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Role of Interventional Cardiology in the Treatment of Neonates - Part III

By P. Syamasundar Rao, MD

"Role of Interventional Cardiology in the Treatment of Neonates – Part III" is the third and final article in a series of articles by P. Syamasundar Rao, MD, Professor of Pediatrics and Medicine, Director, Division of Pediatric Cardiology, University of Texas-Houston Medical School. The first article appeared in September, and the second appeared in the October issue. All issues are on the website in PDF files.

INTRODUCTION

Non-surgical atrial septostomy to enlarge or create atrial septal defects and balloon angioplasty/valvuloplasty to relieve critical obstructive lesions in the neonate were presented in the first two parts of this review [1,2]. Discussion of other interventional procedures (Table I) will be presented in this third and final paper.

Table I. Catheter Interventional Techniques Used in the Neonate

- Non-surgical atrial septostomy
- Balloon angioplasty/valvuloplasty
- Radiofrequency perforation of atretic pulmonary valve
- Transcatheter occlusion of shunts
- Stents

RADIOFREQUENCY PERFORATION OF ATRETIC PULMONARY VALVE

Pulmonary atresia with intact ventricular septum is a complex cyanotic congenital heart defect with poor long-term prognosis [3-6]. One of the objectives of the management of these infants is to optimize chances for restoration of a four-chambered heart [6-9]. To achieve this objective, the hypoplastic right ventricle should be encouraged to grow [6,7]. Surgical pulmonary valvotomy at the time of presentation or shortly thereafter was initially recommended to promote forward egress of the right ventricular output and to stimulate growth of the right ventricular cavity so that it could eventually support the cardiac output into the pulmonary circuit [6,7]. Perforation of the atretic pulmonary valve membrane with the blunt end of a guide wire or by Laser and radiofrequency energy followed by balloon valvuloplasty [8,10-18] has been advocated by some cardiologists. With the availability of radiofrequency wires (now approved by the US Food and Drug Administration), this method replaces perforation with the stiff end of a guide wire.

Radiofrequency Perforation

The procedure involves the usual percutaneous catheterization, followed by right ventricular angiography in sitting-up (15^0 LAO and 35^0 cranial) and straight lateral views to evaluate the anatomy of the right ventricle and to measure the pulmonary valve annu-

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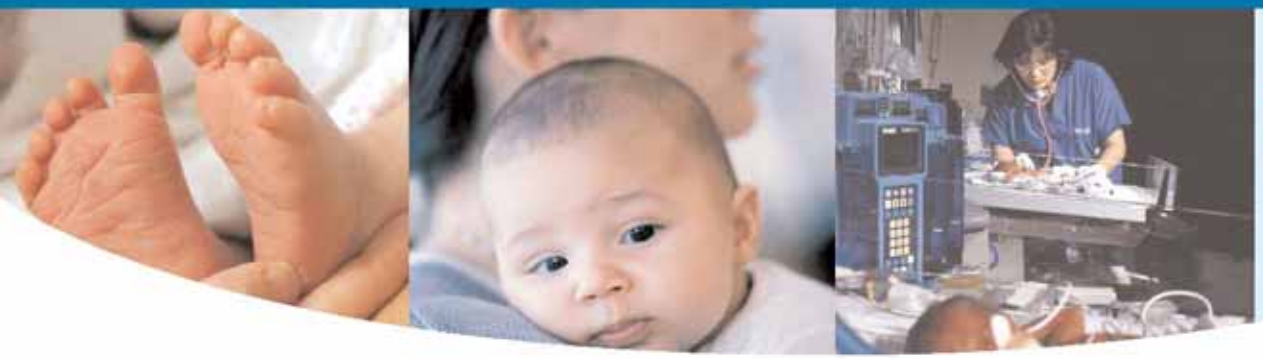

