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Radiofrequency Energy – a Multi-Facetted Tool for the Congenital Interventionist

By Ralf J. Holzer, MD; Jolynn Hardin, RN; Sharon L. Hill, ACNP; Joanne Chisolm, RN; and John P. Cheatham, MD

INTRODUCTION

The application of catheter-derived radiofrequency (RF) energy has long been an established treatment modality in the management of atrial and ventricular arrhythmias. However, the biophysical propensities of this method not only facilitate controlled ablation of arrhythmogenic foci, but also allow RF perforation of (cardiac) tissue through cell vaporization at higher temperatures [1;2]. Consequently, the use of RF energy was introduced into therapeutic cardiac catheterization in the early 1990s as an alternative to laser-guided perforation of the pulmonary valve plate [3]. Further applications of this method have since been identified, including perforation of the atrial septum [4;5], as well as recanalization of obstructed vascular structures [6]. A variety of RF perforation catheters have been used for this purpose. We report our experience using the Nykanen RF perforation catheter, and the Toronto transseptal catheter together with the Baylis radiofrequency generator (All: Baylis Medical Corporation, Montreal, Quebec, Canada) for therapeutic transcatheter management of infants, children, and adults with CHD.

METHODS

All pediatric cardiac catheterization procedures that utilized the Nykanen radiofrequency (RF) perforation catheter or the Toronto transseptal catheter, performed at Columbus Children's Hospital between October 2002 and March 2006 were retrospectively reviewed. The procedures were categorized into perforation of the pulmonary valve plate (Group 1), perforation of the atrial septum (Group 2), recanalization of occluded vascular structures (Group 3) and creation of atypical vascular communications (Group 4). Collected data included demographic variables, underlying diagnosis, performed catheter procedure and procedural details, as well as procedural outcome, complications and adverse events.

Technical considerations

In most patients, the Nykanen RF perforation wire, as well as the Baylis radiofrequency puncture generator, (Both: Baylis Medical Corporation, Montreal, Quebec, Canada) were used to induce perforation of tissue. The technique is described as follows: a 4 or 5Fr catheter, such as a Judkins 2.5 right coronary catheter, is advanced towards the structure that is intended to be perforated. The 180cm 0.035" outer diameter coaxial injectable catheter (Baylis Medical Corporation, Montreal, Quebec, Canada) is loaded onto the 260cm

