

CONGENITAL CARDIOLOGY TODAY

News and Information for Pediatric and Congenital Cardiovascular Physicians and Surgeons

Vol. 4 / Issue 6
June 2006
International Edition

WWW.CONGENITALCARDIOLOGYTODAY.COM

INSIDE THIS ISSUE

Radiofrequency Energy – a Multi-Faceted Tool for the Congenital Interventionist
by Ralf J. Holzer, MD; Jolynn Hardin, RN, Sharon L. Hill, ACNP; Joanne Chisolm, RN; John P. Cheatham1, MD
–Page 1

Highlights from the Hands-on Cardiac Morphology Course - 27, 28 February, 1 March 2006
by Christof Stamm, MD
–Page 10

DEPARTMENTS

Medical Conferences
–Page 8

CONGENITAL CARDIOLOGY TODAY
9008 Copenhaver Drive, Ste. M
Potomac, MD 20854 USA
Tel: +1.301.279.2005
Fax: +1.240.465.0692
www.CongenitalCardiologyToday.com

© 2006 by Congenital Cardiology Today (ISSN 1554-7787-print; ISSN 1554-0499-online). Published monthly. All rights reserved. Congenital Cardiology provides timely news and information for pediatric and congenital cardiologists. Statements or opinions expressed in Congenital Cardiology Today reflect the views of the authors and sponsors, and are not necessarily the views of Congenital Cardiology Today.

CAREER OPPORTUNITIES

See page 9

Congenital Cardiology Today would like to share your interesting stories or research in congenital cardiology.

Submit a brief summary of your proposed article to

Article-June@CCT.bz

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 transeptal 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 transeptal 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

Do You Want to Recruit a Pediatric Cardiologist?

Advertise in the only monthly publication totally dedicated to pediatric and congenital cardiology. For more information: call +1.301.279.2005, or send an email to:

TCarlsonmd@gmail.com

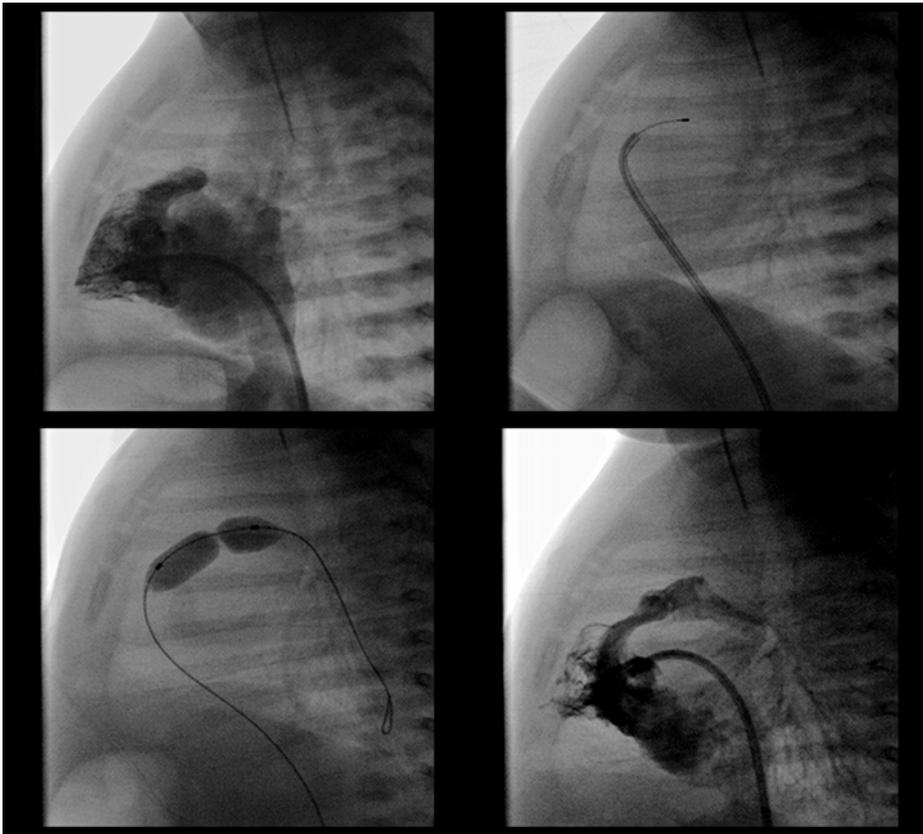


Figure 1. RF perforation for pulmonary atresia with intact ventricular septum. The first image (top left) demonstrates an RV angiogram delineating the RVOT. The second (top right) image shows the RF wire across the pulmonary valve plate. The third image (bottom left) demonstrates balloon valvuloplasty 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