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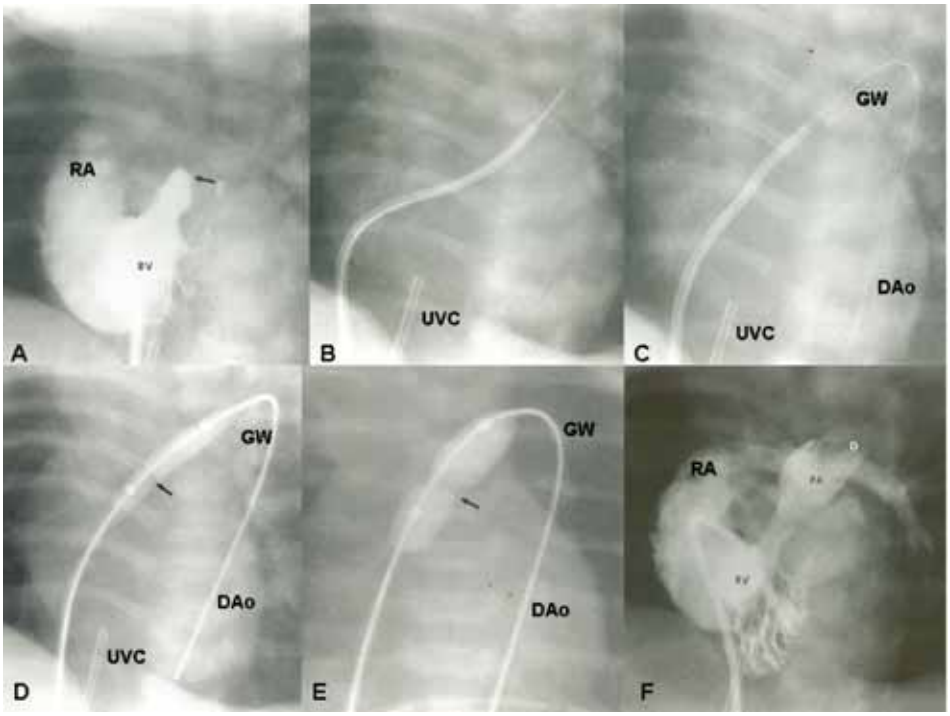

Figure 1. [A]. Selected right ventricular (RV) cineangiographic frame in a sitting-up (15^0 LAO and 35^0 cranial) view demonstrating an atretic pulmonary valve (arrow). Note opacification of the right atrium (RA) due to tricuspid insufficiency. [B & C]. Following perforation of the atretic pulmonary valve, note passage of a guide wire (GW) into the pulmonary artery and then into the descending aorta (DAo). [D & E]. Five mm diameter and 8mm diameter balloon dilatation catheters across the perforated pulmonary valve membrane are shown with "waisting" of the balloon (arrows) during the initial phases of balloon inflation which has disappeared following full inflation of the balloon (Not shown). [F]. Right ventricular angiography following the procedure demonstrates opacification of the pulmonary artery (PA) and its branches. Also note opacification of pulmonary end of patent ductus arteriosus (D). There was significant tricuspid insufficiency both before and after the procedure. UVC, Umbilical venous catheter.

lus. The echo data along with angiographic data should ensure that there is no right ventricular dependent coronary circulation. A right coronary artery (Cordis) or a similar guide catheter is placed in the right ventricular outflow tract and a Nykanen radiofrequency perforation catheter (wire) (Baylis, Montreal, Canada) is positioned against the pulmonary valve. After confirming the position of the catheter, low power (5 to 10 watts) radiofrequency energy of one to two second duration is applied with a BMC radiofrequency perforation generator (Baylis), thus perforating the pulmonary valve. The perforation catheter is advanced across the pulmonary valve and then into the branch pulmonary arteries or into the descending aorta via the ductus. A Protrach^{tm} Micro catheter (Baylis) (into which the radiofrequency wire was preloaded) is then advanced over the Nykanen radiofrequency perforation catheter and exchanged with a floppy-tipped coronary guide wire that is suited to position the selected balloon dilatation catheter. A balloon angioplasty catheter is advanced over the guide wire and positioned across the pulmonary valve. The balloon is inflated with diluted contrast material (1 in 4), as described in the Critical Pulmonary Stenosis section [2]. Progressively increasing sizes of balloon diameters are usually required, with a final balloon diameter of 6 to 8 mm, depending upon the measured pulmonary valve annular diameter. Various steps in accomplishing the procedure are illustrated in Figure 1.

Results

The feasibility of perforation of the atretic valve varies from one study to the other, reviewed elsewhere [8]. In one large series [19], successful perforation was achieved in 27 out of 30 (90%) patients. In half the patients a modified Blalock-Taussig shunt was required between 2 and 24 days after opening the valve. There were three early deaths and two late deaths. During follow-up, sixteen patients achieved biventricular circulation. The study authors concluded that percutaneous perforation followed by balloon dilatation is a good treatment strategy for neonates with pulmonary atresia provided that there is no right ventricle-dependent coronary circulation and the right ventricular infundibulum is patent.

TRANSCATHETER OCCLUSION OF SHUNTS

Atrial and Ventricular Septal Defects and Patent Ductus Arteriosus

A number of devices to close the atrial [20-23] and ventricular [24] septal defects and patent ductus arteriosus [25-27] have been developed. However, closure of these defects by transcatheter methodology is either not necessary or feasible in the neonate and will not be further discussed.