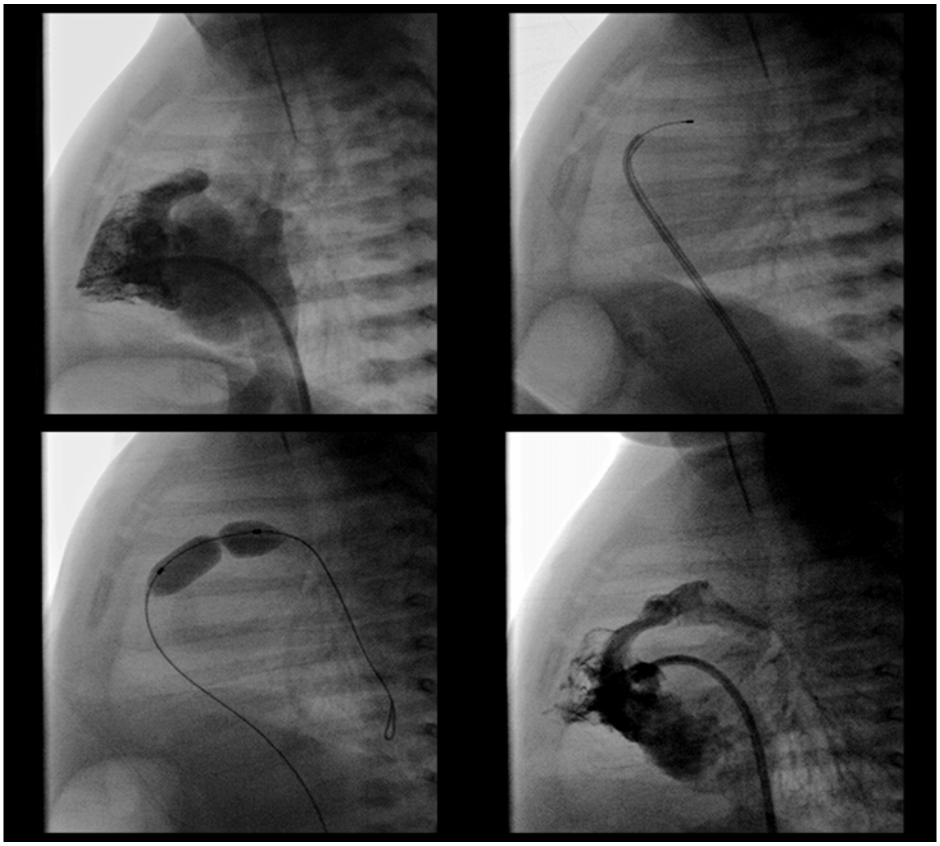

Figure 1. RF perforation for pulmonary atresia with intact ventricular septum. The first image (top left) demonstrates an RV angiogram delineating the RVOT. The second (top right) image shows the RF wire across the pulmonary valve plate. The third image (bottom left) demonstrates balloon valvuloplasty with a wire positioned in distal right pulmonary artery. The fourth image (bottom right) demonstrates the newly created continuity between right ventricle and main pulmonary artery.

0.024” Nykanen RF perforation wire and the RF wire is advanced to the tip of the (Judkins right coronary) catheter. Once an accurate position is confirmed with hand injections of contrast through the side-port of a Touhy Borst adapter, RF energy is applied at about 5 Watts/second for about 2-5 seconds (depending on the structure that is being perforated), while applying a gentle push of the RF wire. Once perforation has occurred, an orientating injection of contrast can be performed through the Touhy Borst adapter, before advancing the coaxial catheter over the RF wire across the perforated lesion. The RF wire is then exchanged to an appropriate exchange-length wire that will be used for further balloon angio- or valvuloplasty.

Transcatheter RF perforation of the pulmonary valve plate is performed under general anesthesia (Figure 1). Suitability for this procedure is assessed using 2-dimensional echocardiography with minimal criteria used in our institutions being in most cases, the presence of a tripartite right ventricle as well as a membranous atretic pulmonary valve with a well-formed infundibulum [7]. Vascular access is routinely obtained via right femoral venous cannulation and a femoral arterial pressure monitoring line is placed. Initial hemodynamic evaluation includes measurement of right ventricular and systemic arterial pressures, followed by angiography in the right ventricle using 20 degree cranial angulation on the frontal tubes as well as standard lateral projection. This allows measurement of the pulmonary valve plate diameter as well as exclusion of an RV dependent coronary circulation. Further angiography is obtained in the left ventricle in the same projection. The combination of these two angiographies allows documentation of the relationship between blind ending right ventricular infundibulum and main pulmonary artery. A 4 or 5 Fr Judkins 2.5 right coronary artery catheter is placed below the pulmonary valve plate within the right ventricular outflow tract using a Touhy Borst adapter to allow for passage of the RF wire as well as simultaneous contrast injections. Once the RF wire and coaxial catheter are loaded, and accurate positioning is confirmed, RF energy is applied while maintaining a gentle push of the RF wire towards the valve membrane. RF energy is discontinued once the wire is observed to advance through the valve plate. Appropriate position is confirmed using an injection of contrast through the Touhy Borst adapter. The coaxial catheter is then advanced over the RF wire into the main pulmonary artery and the RF wire is exchanged for a 0.014” coronary wire, which can be directed either to a position in a distal branch pulmonary artery or preferably through the PDA into descending aorta. A low-profile balloon valvuloplasty catheter, such as the Mini-Tyshak (NuMED, Hopkinton, NY), with a diameter of about 130% of the valve plate annulus , is then advanced over the coronary wire and balloon dilation is performed. In cases

