occlud PDA in 2013 based on the results of the pivotal trial which along with the continued access protocol enrolled 357 patients prospectively. The Nit-Occlud prospective post-approval study (PAS) which was performed at 11 centers has completed its 5-year follow-up. These results are reported. Methods: A total of 184 subjects greater than 6 months of age and 5 kg with PDAs less than 4 mm by angiogram were enrolled at 11 centers for the PAS. Patients were followed prospectively with ECHO and clinical assessments at 2 months, 12 months, and 24 months post-procedure. Subjects with any residual shunts or device related obstruction or issues were followed annually to the 5-year timepoint. The echo findings were adjudicated by an ECHO core lab and a clinical events committee and DSMB reviewed all adverse events. Results: Of the subjects enrolled in the PAS trial, 68.5% were female, the median age was 3.4 years. 83.7% had a Type A PDA. An antegrade venous approach was used in 95.6% of the subjects. 180 of the original 184 patients were implanted. In three subjects, the device was retrieved prior to release secondary to incorrect PDA sizing. The device prematurely released in one patient and was removed. After release, three devices embolizations occurred; all were removed with a snare without incident. There was no significant device obstruction to the pulmonary arteries or aorta and there were no deaths, no episodes of hemolysis and no need for blood transfusion or surgery. To date, six subjects have withdrawn consent and 18 are lost to follow up. At the 2-month follow-up, 97.0% (165/170) of subjects had trivial or no residual shunt as assessed by ECHO and the remainder had a small residual shunt. At 12-month follow-up, there were 4 patients with "trivial" shunts and 5 patients with "small" residual shunts but none with more than a small shunt. By the 5-year follow-up, there were only two patients with residual shunts both of which were "trivial". Two of the "small" shunts had resolved and the other two "small" shunts were lost to follow up. **Conclusion** As evidenced by long-term follow-up of 180 subjects enrolled prospectively in the NitOclud PDA device PAS trial, this device has been shown to be both a very safe and effective device for PDA occlusion.

ETHICS DECLARATIONS

Conflict of Interest: Industry sponsored FDA mandated study by pfm Medical. Dr Levi is a paid consultant for pfm Medical.

Ethical Approval: Not applicable.

Consent for Publication: All patients were consented and consent was approved by FDA. Consent for publication is required for all case reports—The authors and pfm Medical give full consent for publication.

153. MIRTH (Myocardial Intramural Remodeling by Endovenous TeTHer) Ventriculoplasty

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Background: Mechanical ventricular remodeling therapies aim to improve myocardial performance by reducing ventricular diameter and wall stress in dilated cardiomyopathy. **Objectives**: We developed a transcatheter ventricular remodeling procedure that uniquely implants a tension element within ventricular walls. The procedure is called MIRTH (Myocardial Intramural Remodeling by transvenous interstitial teTHer). Methods: MIRTH experiments were performed in 68 swine. We developed a technique of controlled intramyocardial navigation to steer commercially available guidewires within the left ventricular wall. Guidewire navigation was assisted by the new technique of Electrocardiographic radial DEpth Navigation (EDEN). Basal- or mid-ventricular level MIRTH was performed in healthy (n = 17) and ischemic cardiomyopathy (n = 13) animals, survived up to 90d, with interval CMR, CT, and pressure–volume loops. Implant longevity was simulated in vitro using a pulsatile jig. Results: Intramyocardial navigation was successful through both healthy and fibrotic myocardium. EDEN electrograms accurately reflected intramyocardial guidewire position. MIRTH caused a sustained reduction in left ventricular dimensions. Mid-ventricular implants approximated papillary muscles. CMR-derived regional strain favorably increased remotely to MIRTH implants. During implantation in cardiomyopathy, myocardial pressure–volume loops exhibited a biphasic response to increasing MIRTH tension, initially improving end systolic elastance, preload recruitable stroke work, efficiency and reducing myocardial oxygen demand up to a maximum, beyond which further tension was detrimental. Conclusions: In animal models, MIRTH effectively reduces left ventricular dimensions, approximates papillary muscles and improves myocardial performance in cardiomyopathic ventricles. MIRTH may help treat dilated cardiomyopathy by slowing progression or encouraging reverse remodeling. Clinical investigation is warranted.

ETHICS DECLARATIONS

Conflict of Interest: Supported by the Division of Intramural Research, National Heart, Lung and Blood Institute, National Institutes of Health, USA, Z01-HL006040 (to RJL). CGB and RJL are co-inventors on patents, assigned to NIH, on MIRTH related devices.

Ethical Approval: Animal experiments were approved by the Institutional Animal Use and Care Committee and followed contemporary NIH guidelines.

Consent for Publication: Not applicable.