Superfluous Vascular Lesions

Transcatheter embolization of superfluous vascular lesions, although well-described by the late 1970s [28,29], was by and large a procedure used in adult subjects, usually performed by radiologists. A number of embolic materials have been used, but the steel coil described by Gianturco and his associates in 1975 [30] has become the embolic material of choice. Transcatheter occlusion has been applied to children to close pulmonary arteriovenous fistulae, aorto-pulmonary collateral vessels, veno-venous collateral vessels, aorto-pulmonary surgical shunts, coronary arterio-venous fistulae, and vessels associated with pulmonary sequestration and hemoptysis [31,32]. While Gianturco coils are most commonly used, other embolic materials such as detachable balloons, devices and more recently Amplatzer vascular plugs are also used.

While not frequent, need for occlusion of superfluous vascular lesions in the neonate does exist and these include: cerebrovascular and hepatic arterio-venous fistulae, multiple aorta-pulmonary collateral vessels (MAPCVS) associated with pulmonary atresia with ventricular septal defect (Tetralogy of Fallot) and anomalous systemic artery associated with pulmonary sequestration/scimitar syndrome. Cerebrovascular and hepatic arterio-venous fistulae are usually dealt with by the neurosurgeons and/or interventional radiologists and will not be reviewed.

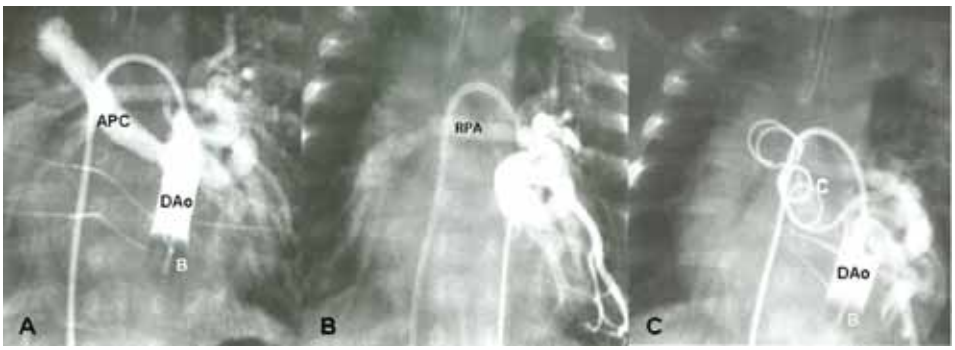

Figure 2. [A]. Selected cineangiographic frame from balloon (B) occlusion aortography in a neonate with severe congestive heart failure demonstrating a large persistent aorto-pulmonary collateral (APC) vessel connecting the descending aorta (DAo) to the right pulmonary artery (RPA). [B]. Dual blood supply to the RPA is demonstrated from an APC on the left side. [C]. Occlusion initially with an 8-mm diameter Gianturco coil (c) and a few smaller coils resulted in complete occlusion of the APC. The infant improved remarkably from congestive heart failure and eventually underwent unifocalization and complete correction.

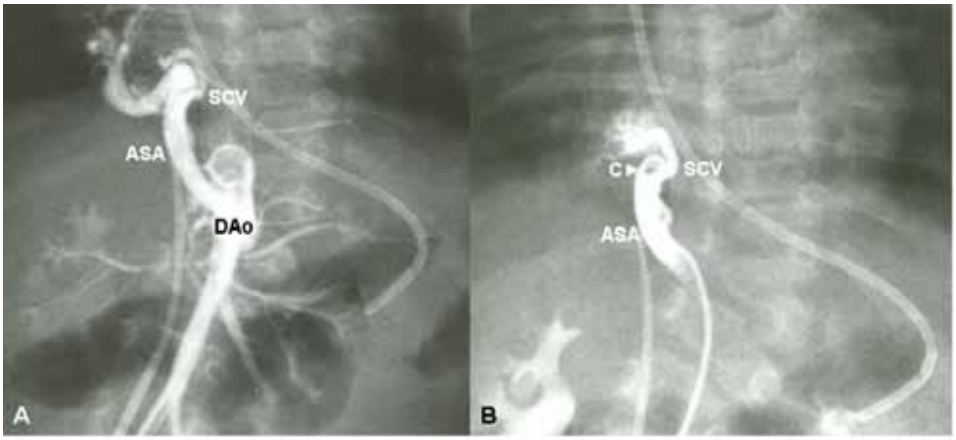

Figure 3. [A]. Selected descending aorta (DAo) cineangiographic frames demonstrating a large anomalous systemic artery (ASA) opacifying a sequestered lung segment in an infant with severe congestive heart failure. [B]. The ASA was occluded with a coil (c) resulting in complete occlusion of the ASA. A small vessel (SV) was not occluded. Following the procedure the infant improved dramatically.