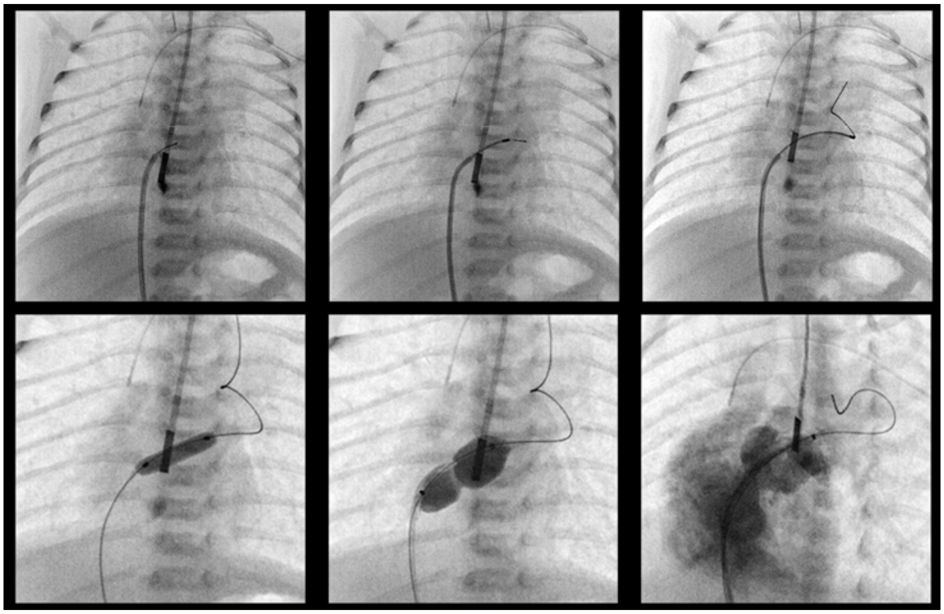

*Figure 2. Seven day old infant with hypoplastic left heart syndrome, intact atrial septum and a restrictive decompressing vein from left atrium to innominate vein. Images (from left to right and top to bottom) demonstrate the RF wire across the atrial septum, the coaxial catheter advanced over the RF wire into the LA, wire position through the coaxial catheter into the decompressing vein, cutting balloon septoplasty (4mm *15mm 3-blade cutting balloon) followed by balloon atrial septoplasty (12mm * 2cm Tyshak II) and final left atrial angiography demonstrating the newly created intraatrial communication. All images demonstrate an intracardiac echocardiography probe in TEE position.*

where the balloon catheter cannot be advanced across the valve, sequential dilatation can be performed starting with a lower profile 2.5mm coronary balloon. Trackability can also be improved through arterial fixation or snaring of the coronary wire. Balloon valvuloplasty is followed by assessment of the pressure gradient across the pulmonary valve, as well as the RV-to-systemic pressure ratio, and a final RV angiography is performed to document the result of the procedure.

RF perforation of the atrial septum with the Nykanen RF perforation wire is performed using a very similar technique to RF perforation of the pulmonary valve plate (Figure 2). The perforating position in the atrial septum is confirmed using fluoroscopy as well as transesophageal echocardiography. In neonates, intracardiac echocardiography probes can be used to obtain TEE imaging of the atrial septum. Once the coaxial catheter is advanced into the left atrium, the position should again be confirmed using pressure recording or injection of contrast. Of importance is the need to subsequently place a sufficient length of the (exchange) wire within the left atrium, to allow a (cutting) balloon catheter to track over the wire without causing the wire to recoil into the right atrium [4].

An Alternative to using the Nykanen RF perforation wire in larger patients is using, the Toronto transseptal catheter in combination with the 8Fr Torflex transseptal sheath and dilator (Both: Baylis Medical Corporation, Montreal, Quebec, Canada). The Toronto transseptal catheter is curved at the end by about 210 degrees to avoid continued perforation of adjacent structures once the atrial septum is traversed. It also has a slightly increased stiffness when compared to the Nykanen RF perforation wire that is specifically suited to allow tracking of the transseptal sheath across the perforated atrial septum.

RESULTS

Twenty-two therapeutic cardiac catheter procedures utilizing radiofrequency (RF) energy were performed between October 2002 and March 2006. The median age was 94 days (1 day to 67 years) and the median weight was 8.6 kg (2.1 to 114.6 kg).

In nine patients between one and three deliveries of 5 w/sec, mostly in 2 second intervals were required for successful RF perforation, while three patients had a maximum delivery of 8w/sec and five patients had a maximum delivery of 10 w/sec. One patient, in whom RF perforation was unsuccessful, had an energy delivered of 25w/sec. In four patients RF energy data was unavailable.

Group 1 – RF perforation of the pulmonary valve plate

Eight patients with pulmonary atresia and intact ventricular septum had suitable anatomy for RF perforation of the pulmonary valve and absence of RV dependant coronary circulation. The median age was 3 days (1 to 7 days) and median weight was 2.8 kg (2.5 to 4 kg). All patients were maintained on intravenous Prostaglandin. The median lateral tricuspid valve annulus obtained from apical 4-chamber view was 0.97 cm (0.56 to 1.56 cm), evaluating to a median Z-score of -0.48 (-2.07 to 1.97). On angiography, the median pulmonary valve plate diameter measured 5.6 mm (2.1 to 6 mm). In all attempted procedures the RVOT was successfully crossed and the pulmonary valve dilated using maximum balloon sizes of 8 mm (3.7 to 8 mm). Prior to RF perforation of the pulmonary valve plate, the median RV systolic to systemic arterial systolic pressure ratio was 2.03 (1.44 to 2.5), decreasing significantly to a median of 0.8 (0.68 to 1.28) after successful pulmonary valvuloplasty (p = 0.0002). The median residual gradient across the right ventricular outflow tract after the procedure was 4 mmHg (0 to 18 mmHg). In one patient with a bipartite right ventricle the arterial duct was stented in the same procedure. After RF perforation, intravenous prostaglandin was continued for a time period between 0 to 23 days. One patient could not be weaned off intravenous prostaglandins and therefore, required stenting of the arterial duct 23 days after initial RF perforation. The echocardiographic Z-scores of the tricuspid valve in those two patients that required ductal stenting were -2.07 and +1.5.