PICS 2006

Pediatric & Adult Interventional
Therapies for Congenital & Valvular Heart Disease



www.picsymposium.com

September 10-13, 2006 | Bellagio, Las Vegas

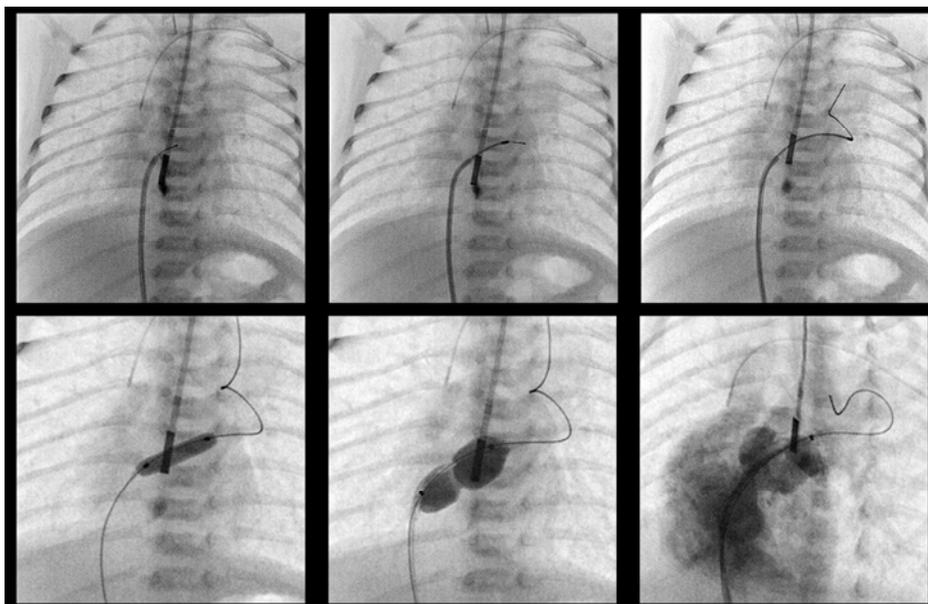


Figure 2. Seven day old infant with hypoplastic left heart syndrome, intact atrial septum and a restrictive decompressing vein from left atrium to innominate vein. Images (from left to right and top to bottom) demonstrate the RF wire across the atrial septum, the coaxial catheter advanced over the RF 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 echocardiogra-

phy. 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 transeptal catheter in combination with the 8Fr Torflex transeptal sheath and dilator (Both: Baylis Medical Corporation, Montreal, Quebec, Canada).

The Toronto transeptal 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 transeptal 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 maxi-



NuMED

www.numed.on.ca

NuMED, Inc.

Hallenweg 40, 5683 CT Best, The Netherlands

Tel: +31 (0)499 377388 Fax: +31 (0)499 377456

Manufacturer of angioplasty and valvuloplasty catheters, has a long standing commitment in meeting our customer's expectations by providing a high quality product. At NuMED, we see quality improvement as a continual process, aimed at satisfying these expectations and requirements at every stage.

mum 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. Indica-

tions 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 transeptal 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