MAPCV

In patients with pulmonary atresia or tetralogy of Fallot, MAPCVS arise most commonly from the descending aorta or from brachiocephalic vessels. Whereas the pulmonary blood flow through these vessels is useful in maintaining good systemic arterial oxygen saturation, such vascular connections may become problematic when excessive pulmonary blood flow through these vessels may precipitate congestive heart failure. The procedure involves defining the pulmonary arterial supply and then occluding the collateral vessel(s) after ensuring dual supply to that particular lung segment. Gianturco coils are usually used (Figure 2) although devices and vascular plugs may be useful in such situations. Such aorta-pulmonary collateral vessels are seen in other cardiac defects and even in otherwise normal hearts and can cause significant cardiac dysfunction requiring closure in the neonatal period.

Pulmonary Sequestration

Pulmonary sequestration may either be intralobar or extralobar [33] and is usually associated with Scimitar syndrome [34,35]. The sequestered lung, however, receives blood supply from an anomalous systemic artery, most commonly arising from abdominal or thoracic aorta. Large intrapulmonary shunt may result in congestive heart failure in the newborn. Whereas surgical resection of the sequestered lung along with ligation of the vessel supplying the sequestered lung segment has been the conventional approach, several workers, over the years [32,36-40], employed transcatheter embolization and found successful results. Gianturco coils have successfully been used [32,36-40]. Indication for transcatheter intervention in the neonate is severe or difficult to treat heart failure. Transcatheter coil occlusion (Figure 3) is safe, feasible and effective. The procedure involves performing selective descending aortography to define the vascular supply to the sequestered lung segment and then occluding the vessel(s) with a coil or vascular plug.

STENTS

Balloon angioplasty may be effective in relieving vascular obstructive lesions. However, elastic recoil of the vessel wall may result in ineffective relief of obstruction in some cases. Stents, by exerting radial forces, prevent elastic recoil of the vessel wall and produce more effective relief of obstruction. The concept of the stent was initially proposed by Dotter and Judkins and their associates [41,42] in the 1960s. Clinical use was not established

until late 1980s when Palmaz, Sigwart and their colleagues brought it to fruition [43-45]. Pediatric applications of stent technology followed [46,47] and were reviewed in detail elsewhere [48]. The major limitation of stents in the pediatric patient is that the stents do not grow as the child grows, because the majority of stents are metallic. Stents, in addition to keeping open obstructed stenotic vessels may also be used to keep open naturally occurring structures such as patent foramen ovale (PFO) and patent ductus arteriosus (PDA). Potential uses of stents (Table II) in the neonates will be discussed below.

Table II. Potential Uses of Stents in the Neonate

- Obstruction at patent foramen ovale/ atrial septum
- Ductus arteriosus
- Aortic coarctation
- Branch pulmonary arteries
- Miscellaneous

Atrial Septum/PFO

The role of stents in creating or keeping open an atrial defect has been discussed in the section on non-surgical atrial septostomy [1] and will not be discussed further.

Ductus Arteriosus

There are a number of cardiac defects in which the ductus, if it remained patent, would be beneficial, providing pulmonary or systemic blood flow. These lesions are listed in Table III. Pharmacologic means of maintaining the ductus by intravenous infusion of Prostaglandin E1 is quite helpful, but requires prolonged and continuous intravenous access, and more importantly, the effectiveness of PGE1 fades as the neonate ages. Consequently, alternative methods of keeping the ductus open have to be pursued. Balloon dilatation of the ductus was attempted, as reviewed elsewhere [49], but the long-term patency is uncertain. Therefore, stenting of the ductus arteriosus is a logical extension of transcatheter methodology. Stent implantation in experimental animal models [50-54] to maintain ductal patency have been undertaken and have demonstrated that stents are superior to balloon dilatation in maintaining ductal patency [49,52]. Clinical applications followed and include ductal stent implantation for treatment of pulmonary atresia [8,54,55], right ventricular hypoplasia [56], critical pulmonary stenosis [55], other complex heart defects with reduced pulmonary blood flow [55,57] and Hypoplastic left heart syndrome [58,59].