Patients have so far been followed up for a median of 1.3 years (18 days to 3.5 years). One patient was transferred to a different center after being weaned off prostaglandin and subsequently lost to follow up. Two patients have required further transcatheter or surgical procedures: One patient underwent a bidirectional Glenn procedure with PDA stent removal. A second patient underwent transcatheter closure of his ASD with occlusion of the PDA stent using a vascular plug about two years after RF perforation. At the most recent follow-up, one patient is following a univentricular pathway and five patients have a functioning and non-palliated biventricular circulation. In one patient, the ultimate outcome and pathway is still undecided, whilst another patient has been lost to follow up. Four patients had no evidence of cyanosis at the most recent follow-up.

Procedure related complications or adverse events were encountered in 5/8 (62.5%) patients, mostly of minor degree and without residual sequelae. These included transient vascular complications in one, the need for blood transfusions in two, intermittent and transient atrial flutter in one, and false passage with or without resulting effusion/tamponade in two patients. One of the patients with false passage of the RF wire had a perforation of the MPA with a resulting pericardial effusion and required resuscitation including pericardiocentesis. The patient did well subsequently, and was successfully weaned of prostaglandin.

Group 2 – RF perforation of the atrial septum

In nine patients (10 procedures), the creation of an intraatrial communication was facilitated using RF energy. Indications for creating an intraatrial communication included: the presence of an intact atrial septum in patients with hypoplastic left heart syndrome (three patients), the need for transseptal access to facilitate balloon mitral valvuloplasty (four patients - five procedures), the need for limited right atrial decompression in one patient with primary pulmonary hypertension, as well as the need to decompress the left atrium in a patient with very poor LV systolic and diastolic function on ECMO support. Out of three patients with HLHS and intact atrial septum, one patient had partial anomalous pulmonary venous drainage of the right lung to SVC, one patient had a decompressing vein from left atrium to innominate vein, whilst the third patient presented with mitral stenosis and aortic

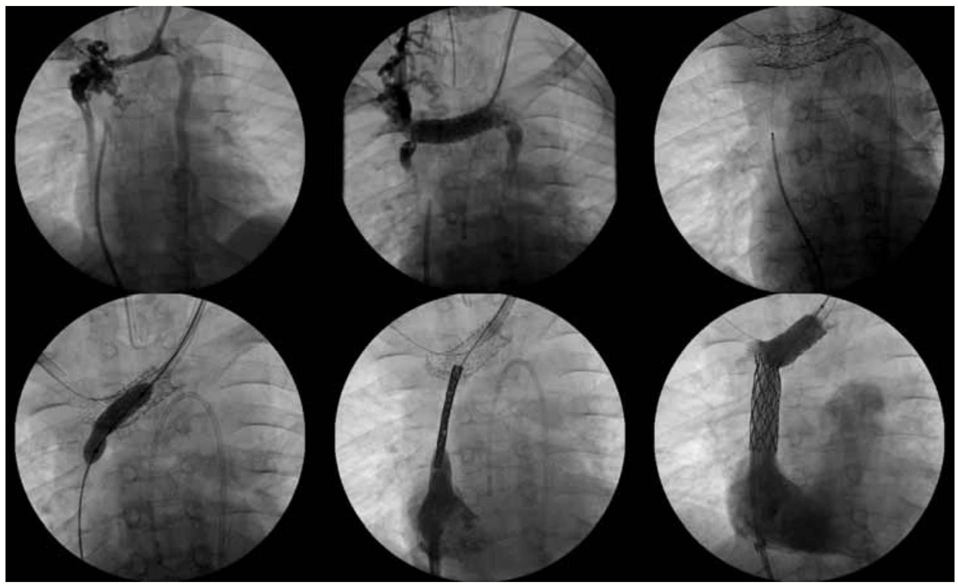

Figure 3. Recanalization of an obstructed SVC and stenotic innominate vein in a 16 year old boy with juvenile rheumatoid arthritis and a history of an indwelling central venous line. Images (from left to right and top to bottom) demonstrate the occluded SVC and stenotic innominate vein with collateral formation, innominate vein appearance after placement of an ev3 36mm Mega LD stent expanded to 12mm, RF wire positioning from right atrium to innominate vein, balloon angioplasty of the open cell innominate vein stent to accommodate the SVC stent (over wire loop), final positioning of a covered 8-zig 45mm NuMED CP stent with angiography in the proximal SVC/RA pouch, as well as final result after stent expansion to 10mm with significantly improved drainage from innominate vein to right atrium .