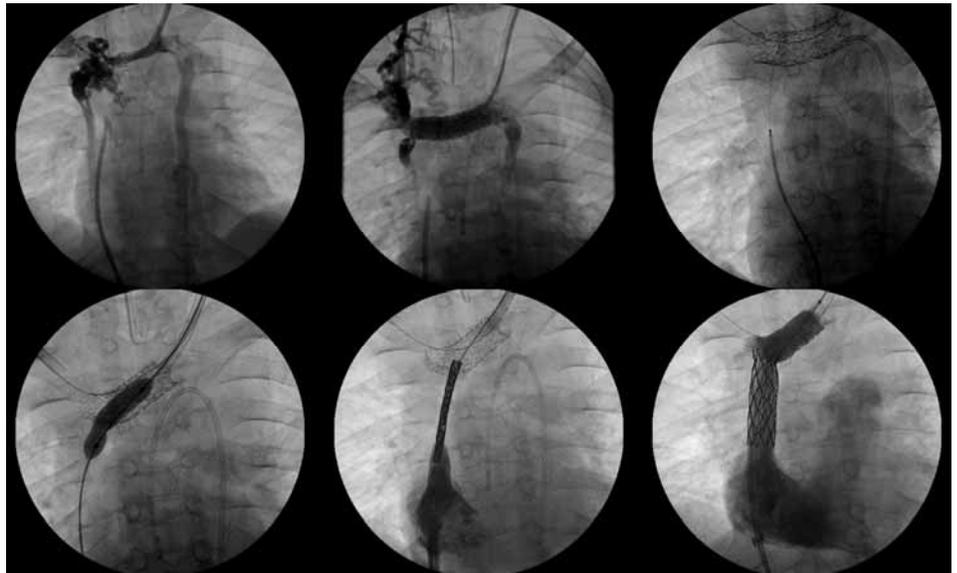


Figure 3. Recanalization of an obstructed SVC and stenotic innominate vein in a 16 year old boy with juvenile rheumatoid arthritis and a history of an indwelling central venous line. Images (from left to right and top to bottom) demonstrate the occluded SVC and stenotic innominate vein with collateral 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 .



International Symposium on the Hybrid Approach to Congenital Heart Disease (ISHAC)
with live case presentations

June 28-30, 2006
www.hybridsymposium.com

COLUMBUS
Children's
HOSPITAL

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 trans-mitral 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-

“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.”

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.

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 than 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 properties 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



**The iE33 intelligent echo system ...
for better visualization of congenital heart defects**

Learn more at:
www.medical.phillips.com/iE33
or call 800-229-6417

PHILIPS

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 pulmo-

nary 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 Osycka 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.

REFERENCES

1. Shimko N, Savard P, Shah K. Radio frequency perforation of cardiac tissue: modeling and experimental results. *Medical & Biological Engineering & Computing* 38(5):575-82, 2000.
2. Benson LN, Nykanen D, Collison A. Radiofrequency perforation in the treatment of congenital heart disease. [Review] [68 refs]. *Catheterization & Cardiovascular Interventions* 56(1):72-82, 2002.
3. Redington AN, Cullen S, Rigby ML. Laser or radiofrequency pulmonary valvotomy in neonates with pulmonary atresia and intact ventricular septum - description of a new method avoiding arterial catheterization. *Cardiology in the Young* 1992;2:387-90.
4. Justino H, Benson LN, Nykanen DG. Transcatheter creation of an atrial septal defect using radiofrequency perforation. *Catheterization & Cardiovascular Interventions* 54(1):83-7, 2001.
5. Hill SL, Mizelle KM, Vellucci SM, Feltes TF, Cheatham JP. Radiofrequency perforation and cutting balloon septoplasty of intact atrial septum in a newborn with hypoplastic left heart syndrome using transeptophageal ICE probe guidance. *Catheterization & Cardiovascular Interventions* 64(2):214-7, 2005.
6. Fink C, Peuster M, Bertram H, Hausdorf G. Transcatheter recanalization of the left main pulmonary artery after four years of complete occlusion. *Catheterization & Cardiovascular Interventions* 53(1):81-4, 2001.
7. Cheatham JP. To perforate or not to perforate-that's the question...or is it? just ask Richard! *Catheterization & Cardiovascular Diagnosis* 1997;42:403-4.
8. Veldtman GR, Hartley A, Visram N, Benson LN. Radiofrequency applications in congenital heart disease. [Review] [48 refs]. *Expert Review of Cardiovascular Therapy* 2(1):117-26, 2004.
9. Gournay V, Piechaud JF, Delogu A, Sidi D, Kachaner J. Balloon valvotomy for critical stenosis or atresia of pulmonary valve in newborns. *Journal of the American College of Cardiology* 26(7):1725-31, 1995.
10. Walsh KP, Abdulhamed JM, Tometzki JP. Importance of right ventricular outflow tract angiography in distinguishing critical pulmonary stenosis from pulmonary atresia. *Heart* 77(5):456-60, 1997.
11. Wang JK, Wu MH, Chang CI, Chen YS, Lue HC. Outcomes of transcatheter valvotomy in patients with pulmonary atresia and intact ventricular septum. *American Journal of Cardiology* 84(9):1055-60, 1999.
12. Alwi M, Geetha K, Bilkis AA et al. Pulmonary atresia with intact ventricular septum percutaneous radiofrequency-assisted valvotomy and balloon dilation versus surgical valvotomy and Blalock Taussig shunt. *Journal of the American College of Cardiology* 35(2):468-76, 2000.
13. Agnoletti G, Piechaud JF, Bonhoefer P et al. Perforation of the atretic pulmonary valve. Long-term follow-up. *Journal of the American College of Cardiology* 2003;41:1399-403.
14. Justo RN, Nykanen DG, Williams WG, Freedom RM, Benson LN. Transcatheter perforation of the right ventricular outflow tract as initial therapy for pulmonary valve atresia and intact ventricular septum in the newborn. [see comment]. *Catheterization & Cardiovascular Diagnosis* 40(4):408-13, 1997.
15. Alwi M, Kandavello G, Choo KK, Aziz BA, Samion H, Latiff HA. Risk factors for augmentation of the flow of blood to the lungs in pulmonary atresia with intact ventricular septum after ra-