Table III. Ductal-Dependent Cardiac Defects

A. Ductal-Dependent Pulmonary Flow

- Pulmonary atresia or critical stenosis with intact ventricular septum
- Pulmonary atresia with ventricular septal defect
- Severe tetralogy of Fallot
- Tricuspid atresia
- Complex cyanotic heart disease with pulmonary atresia or severe stenosis
- Ebstein's anomaly of the tricuspid valve
- Hypoplastic right ventricle

B. Ductal-Dependent Systemic Flow

- Hypoplastic left heart syndrome
- Severe coarctation of the aorta syndrome
- Interrupted aortic arch

Stent Implantation Procedure

Two groups of lesions (Table III) will require separate consideration. First is the pulmonary oligemia group (ductal dependent pulmonary flow; Table III A), comprising complex cyanotic congenital heart defects with severe pulmonary stenosis or atresia that are not correctable in the neonatal period. The established management practice involves creation of an aorto-pulmonary anastomosis (usually a modified Blalock-Taussig shunt) to alleviate pulmonary oligemia and systemic arterial hypoxemia. An alternative approach is to keep the ductus open by placing a stent in it. Similarly, left heart obstructive lesions, particularly Hypoplastic left heart syndrome patients may be benefited by ductal stents while awaiting for a more definitive procedure or as a part of hybrid procedures [58-63].

Pulmonary Oligemia

Initially, diagnostic cardiac catheterization and selective cineangiography are performed to determine the type of heart defect and sources of pulmonary blood flow. If it is determined that the defect is not correctable in the neonatal period, ductal stent implantation is a reasonable option. Aortograms are reviewed, and if necessary, additional aortograms are performed to define the ductal anatomy and its minimal diameter and length. Straight lateral, sitting-up (15^0 LAO and 35^0 cranial) and 30^0 RAO views are best to define the ductal morphology. This will also establish landmarks for ductal stenting. A #4-French Judkins right coronary artery (RCA) catheter or a cut-pigtail catheter is positioned in the aortic arch and a coronary guide wire (Choice PT Extra S'port (Boston Scientific) or a similar wire) is manipulated into the ductus arteriosus and main pulmonary artery and from there into a distal left or right pulmonary artery. The ductal length is re-measured since its straightening by the guide wire may alter its length. The catheter and femoral arterial sheath are removed and replaced with a 4-French long sheath (Cook, Bloomington, IL). A 3.5 to 4.5 mm diameter (depending upon the

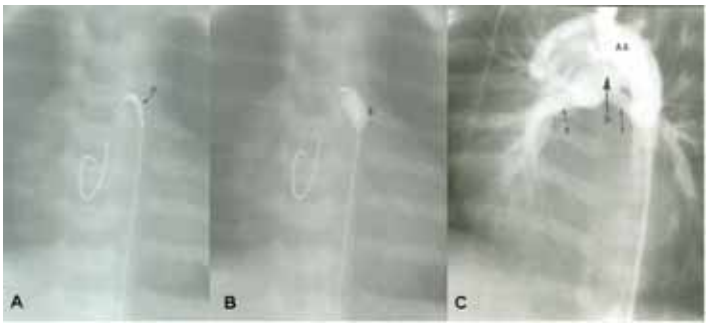

Figure 4. [A]. Selected cinefluorographic frames demonstrating the position of a guide wire which was advanced from the aorta into the right ventricle via the ductus arteriosus and the main pulmonary artery over which an uninflated stent/balloon assembly is deployed. The arrow marks the articulation within the stent. [B]. Note the position of the stent in the ductus while inflating the balloon. [C]. Aortic arch (AA) angiogram shows the stented ductus (St) and good opacification the right (R) and left (L) pulmonary arteries. The main pulmonary artery is not shown.

weight of the baby) coronary stent mounted on a balloon is introduced through the 4-French sheath, over the guide wire, and positioned across the ductus arteriosus (Figure 4A) and the balloon is inflated (Figure 4B), thus implanting the stent into the ductus. The length of the stent should be 1 to 2 mm longer than the measured length of the ductus. A variety of stents have been used in the past and include Palmaz-Schatz articulated (Johnson & Johnson, Warren, NJ), Jostent (JoMed, Ramendingen, Germany), Express (Boston Scientific, Maple Grove, Minnesota), Multi-link Tetra/Penta (Guidant, Santa Clara, California), Cordis JJ (Cordis Europa, Roden, The Netherlands), Medtronic AVE (Medtronic Inc., Minneapolis, MN), liberté (Boston Scientific), Driver (Medtronic), Tsunami (Terumo), NIR coronary (Medinol/SciMed Life, Maple Grove, MN), Coroflex (B Braun Medical, Emmenbruche, Switzerland), Tristar (Guidant, Santa Clara, California), and others depending upon the availability at that particular time at a given institution. Aortography following stent implantation (Figure 4C) is performed to demonstrate the patency of the stent and opacification of the main and both right and left pulmonary arteries. The arterial oxygen saturation is measured.