stenosis and severe hypoxemia.

In five patients who required the creation of a therapeutic intraatrial communication, successful RF perforation was followed by sequential balloon septoplasty, using initially 4 mm cutting balloons in three patients. In all five patients, the Nykanen RF perforation wire was used together with the coaxial injectable catheter. The median maximum balloon size used for septoplasty was 10 mm (4 to 12 mm). The median residual transseptal gradient was 2 mmHg (0 to 11 mmHg). With the exception of transient junctional rhythm and right bundle branch block in one patient, no significant complications were encountered during the procedures. However, four out of five patients died subsequently unrelated to the procedure of the underlying illness. The sole surviving patient in this group required repeated cutting balloon septoplasty for recurrent atrial restriction 40 days after the initial procedure.

In four patients with rheumatic mitral valve stenosis and a median age of 39.7 years (21.7 to 67.1 years), trans-atrial access for mitral balloon valvuloplasty was facilitated through RF perforation. In all patients, the Torflex transseptal sheath was used together with the Toronto transseptal wire. Either a 26 or a 28mm Inoue balloon was used and the mitral valve was dilated up to a maximum of 23 to 28 mm. The transmitral gradient was reduced from a median of 10 mmHg (5 to 25 mmHg) to a median of 6.5 mmHg (2 to 8 mmHg). In one patient the degree of mitral insufficiency increased from mild to mild-moderate, while in another patient it increased from trivial to mild – in all other patients, the degree of mitral insufficiency remained unchanged. One patient had intermittent atrial tachycardia during the procedure requiring the administration of adenosine. The median follow up so far has been 356 days (198 to 580 days). One patient required re-intervention about one year after the initial procedure, this time reducing the transmitral gradient from 15 to 8 mmHg. All other patients have remained free from re-intervention with symptomatic improvement.

"Even though the use of radiofrequency for the management of cardiac arrhythmias has long been established, it is important to emphasize that its use by the cardiac interventionist is very different from transcatheter ablation."

Group 3 – Recanalization of vascular structures

Three patients underwent an attempt at recanalization of obstructed vascular structures, using the Nykanen RF perforation wire together with the coaxial injectable catheter. A 16-year old patient underwent stenting of an obstructed innominate vein followed by successful recanalization of an occluded SVC using a combination of Nykanen RF wire and preformed standard transseptal needle (Figure 3). SVC patency was maintained using an 8zig 45mm covered Cheatham-Platinum stent. In a second patient with the underlying diagnosis of pulmonary atresia with VSD, an occluded PDA stent was successfully crossed with the RF wire, but difficulties were encountered when attempting to pass a balloon through the occluded stent. The procedure had to be terminated due to occurrence of 2nd and 3rd degree heart-block. However, after subsequent thrombolysis, successful balloon angioplasty of the PDA stent was performed two days later and the patient has remained free from re-intervention for more than one year so far. A third patient who had a history of Mustard procedure underwent successful RF perforation of an occluded SVC baffle with patency being maintained through implantation of a 36mm Max LD stent (EV3, Plymouth, MN). No complications were encountered.

Group 4 – Creation of atypical vascular communications

In one patient with an extracardiac Fontan circulation and occluded fenestration, recanalization of the fenestration was attempted using both the Nykanen RF wire, as well as the Toronto wire. These attempts were unsuccessful, but the occluded fenestration was subsequently crossed using the stiff end of a 0.018" V18 wire. Implantation of two coronary stents failed to maintain patency due to the stents being obstructed by atrial tissue. However, subsequent transcatheter placement of a covered stent three weeks later led to a sustained patency of the fenestration (maintained for more then 1.5 years since).