154. Safety and Efficacy of Intentional bioprosthetic valve fracture in the tricuspid position

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Background: Transcatheter tricuspid valve-in-valve (TVIV) replacement has yielded good hemodynamic outcomes in the treatment of dysfunctional bioprosthetic valves (BPVs). Intentional fracture of certain rigid BPV frames, if feasible, allows greater enlargement of the implanted valve when compared with implant into an unfractured BPV. Aortic and pulmonary valve frame fractures demonstrate promising results during valve-in-valve therapy though there remains limited data on the safety of tricuspid BPV frame fracture. **Objectives**: Evaluate the safety and feasibility of bioprosthetic tricuspid valve frame fracture during TVIV replacement. Methods: A multicenter registry was formed for cases of TVIV replacement with intentional BPV frame fracture and data was collected from 6 centers. Demographic data along with procedural characteristics, outcomes and follow-up data was collected. Results: A total of 10 patients from 6 centers who underwent TVIV replacement with intentional BPV frame fracture were included (median age and weight were 29 years and 67.2 kg, respectively). The primary indication for TVIV replacement included stenosis (n = 3), regurgitation (n = 3), or mixed degeneration (n = 4). TVIV replacement preceded frame fracture in four patients. BPV frame fracture was performed using a balloon diameter 4.25 mm (median) larger than the true ID (range 3.0–6.0 mm). A Sapien S3 valve was implanted in nine of the cases with the remaining patient receiving a Melody valve. The final inner diameter was a median of 1.55 mm (IQR 0.58 – 2.08) larger than the reported true ID of the surgical BPV after TVIV replacement. The right coronary artery was evaluated prior to frame fracture in five cases with follow-up evaluation in only one case post-frame fracture. All procedures were completed without complication, specifically there was no heart block, pericardial effusion, or right coronary disruption. Conclusions: In this preliminary experience, intentional BPV ring fracture with TVIV replacement can effectively increase the valve orifice potentially reducing the risk of valve-in-valve patient prosthesis mismatch and is not associated with significant complications in this small cohort. Larger multicenter prospective studies will be required to determine whether long-term outcomes such as valve durability areis affected by this maneuver.

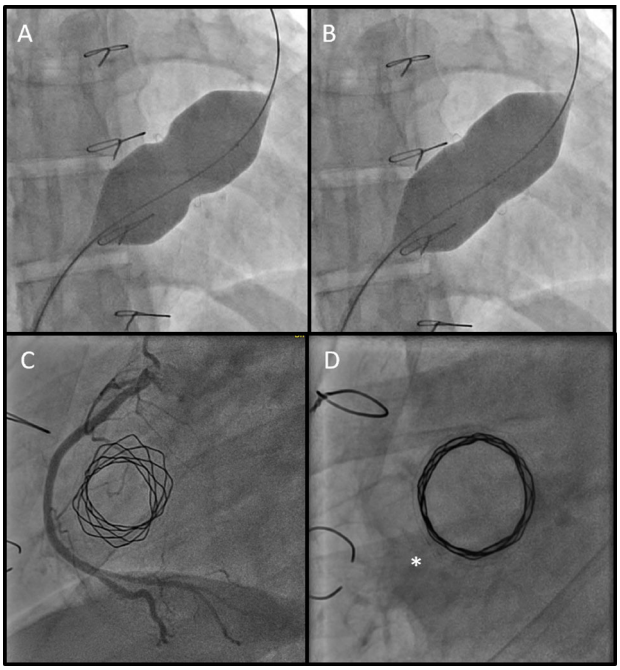

Fig. 1 A and **B** High pressure angioplasty of Epic Supra Valve with moderate waist on the left and with relief of waist after BPV frame fracture on the right; **C** Coronary artery angiography prior to valve ring fracture in a patient with Melody valve implanted within a Epic Valve; **D** Post-dilation of the TVIV replacement with clear fracture of the surgical BPV ring (*)

ETHICS DECLARATIONS

Conflict of Interest: Allison Cabalka—Consultant Medronic, Inc., Edwards Life Sciences, Jeff Zampi—Consultant Medtronic Inc, Athar Qureshi—Consultant Medtronic Inc, WL Gore and Associates, Abiomed. Shabana Shahanavaz—Consultant Medtronic Inc, Edwards Life sciences.

Ethical Approval: This retrospective study was performed under a waiver of informed consent. IRB approval was obtained at each participating institution.

Consent for Publication: Yes.