In nearly 10% of the patients the aortic origin of the ductus may be very proximal (from the undersurface of the aorta) and conventional retrograde trans-femoral arterial access may not be feasible. In such instances, the ductus may be cannulated via an anterograde transvenous route through the ventricular septal defect or via trans-carotid artery cut-down.

Results

Gibbs and associates [54] were the first to report placement of ductal stents; they implanted ductal stents (Palmaz-Schatz) via axillary arteriotomy in two neonates with pulmonary atresia which resulted in improvement of systemic arterial oxygen saturation. Both infants, however, died suddenly within five weeks of stent placement, although the stented ducts were patent. They concluded that: (a) stenting of arterial duct is technically feasible, (b) stenting provides adequate palliation and this technique may prove to be a promising alternative to aorto-pulmonary shunt surgery. Despite initial enthusiasm [54,64], Gibbs et al [65] were discouraged with stenting be-

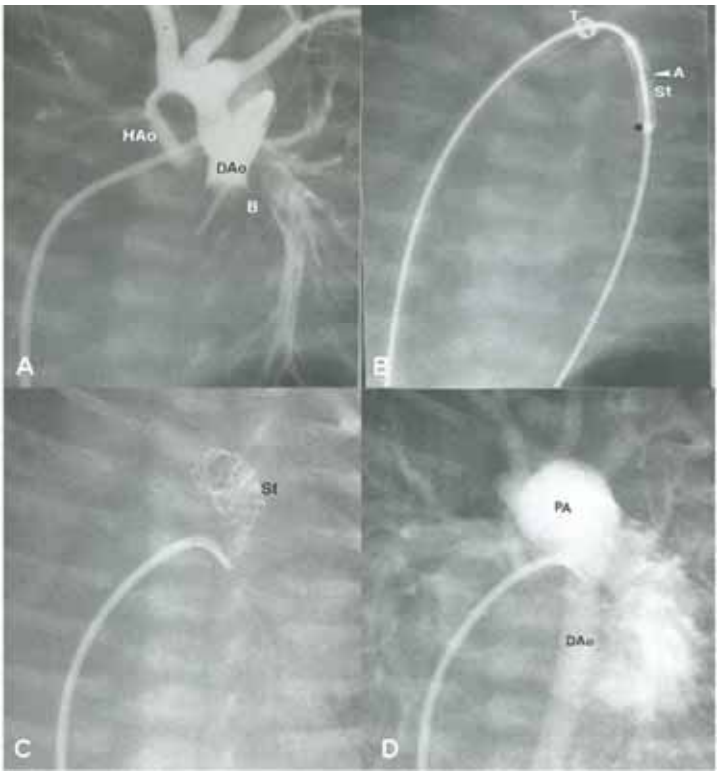

Figure 5. [A]. Selected frame of balloon (B) occlusion descending aortic (DAo) angiogram demonstrating good retrograde opacification of the aortic arch and brachiocephalic vessels and a hypoplastic ascending aorta (HAo). The ductus and left pulmonary artery are also seen, but not labeled. [B]. Selected cinefluorographic frame showing the position of the unexpanded stent (St) in the ductus. The articulation of the stent (A) and tip (T) of the delivery sheath are marked. [C]. The deployed stent (St) in the ductus after removal of the balloon is shown. The catheter is in the pulmonary artery. [D]. Pulmonary artery (PA) cineangiographic frame demonstrating opacification of the descending aorta (DAo) and branch pulmonary arteries. Retrograde opacification of the brachiocephalic vessels and a hypoplastic ascending aorta (not labeled) is also seen.

cause of intimal proliferation in the majority of patients, requiring re-intervention. A larger experience reported by Alwi et al [66] demonstrated feasibility, safety and effectiveness of ductal stents. They attempted stenting the ductus in 56 patients, aged 7 days to 2.8 years (30% were neonates) with successful implantation in 91% patients. Complications occurred in 3 (6%) patients. The oxygen saturation improved from 70 ± 14% to 91 ± 7%. At follow-up in 3 to 20 months (mean 10 months), the oxygen saturations remained improved and were 79 ± 5%. Additional interventions such as balloon dilatation of the stent, placement of an additional stent or Blalock-Taussig shunt were performed in 8 (16%) patients. Re-intervention-free rates were 89% and 55% at six and 12 months respectively. They conclude that stenting of the ductus is an attractive alternative to surgical aorto-pulmonary shunts in palliating infants with ductal dependant pulmonary circulation. They also suggested that ductal stenting should not be undertaken if left pulmonary artery stenosis is present.