DISCUSSION

Even though the use of radiofrequency for the management of cardiac arrhythmias has long been established, it is important to emphasize that its use by the cardiac interventionist is very different from transcatheter ablation. Benson and colleagues very nicely summarized the physical propensities of radiofrequency [2;8]. Whilst radiofrequency ablation leads to desiccation of cells and a resulting electrically inactive scar, radiofrequency perforation completely vaporizes cells and, as such , allows penetration of tissue, an effect that is not desirable during radiofrequency ablation [2]. To achieve this, radiofrequency used for perforation has a higher voltage of about 150-180 V, while using a lower power of 5-10 W and a shorted duration of

Series	RF System	Age	Indication	Complication
Columbus Series (incl. Hill et al [5])	Nykanen / Coaxial	7d (Fig.2)	LA decompression (HLHS+decompressing vein)	None
		3m	RA 'pop-off' – restrictive (PPHTN)	None
		6m	LA decompression (CHD, poor LV on ECMO)	None
		1d	LA decompression (HLHS)	None
		6wk	LA decompression (HLHS + PAPVR)	RBBB Junctional rhythm
	Toronto transseptal	23y	Transseptal access for BMV	Atrial tachycardia
		35y	Transseptal access for BMV	None
		44y	Transseptal access for BMV	None
		22y	Transseptal access for BMV	None
		67y	Transseptal access for BMV	None
Javois et al [16]	Nykanen / Coaxial	1d	LA decompression (HLHS)	Cardiac perforation
Sherman et al [17]	Toronto transseptal	32y	Transseptal access for BMV	None
		64y	Transseptal access for BMV	None
		35y	Transseptal access for BMV	None
		16y	Transseptal access for BMV	None
		34y	Transseptal access for BMV	None
Sarvaas et al [18]	Nykanen	1d	LA decompression (HLHS)	None
		1d	LA decompression (HLHS)	None
		1d	LA decompression (CHD)	None
Justino et al [4]	Nykanen / Coaxial	5m	LA decompression (CHD)	None

Table 1. Reports of atrial septal perforation using RF energy. Use of either the Nykanen RF wire together with the coaxial injectable catheter (Nykanen / Coaxial), or the Toronto RF wire together with the Torflex transseptal sheath (Toronto transseptal), or the Nykanen RF wire alone (Nykanen). Abbreviations: LA – left atrium, HLHS – hypoplastic left heart syndrome, PAPVR – partial anomalous pulmonary venous return, BMV – balloon mitral valvuloplasty, CHD – congenital heart disease, RA – right atrium, PPHTN – primary pulmonary hypertension, RBBB – right bundle branch block.

1-20 seconds [2]. The tissue temperature achieved during RF perforation of about 100 degree Celsius is about 30 degrees above the temperature required to induce cell desiccation. In addition, the electrode used for RF perforation has a much smaller tip than the one used for RF ablation.

A variety of studies have reported on the outcome of RF perforation of the pulmonary valve and these results have been summarized by Benson and colleagues [2;9-14]. Most series are very small and include less than 5 patients. The overall procedural mortality was about 8% with incidence of procedural complications being about 15%. Even though a wire position in the distal pulmonary arteries or preferably across the PDA needs to be established, this should not be attempted with the Nykanen RF wire. In one of our patients, the RF wire was advanced into the distal MPA after RF perforation of the valve plate, and then, likely caused a small perforation of the MPA itself. Once the valve plate is crossed, the coaxial catheter should be advanced into the MPA and then the RF wire exchanged to a 0.018" or 0.014" wire with a softer tip that can be more readily maneuvered across the PDA or into the distal pulmonary arteries. This presence of a coaxial catheter is a significant advantage when comparing the Baylis to the Osypka RF system.

It has been advocated, that the combination of ductal stenting with RF perforation in one single procedure may reduce the number of transcatheter interventions and prevent prolonged post-procedural care. However, from our data it is difficult to predict which patients require additional invasive therapy to augment pulmonary blood flow. Some authors have suggested using the tricuspid valve z-score [15], but this has not consistently been identified as being predictive of the need for pulmonary blood flow augmentation. One of two patients requiring ductal stenting in our series had a Tricuspid valve z-score of +1.5. We performed ductal stenting at the same time of RF perforation in one patient with a tricuspid valve z-score of -2.07, in whom the presence of a bipartite right ventricle made long-term sustainability of a biventricular circulation extremely unlikely. In most patients a power setting of 5W/sec should be sufficient to perforate the pulmonary valve plate and it is important for the operator to be particularly suspicious of creating a false track if high power settings are required.