SickKids
THE HOSPITAL FOR
SICK CHILDREN

**2ND ANNUAL TORONTO SYMPOSIUM
CONTEMPORARY QUESTIONS IN CONGENITAL HEART DISEASE:
THE RIGHT HEART**

June 18-20, 2006

Call: (416) 813-6132 or visit www.sickkids.ca/cardiologysymposium

**20
06**

diofrequency valvotomy. *Cardiology in the Young* 15(2):141-7, 2005.

16. Javois AJ, Van Bergen AH, Cuneo BF, Husayni TS. Novel approach to the newborn with hypoplastic left heart syndrome and intact atrial septum. *Catheterization & Cardiovascular Interventions* 66(2):268-72, 2005.

17. Sherman W, Lee P, Hartley A, Love B. Transatrial septal catheterization using a new radiofrequency probe. *Catheterization & Cardiovascular Interventions* 66(1):14-7, 2005.

18. Du Marchie Sarvaas GJ, Trivedi KR, Hornberger LK, Lee KJ, Kirsh JA, Benson LN. Radiofrequency-assisted atrial septoplasty for an intact atrial septum in complex congenital heart disease. *Catheterization & Cardiovascular Interventions* 56(3):412-5, 2002.

19. Kort HW, Balzer DT. Radiofrequency perforation in the treatment of acquired left pulmonary artery atresia following repair of tetralogy of Fallot. *Catheterization & Cardiovascular Interventions* 60(1):79-81, 2003.

20. Pedra CA, Filho RM, Arrieta RS, Tellez R, Fontes VF. Recanalization of a discrete atretic right pulmonary artery segment with a new radiofrequency system. *Catheterization & Cardiovascular Interventions* 60(1):82-7, 2003.

~CCT~

Corresponding Author

Ralf J Holzer, MD
Heart Center, Columbus
Children's Hospital
700 Children's Drive
Columbus, Ohio 43205 USA
Phone: +1 (614) 722-4799
Fax: +1 (614) 722-2549
rholzer@chi.osu.edu

Jolynn Hardin, RN
Heart Center
Columbus Children's Hospital
Columbus, Ohio USA

Sharon L. Hill, ACNP
Heart Center
Columbus Children's Hospital
Columbus, Ohio USA

Joanne Chisolm, RN
Heart Center
Columbus Children's Hospital
Columbus, Ohio USA

John P. Cheatham, MD
Heart Center
Columbus Children's Hospital
Columbus, Ohio USA

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.

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>

NuMED



NuMED, Inc.