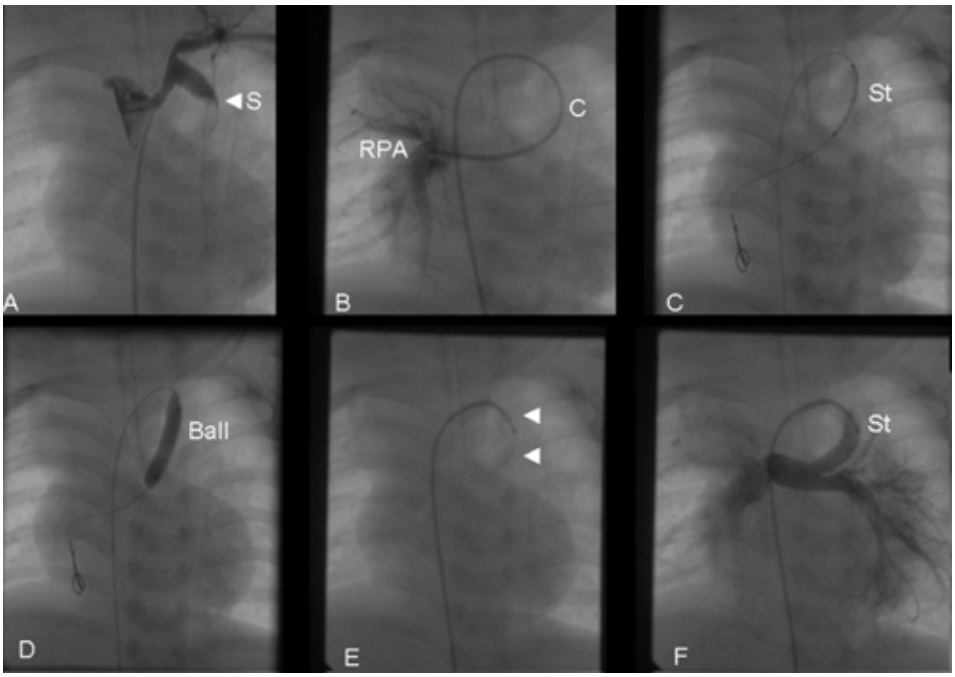

Figure 6. [A]. Selected cineangiographic frame from subclavian artery injection demonstrating stenotic and almost completely obstructed (arrowhead S) Blalock-Taussig shunt. [B]. A catheter (c) is positioned across the Blalock-Taussig shunt into the right pulmonary artery (RPA). [C]. A guide wire has been passed through Blalock-Taussig shunt and its tip positioned in the distal RPA over which a stent (unexpanded) is placed within the Blalock-Taussig shunt. [D]. Same as C except that the stent-coved balloon is expanded. [E]. The balloon is removed showing the deployed stent (arrow heads). [F]. Post-stent implantation angiogram showing the well opacified, widely open stent (St) in the Blalock-Taussig shunt with subsequent opacification of the branch pulmonary arteries.

Comments

Based on our experience and that of others [8,54-57,66] ductal implantation of stent is a technically demanding but a feasible procedure. Inability to cannulate the ductus and constriction of the ductus [64,66], the latter being potentially fatal, may occur. It is important to stent the entire length of the ductus [8,64,66] lest constriction of the unstented ductus may occur later, requiring a repeat procedure. In neonates, the stent should not be expanded to more than 4 mm diameter; larger diameter stents may produce heart failure [18]. The availability of more flexible stents on smaller delivery catheters and recognition that selected use in situations where progressive closure of the stented ductus over a period of months may indeed be beneficial, could rejuvenate the use of ductal stents in the future.

Left Heart Obstruction

The stent implantation procedure is performed anterogradely from the femoral venous route (Figure 5) or via a pulmonary artery purse-string suture during hybrid procedures. It is important to define the ductal anatomy [67] and to cover the entire length of the ductus. Stent diameter is 6 to 10 mm, much larger that that used for pulmonary oligemia patients. Both balloon expandable and self-expandable stents have been used. In most reported studies, palliation is deemed to have been achieved, but the experience is limited. Further studies and experience is required before general use.

Other Uses of Ductal Stents

In addition to the above two groups, ductal stents have also been successfully used to treat pulmonary oligemia secondary to right ventricular outflow tract rhabdomyoma [68] and to retrain the left ventricle in transposition of the great arteries with intact ventricular septum [69].