Including the ten patients from this report, the use of RF energy to perforate the atrial septum has been described in 20 patients (Table 1) [4;5;16-18]. Cardiac perforation requiring pericardiocentesis occurred in one reported patient due to a slightly superior puncture site [16]. The combination of Toronto wire and Baylis transseptal sheath was used in ten patients with rheumatic mitral valve stenosis to provide access for balloon mitral valvuloplasty. The Toronto RF wire, however, is less suitable for smaller children, especially when the left atrium is rather small, because of the larger diameter of the angulated curve of this wire. In these circumstances, the Nykanen RF wire in conjunction with the coaxial catheter facilitates placement of the appropriately curved wire within the left atrium. In patients with hypoplastic left heart syndrome, the left atrium is very small and, therefore, (cutting) balloon septoplasty is frequently performed initially before attempting to perform balloon atrial septostomy. If balloon septostomy is performed then a small balloon size such as the 1cc NuMED septostomy balloon (NuMED, Hopkinton, NY) is best suited. The use of RF energy allows a more controlled septal perforation when compared to the standard Brockenbrough needle.

A number of articles have reported on successful vessel recanalization using RF energy [19;20]. When attempting vessel recanalization it is of fundamental importance to have clear delineation of proximal and distal entry point. The operator has to be diligent to avoid inadvertent perforation of a nearby vascular structure that may cross the path of the RF wire. This is particularly important when attempting to reconstruct obstructed innominate vein or SVC, where the aortic arch vessels not infrequently prohibit safe recanalization.

As a summary, the use of RF energy has enhanced the interventional armamentarium. It facilitates the transcatheter treatment of PAITS and has added a new method for perforation of the atrial septum that is specifically suitable in neonates with a small left atrium, where the use of the Brockenbrough needle has a higher likelihood of inadvertent perforation of the atrial wall. Vessel perforation using RF energy is feasible but caution has to be applied to avoid perforation of other vascular structures.

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CORRECTION FROM THE MAY 2006 ISSUE:

The news item on page 8, of the May 2006 edition of Congenital Cardiology Today "AGA Medical Introduces New AMPLATZER TorqVue Delivery System" should have included a statement that it is not yet available in the United States. The TorqVue Delivery System is presently available in EU nations and most other countries worldwide.

Highlights from the 16th Utah Conference on Pediatric Cardiovascular Disease

By Collin Cowley, MD

The 16th Utah Conference on Pediatric Cardiovascular Disease was held at Snowbird, Utah February 18th-21st, 2006. This year's meeting was again organized and hosted by the divisions of pediatric cardiology from the University of Utah and the University of Michigan. Guest faculty included Frank Hanley, MD from Stanford University, Jane Newburger, MD, MPH from Harvard University, David Balzer, MD from Washington University, Timothy Olson, MD from the Mayo Clinic and Larry Latson, MD from the Cleveland Clinic. Faculty members from the University of Utah and the University of Michigan rounded out the collection of interesting and clinically useful presentations.

A multitude of topics in pediatric cardiovascular disease were covered including a brief history of surgical intervention for congenital heart disease focusing on the evolution of single ventricle palliation presented by Dr. Thomas Kulik of the University of Michigan. Excellent sessions on valvular heart disease, dilated cardiomyopathies, and interventional catheterization were also included. An in-depth session on pulmonary valve atresia with ventricular septal defect and major aortopulmonary artery collateral vessels allowed a comparison of surgical approaches and outcomes among major pediatric cardiology centers. Although this complex form of congenital heart disease continues to pose a significant challenge to pediatric cardiologists and heart surgeons alike, it was apparent from this session that favorable results that can be achieved using differing surgical strategies. A general pediatric cardiology session included a stellar presentation by Dr Jane Newburger on neurodevelopmental outcomes in congenital heart disease. This presentation highlighted the fact that even though survival rates have continued to improve among previously uniformly fatal forms of heart disease, deficits in our ability to protect the brain fully before, during, and after intervention remain.

The final session of this year's meeting was jointly hosted and attended by the 16th Annual Pediatric Critical Care Colloquium. Speakers for this special overlap session included Jack Price, MD and David Nelson, MD, PhD from Baylor University and Robert Shaddy, MD from the University of Utah. These speakers explored neurohormonal activation in heart failure and its implications for treatment.

As usual, this meeting was organized to allow attendees the opportunity to ski the Utah Rockies between morning and afternoon sessions. The recreational highlight was again the Gore Cup Invitational Giant Slalom ski race, sponsored annually since this meeting's inception by W.L. Gore and Associates. Awards in a variety of "creative" categories were provided to the winners as part of the gala dinner. Other Gold Level sponsors of this year's meeting included AGA Medical, Cook, Guidant, Medtronic, Roche Laboratories, and St Jude Medical.