Hallenweg 40, 5683 CT Best, The Netherlands

Tel: +31 (0)499 377388

Fax: +31 (0)499 377456

Manufacturer of angioplasty and valvuloplasty catheters, has a long standing commitment in meeting our customer's expectations by providing a high quality product. At NuMED, we see quality improvement as a continual process, aimed at satisfying these expectations and requirements at every stage.

www.numed.on.ca

PEDIATRIC CARDIOLOGIST

The Division of Pediatric Cardiology at the University of Utah is recruiting a pediatric cardiologist with a major interest in fetal cardiology and echocardiography. The candidate should have a strong clinical background in all areas of pediatric cardiology with expertise in fetal cardiology and echocardiography including transthoracic echocardiography and transesophageal echocardiography. The candidate will be joining a 14-member Division of Pediatric Cardiology with 2 physicians involved with fetal cardiology and 6 physicians currently dedicated to echocardiography and non-invasive imaging. The position is ideally suited for someone with primary interest in fetal cardiology, particularly someone with additional training in this area. There will be protected time for clinical research with mentoring available within the Division for clinical research studies. The Division has a very active clinical program, seeing over 350 fetal patients yearly. We are adding a dedicated nurse coordinator for this program. The Division also has a very active clinical research program, and is one of the participating centers in the Pediatric Heart Disease Clinical Research Network funded by the NIH. All subspecialties within pediatric cardiology are represented within the Division by individuals with significant experience and expertise.

The successful candidate will receive a faculty appointment at the University of Utah School of Medicine. The Pediatric Cardiology Division is based at Primary Children's Medical Center, a tertiary referral center for a three-state area, which is located on the hills overlooking Salt Lake City. The area offers an excellent quality of life with immense cultural and recreational opportunities close and available. The University of Utah is an Equal Opportunity Employer and welcomes applications from minorities and women and provides reasonable accommodations to the known disabilities of applicants and employees.

Interested individuals should contact: Robert E. Shaddy, Professor of Pediatrics, Division Chief of Pediatric Cardiology, University of Utah School of Medicine, 100 North Medical Drive, Salt Lake City, Utah 84113. E-mail: robert.shaddy@ihc.com



PEDIATRIC CARDIOLOGIST

Phoenix, Arizona

We are seeking a BC/BE Pediatric Cardiologist to join a 12-member group practice with offices in the Phoenix and Tucson metropolitan areas. For the Phoenix area practice, we are recruiting a generalist with experience in fetal, transthoracic and transesophageal echocardiography. Annually, this premier group performs 400 catheterization cases, 400 fetal echocardiograms and close to 12,000 echocardiograms (over 5,000 are done in the office). The practice is engaged in clinical research and covers teaching rotations for residents and medical students.

While living in Phoenix, enjoy 325 days a year of sunshine, 200 picturesque golf courses, world-class dining, exhilarating outdoor adventure, trendy shopping and enriching culture.

Receive a competitive income plus outstanding benefits, including health, life and disability insurances, paid malpractice insurance and generous CME allowance.

**For more information, please contact
Lori Abolafia, Physician Relations Specialist
lori_abolafia@pediatrix.com**

**Pediatrix Medical Group
1301 Concord Terrace
Sunrise, FL 33323**

800.243.3839 ext. 5209
www.pediatrix.com

Arizona Pediatric Cardiology Consultants, an
affiliate of Obstetrix Medical Group, Inc.



For Hearts and Souls

Providing and developing pediatric cardiac care around the world

www.forheartsandsouls.org

HIGHLIGHTS FROM THE HANDS-ON CARDIAC MORPHOLOGY COURSE- 27, 28 FEBRUARY, 1 MARCH 2006

By Christof Stamm, MD

In early spring this year, Dr. Yen Ho conducted her Hands-on course for the seventh year with the help of an international faculty from various specialties (morphology, cardiac surgery, pathology, paediatric cardiology). As one of the regular faculty members, I admit to being almost addicted to it mainly because of the feedback from the participants and here are just a few of them in response to the question "What did you find most useful about the course?"