155. Outlining the Mechanical Properties and Vessel Characteristics in Porcine Muscular and Elastic Arteries with a View to Designing Bespoke Therapies for Neonatal Coarctation of the Aorta

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Introduction Coarctation of the aorta has an incidence of 0.3 to 0.6 in 1000 live births, accounting for 5% to 12% of all congenital heart disease [1, 2]. Coarctation is associated with structural pathologies of the aortic wall and is considered as a continuum of a disease process which affects the entire aorta [3]. Balloon angioplasty of native coarctation in vitro was reported in 1982 by Lock et al. [4]. Intimal tears were observed in all patients but no cases of aortic wall rupture. Examination under light microscopy demonstrated intimal hyperplasia, medial thickening, and confirmed the presence of tissue tears [4]. Ho et al. demonstrated that ductal tissue is commonly a cause of coarctation and that ductal tissue is histologically different to the surrounding aorta [5]. This study explores how different vessels can be at the coarctation site and the importance of considering these difference when designing for bespoke patient therapies to treat coarctation. The aim of this study is to initially assess the mechanics of two types (muscular and elastic) of porcine artery and follow-up with testing of harvested neonatal coarcted aortic tissue. Materials and Methods: Three sections of coronary artery and thoracic aorta were harvested from pigs from a local slaughterhouse and were cleaned to remove excess connective tissue and stored at – 80 °C. The vessels were cut into 2-mm ring samples using a custom cutter and uniaxial tensile testing was performed to two distinct strain levels (40% and 80%) before being fixed and mounted on glass slides for histological analysis. Neonatal aortic tissue was obtained at the time of surgery from Children's Health Ireland at Crumlin and transported to Trinity College Dublin in saline where it was been placed in tissue freezing media and stored at -80 degrees until use. Results: 28 sections (14 @40%, 14 @80%) each of porcine coronary and aorta were tested. The graphs (Figs. 1 and 2) below demonstrate the difference in the mechanical response to a 80% strain level for two different types of arteries and even within an artery type.

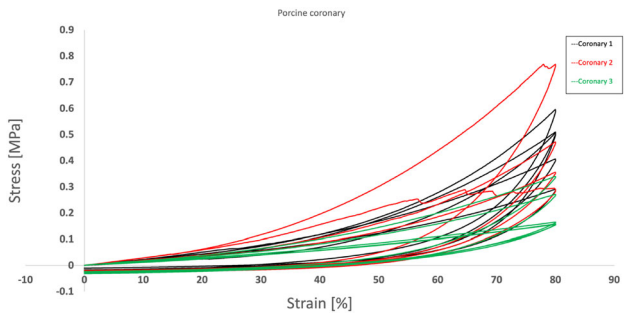

Fig. 1 Porcine coronary artery stress–strain curves

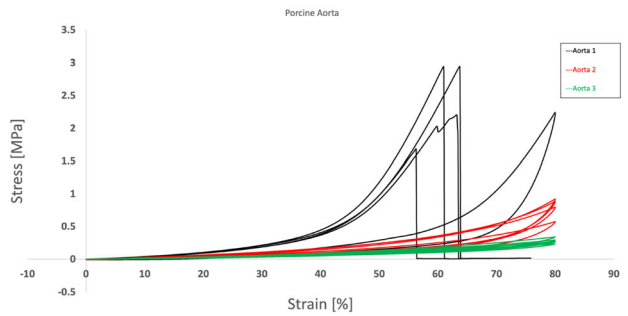

Fig. 2 Porcine aorta stress–strain curves

To date five neonatal coarctation samples have been harvested and prepared for testing. Figure 3 demonstrates the varying morphology seen in coarctation of the aorta and this will likely lead to different mechanical properties when tested.

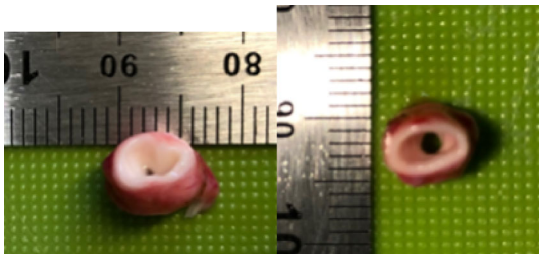

Fig. 3 Two discrete neonatal coarctation samples

Conclusion Muscular and elastic arteries demonstrate different stiffnesses when responding to stretch. Furthermore, there is variability even within an artery group. Coarcted segments of aorta have a variable morphological appearance and most likely have combined characteristics of both muscular and elastic arteries, thus bespoke therapy designed for this heterogenous group has to consider the difference in these two artery types and how they respond to stretch.

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ETHICS DECLARATIONS

Conflict of Interest: Research funded by RCSI for StAR MD program in collaboration with Beacon Hospital, Dublin, Ireland

Ethical Approval: Ethical approval has been provided by the local research and ethics board

Consent for Publication: All participating patients consented and follow on data anonymized.