Home of the 2002 Winter Olympics, the mountain ski resorts located just outside Salt Lake City, Utah provides a spectacular venue for this winter ski meeting. With approximately 500 inches of snowfall annually, the world class skiing, combined with superb meeting facilities, are unbeatable, and located only a short drive from the Salt Lake International Airport. The 17th Utah Conference on Pediatric Cardiovascular Disease is scheduled for March, 2008. For additional information, you may contact Pediatric Education Services at Primary Children's Medical Center (801) 588-4060.

~CCT~

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MEDICAL CONFERENCES

9th International Workshop in Catheter Interventions in Congenital and Structural Heart Disease
June 8-10, 2006; Frankfurt, Germany
www.chd-workshop.org

Pediatric Cardiology Review 2006
June 12-16, 2006; South Beach, Miami, FL USA
www.cbcbiomed.com

Electrophysiology and Cardiac Techniques
June 14-17, 2006; Nice - French Rivera, France
www.cardiostim.fr

A Live Symposium of Complex Coronary & Vascular Cases VIII
June 15-18, 2006; New York, NY USA
www.cccsymposium.org

Heart Failure 2006
June 17-20, 2006; Helsinki, Finland
www.escardio.org/congresses/HF2006/

2nd Annual Toronto Symposium—Contemporary Questions in Congenital Heart Disease—The Right Heart
June 18-20, 2006; Toronto, Canada
www.sickkids.ca/cardiologysymposium

Specialty Review in Pediatric Cardiology- (University of Illinois College of Medicine)
June 26-29, 2006; Chicago, IL USA
www.conferences.uiuc.edu/pcard06

XV PARMA Echo Meeting
June 28-30, 2006; Parma, Italy
www.unipr.it/arpa/echomeet

2006 International Symposium on the Hybrid Approach to Congenital Heart Disease (ISHAC)
June 29-30, 2006; Columbus, OH USA
www.hybridsymposium.com

Echocardiography in Congenital Heart Disease
July 5-7, 2006; London, UK
mailto:Morphology@rbht.nhs.uk

SIS 2006 (Summer in Seattle)
July 18-22, 2006; Seattle, WA USA
www.sis.org

Hands-on Cardiac Morphology
July 24-26, 2006; London, UK
www.rbht.nhs.uk/cardiacMorphology

Adult Congenital Heart Disease
August 4-6, 2006; Aspen, Co USA
www.TheChildrensHospital.org

MEDICAL NEWS, PRODUCTS AND INFORMATION

1st Annual ACHD Research Symposium: In conjunction with the 4th Annual Adult Congenital Heart Association National Conference

ACHA is pleased to announce the first annual ACHD Research Symposium which will be held in conjunction with the 4th Annual Adult Congenital Heart Association National Conference. The ACHD Research Symposium will be held September 15 -16, 2006 at the Crowne Plaza San Francisco International Airport.

The aim of the subsection is to propose new research in the following areas: pregnancy risk assessment for women with ACHD, best practices for anticoagulation during pregnancy, and defining hereditary implications of CHD.

There will be two moderated poster sessions to highlight recent scientific advances in these areas. We invite you and your colleagues to submit original research for consideration and presentation.

Abstracts should relate to non-invasive imaging and assessment of the right ventricle, and pregnancy and reproductive issues in ACHD. Up to 10 investigators will be selected for participation; junior investigators who indicate a need for financial assistance will be considered for a travel award.

Individuals may also apply to participate in the research symposium without submitting an abstract. Those interested in the research symposium will be asked to submit curriculum vitae. Up to 30 attendees will be selected for participation in the research symposium by the conference committee on the basis of their expected contribution to the symposium

Deadline for submissions will be Friday, June 30, 2006. Abstracts should be formatted to not exceed one 8 1/2" x 11" page with one inch margins. Abstracts should follow standard guidelines with title, author, and institution preceding the body of the abstract. Font size should be no less than 12 point and all tables and figures need to be included within the single page. Material that has been presented at other national meetings is acceptable for consideration for these sessions as well. Abstracts should indicate the presenting author.

Address abstracts for submission to: Elyse Foster, MD; Director, Echocardiography Laboratory; Department of Medicine, Cardiology; University of California San Francisco; 505 Parnassus Ave. M314A; San Francisco, CA 94143-0214; foster@medicine.ucsf.edu. Be sure to include address, telephone and email contact information for the corresponding author. ACHA anticipates notification of the abstract committee's decision by Friday, July 14th, 2006.

~CCT~

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