- "Time allocated to visualising actual specimens, hints by tutors for anatomical landmarks. Simple clear diagrams + handouts. Makes the heart 'less scary'."
- "Very systematic approach to teaching + describing the heart."
- "Surgical approach to morphology."
- "Combination of lectures and hands-on with very nice specimens beautifully demonstrated. Very well organised with logical progression."
- "I attended it 2 years ago and came back for more! The more times I hear, the better I understand! Very good!"
- "Clarifying congenital lesion understanding in a clinical operating theatre setting"
- "Hands-on, real 3-D awareness."
- "Real time video demonstration, and hands-on with specimens."

- "help to develop a three dimensional approach to malformations working with a 2D-tool (echo) every day."
- "The presentation with projection on a big screen is excellent."

The course started with Dr. Ho giving a series of live video demonstrations of the normal heart with emphasis on spatial relationships of chambers, morphology of chambers, septal structures and valves, and discussion on anatomy applied to specialties such as imaging and surgery. Having established a firm grounding on the normal heart, the course then progressed to sequential segmental analysis and video demonstrations of common cardiac malformations such as ASD, VSD and atrioven-

tricular septal defect on the morning of the first day. The afternoon sessions were practical sessions with the faculty guiding participants through the topics that were covered during the morning. On the second and third days, the participants were taken gradually through increasingly complex defects with video demonstrations in the morning followed by practical sessions in the afternoon. The final session, on assorted malformations, tested the skills of participants. There was also an optional visit to the Leon Gerlis Museum of Cardiac Pathology and Morphology at the Royal Brompton Hospital. All participants were given a superb hand-book with clear text and simple line diagrams in colour making it easy for their own revision and reference when back at their home institutions.



Dr Ho welcoming participants and introducing the team to the faculty (Prof. O'Conner, Prof. Gutierrez, Ms. McCarthy, Dr. Ciotti, Dr. Ho, Dr. Goltz, Mr. Salih, Mr. Barkhordarian, and Dr Stamm).

PICS 2006

Pediatric & Adult Interventional
Therapies for Congenital & Valvular Heart Disease



www.picsymposium.com
September 10-13, 2006 | Bellagio, Las Vegas



Groups of participants with tutors during Hands-on sessions. Tutors and participants review specimens through careful handling and examination.

The combination of lectures using live video demonstrations followed by practical sessions in groups led by tutors is, to many participants, their ideal format. Showing specimens on the big projection screen allows the participants to have a better grasp of the three-dimensional nature of the malformations. The practical sessions allow participants to revise knowledge gained from the video demonstrations. As the participants are from diverse specialties, they have the opportunity during the hands-on sessions to examine the malformations from their perspective. For example, cardiac surgeons were able to discuss specific surgical aspects with surgical tutors. The rotation of tutors and participants allowed good integration of all groups.

This year the course attracted participants who were listed as technicians, trainees and senior clinical staff from departments of pathology, paediatric cardiology, cardiac surgery, paediatrics, intensive care, anaesthetics, radiology, obstetrics, and neonatology. They were from all over the world: UK (42%), rest of Europe (55%), rest of the world (3%). The mix of participants ensured lively interchange of ideas and networking.

Dr. Ho's many courses are always very well received. She and her colleagues at

the Royal Brompton Hospital in London run 6 to 8 courses annually, mostly devoted to congenital heart disease. Details can be obtained from the website www.rbht.nhs.uk/cardiacMorphology. The Hands-on Cardiac Morphology course in particular is the flagship of her courses. Owing to the unique format of the course, participant numbers have to be restricted. The course has grown so popular over the years that it is always heavily oversubscribed and, for the second year running, Dr. Ho has been persuaded to repeat the course in the summer (24-26 July 2006). I am sure many disappointed applicants for the Spring course will be delighted at the opportunity of getting a place this time. I will be back too !