156. To Study the Feasibility of Transcatheter Closure of Large Hypertensive PDA (Type B And C) & PDAs with Unusual Morphology Using the LIFETECH Konar-MF^{TM} Device in Children Weighing < 10 kg

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Background: PDA device closure is always challenging in Large Tubular Hypertensive PDA. Major safety concerns remain when applied to children with large PDA and challenging anatomy. Usual strategy to close these Hypertensive PDAs using Double disk Muscular Occluders. We aimed to report our experience with the new Konar-MF^{TM} ventricular septal defect (VSD) occluder for transcatheter closure of large Tubular Hypertensive patent ductus arteriosus (PDA) in small children as an alternative to Muscular VSD occluders. Methods: Children in whom PDA occlusion was attempted using the Konar-MF^{TM} VSD occluder were analyzed to review procedural characteristics and outcomes. Results: A total of 15 implantations were performed [age: 2-12 years of age], weight [8-35 kg], diameter: 10.6 ± 1.0 (9–12.0) mm, ductal length: 13 ± 0.6 (10-18) mm]. Successful device implantation was achieved in all cases without major complication. Early device embolization occurred in 1 case with safe percutaneous device removal. In that case a second Konar-MF^{TM} VSD occluder was implanted with excellent outcome. Over a median follow-up of 12 (6–25) months, all patients are asymptomatic, with complete occlusion and no delayed device-related complication. Conclusions: Transcatheter closure of large Hypertensive Tubular PDA using the Konar-MF^{TM} VSD occluder appears to be feasible, effective and safe in children. This device proved to be effective alternative to Muscular VSD occluders where routinely using in Tubular Hypertensive PDAs in terms of technique, vascular access, patients with IVC abnormalities (Interrupted IVC etc) and results. This device might be an alternative to other devices in carefully selected childrens, although that remains to be confirmed by extensive experience and long-term outcomes data.

ETHICS DECLARATIONS

Conflict of Interest: The authors declare they do not have any conflict of interests.

Ethical Approval: Not applicable.

Consent for Publication: Not applicable.

157. Device Closure of Large Perimembranous Ventricular Septal Defects (≥ 6 mm) Using the LEPU MEMOPART SYMMETRIC MEMBRANOUS VSD OCCLUDER: Short and Midterm Results

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Aims: The aim of this study is to evaluate the safety and efficacy of transcatheter device closure of moderate to large perimembranous ventricular septal defects ≥ 6 mm using LEPU MEMOPART SYMMETRIC MEMBRANOUS VSD OCCLUDER in pediatric patients at short and mid-term follow-up. Materials and Methods: We prospectively studied 50 patients with large perimembranous VSDs (≥ 6mm) between August 2019 and May 2021 who underwent percutaneous closure at our centre. Transthoracic echocardiography (TTE) and electrocardiogram were done before and after the procedure. All patients were subjected to follow-up evaluation at 48 hours, 1, 3, 6, 12 months and annually thereafter with TTE and electrocardiogram. Results: A total of 50 patients (30 males and 20 females) underwent transcatheter closure of large perimembranous VSD ≥ 6mm. Mean age of patients was 26 months (range 5–180 months) and mean weight was 13.4 (range 5.3–28 kg). 25% had large PM VSD with inlet extension. The mean defect diameter on color flow mapping on TTE was 9.4 (7-14 mm) the pulmonary to systemic blood flow (Qp/Qs) was ≥ 2.1 (range 2.0 to 2.6). The device diameter ranged from 7-16 mm (median = 9 mm). The procedure was carried out successfully in 96% of patients with no reported mortality. Two patients with associated mild aortic valve prolapse developed mild aortic regurgitation so device could not be successfully deployed and referred for surgery. During the catheterization, there were only minor complications and at follow-up of 10 ± 5.1 (1-22 months), the closure rate was high of 96% and freedom from AV block was 100%. A minimal residual shunt seen as a thin streak on transthoracic color flow mapping persisted in 2 (4%) patients, which remained unchanged over a follow-up period. 5 (10%) patients had trivial AR and 8 (16%) patients had mild TR preprocedure which did not worsen on

follow-up. Two patients developed moderate TR which was mild TR pre-procedure not worsen on follow-up. There were no other device related complications such as device migration, systemic thromboembolism, infective endocarditis, pericardial effusion or delayed conduction disturbances. **Conclusion** The LEPU MEMOPART SYMMETRIC MEMBRANOUS VSD OCCLUDER offers excellent closure rates and low morbidity when used to close large Perimembranous VSDs. The device appears to be safe and effective in short and mid-term follow-up. Long-term follow-up is necessary to establish the effectiveness of these type of device in these particular subset of VSDs.

ETHICS DECLARATIONS

Conflict of Interest: The authors declare they do not have any conflict of interests.

Ethical Approval: Not applicable.

Consent for Publication: Not applicable.