~CCT~



Christof Stamm, MD
Cardiovascular Surgeon
Berlin Heart Centre
Germany

© 2006 by Congenital Cardiology Today
(ISSN 1554-7787-print; ISSN 1554-0499-online)
Published monthly. All rights reserved

Publishing Management

Tony Carlson, Founder
TCarlsonmd@gmail.com
Richard Koulbanis, Publisher & Editor-in-Chief
RichardK@CCT.bz
John W. Moore, MD, MPH, Medical Editor/
Editorial Board
JWMoore@CCT.bz

Editorial Board

Teiji Akagi, MD
Zohair Al Halees, MD
Mazeni Alwi, MD
Felix Berger, MD
Fadi Bitar, MD
Jacek Bialkowski, MD
Philipp Bonhoeffer, MD
Anthony C. Chang, MD, MBA
John P. Cheatham, MD
Bharat Dalvi, MD, MBBS, DM
Horacio Faella, MD
Yun-Ching Fu, MD
Felipe Heusser, MD
Ziyad M. Hijazi, MD, MPH
Ralf Holzer, MD
Marshall Jacobs, MD
R. Krishna Kumar, MD, DM, MBBS
Gerald Ross Marx, MD
Tarek S. Momenah, MBBS, DCH
Toshio Nakanishi, MD, PhD
Carlos A. C. Pedra, MD
Daniel Penny, MD
James C. Perry, MD
Shakeel A. Qureshi, MD
Andrew Redington, MD
Carlos E. Ruiz, MD, PhD
Girish S. Shirali, MD
Horst Sievert, MD
Hideshi Tomita, MD
Gil Wernovsky, MD
Zhuoming Xu, MD, PhD
William C. L. Yip, MD
Carlos Zabal, MD

To Contact an Editorial Board Member

Email to: BOARD@CCT.bz. Place the Board Member's name in the Subject line.

FREE Subscription

Congenital Cardiology Today is available free to qualified professionals worldwide in pediatric and congenital cardiology. International editions available in electronic PDF file only; North American edition available in print. Send an email to Subs@CCT.bz. Be sure to include your name, title, organization, address, phone, fax and email.

Contacts and Other Information

For detailed information on author submission, sponsorships, editorial, production and sales contact, current and back issues, see website: www.CongenitalCardiologyToday.com



Barth Syndrome
Foundation

The Barth Syndrome Foundation

P.O. Box 974, Perry, FL 32348

Tel: 850.223.1128

info@barthsyndrome.org

www.barthsyndrome.org

Symptoms: Cardiomyopathy, Neutropenia, Muscle Weakness, Exercise Intolerance, Growth Retardation



Live 3D Echo



PureWave Crystal Technology..

In the last 20 years, there has been a revolution in caring for children with congenital heart disease. Thanks to advances in diagnostics, surgery and treatment, many of these children are living into adulthood and enjoying active lives. With dedicated pediatric cardiology capabilities, the iE33 echo system answers your need for high-performance, non-invasive diagnostic imaging for these patients.

From fetal echo to mature adult, the iE33 system supports the assessment of congenital heart disease through every stage of life and provides new diagnostic information that is changing patient management. Everything about the system is designed to meet the specific needs of pediatric cardiology. Unique ergonomic features make it possible to successfully image the tiniest premie or the largest teenager in many

Pediatric cardiology imaging capabilities from fetal echo up to the mature adult for complete Congenital Heart Disease assessment with analysis capabilities that looks at inflow and outflow of information within the pediatric heart. Listen to the Podcast: <http://tinyurl.com/s42k6>

different environments. Pediatric analysis follows your workflow. And advanced technologies provide best-in-class 2D imaging and Live 3D Echo and give clinicians and surgeons structural information to make decision making

more efficient and outcomes more effective.

A full complement of cardiac transducers, including pediatric and adult TEEs, enables you to image a complete range of patient types – regardless of age, disease state or body composition.

In addition, a unique analysis package truly fol-

lows the patient the way you do – so you don't have to fit your requirements into an analysis package designed for adult echocardiography.

The biggest breakthrough in transducer material in 40 years, PureWave crystal

technology provides significantly better acoustic properties for a radical leap forward in 2D image quality.

Dedicated to your pediatric cardiology clinical and workflow requirements, our commitment goes beyond the system and its technologies. Global educational programs, outstanding service and worldwide centers of excellence help you to get the most out of your system every day.

Pediatric echo from Philips... it just makes sense.

FOR MORE INFORMATION

Philips Medical Systems
22100 Bothell Everett Highway
Bothell, WA 98021
+1 (425) 487 7000
1 (800) 285-5585

www.medical.philips.com/ultrasound