Aortic Coarctation

Neonates with severe aortic coarctation causing congestive heart failure are candidates for intervention. Surgical intervention has been the main approach to treat these babies. More recently, balloon angioplasty techniques have been utilized in the management of aortic coarctation. Because of the high rate of recurrence seen in neonates [2,70-73], balloon angioplasty in neonates and young infants is reserved for critically ill babies, particularly in those in whom avoidance of anesthesia or aortic cross-clamping required for surgery is beneficial in the overall management [2,74]. To address this issue some cardiologists have used stents [75-78]. Unfortunately, as previously mentioned, the stents, which are metallic, do not grow with the child, and therefore, could not routinely be used in neonates and infants. Biodegradable stents [79,80] may offer a solution; the stents will keep the coarcted aortic segment open for a 3 to 6 month period, when the stents would dissolve. Further experience with this methodology is necessary before the adoption of this mode of treatment.

Branch Pulmonary Artery Stenosis

Stenotic branch pulmonary arteries may sometimes pose problems; these are particularly important in patients destined for a Fontan-type of repair. Near-normal sized pulmonary arteries are mandatory for successful completion of Fontan. Rehabilitating the pulmonary arteries may be under-

taken with balloon angioplasty, but, because of lack of uniform response to this mode of treatment, stents have been considered. Again, the growth problems, alluded to in the preceding section, exist. Biodegradable stents or stents that can be expanded to near adult size [81,82] may circumvent this problem. Further studies are awaited to determine the optimum method of management.

Miscellaneous Uses

In some patients with tetralogy of Fallot and MAPCVS, pulmonary oligemia may be relieved by stenting the collateral vessel [83] while awaiting more definitive palliation. Following surgical palliation of pulmonary oligemia with Blalock-Taussig shunts or single ventricle Norwood palliation with Blalock-Taussig or Sano shunts, stenosis may develop at the anastamotic sites or within the connecting Gore-Tex graft, causing hypoxemia. Placement of stents to enlarge the obstructed shunts is feasible and has generally resulted in good outcome [84-88]. An example from our experience is shown in Figure 6. Temporary relief of pulmonary venous obstruction may also be achieved by implantation of stent in the obstructed vertical vein [89].

SUMMARY AND CONCLUSIONS

In this and the previous [1,2] reviews, various transcatheter methodologies available for management of neonates with congenital heart disease have been enumerated and include atrial septostomy procedures, balloon dilatation of stenotic valve or vessel, perforation of atretic pulmonary valve, occlusion of defects or vessels causing cardiac failure and stents to keep open closing fetal circulatory pathways and vascular stenotic lesions. These procedures should complement other medical therapies and surgical interventions. In a given patient, the method selected should be a method that is most likely to provide the best outcome.

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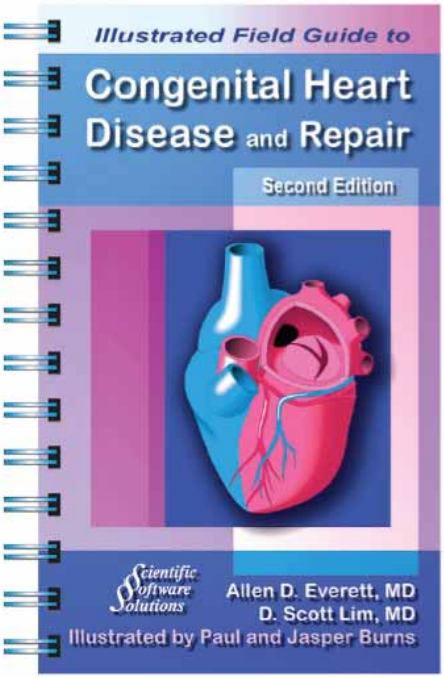
Book Review: Illustrated Field Guide to Congenital Heart Disease and Repair, 2nd Edition

By Alan R. Spitzer, MD



The Illustrated Field Guide to Congenital Heart Disease and Repair, 2nd Edition, edited by Allen Everett, MD and Scott Lim, MD. Illustrated by Paul and Jasper Burns. www.pedheart.com/guide.php

For the practicing neonatologist, few problems are as thorny as trying to explain congenital heart malformations to residents, fellows, nurses, and most especially, families of affected infants. If you are like me, "artistic" renditions of cardiac anomalies on a scrap of paper in the NICU often leave a great deal to be desired. In addition, the subtleties of electro- and echocardiography, common interventions in the cardiac cath lab, and the ever-increasing nuances of surgical repairs of congenital cardiac disease are often difficult to understand and explain. Fortunately, a superb little book has come along that deals with these issues better than anything else that I have ever encountered.

The Illustrated Field Guide to Congenital Heart Disease and Repair, 2nd Edition, edited by Allen Everett and Scott Lim fills these gaps in wonderfully, and more importantly to the busy clinician, most succinctly. This book opens with a concise description of normal cardiac anatomy in the fetus and neonate, accompanied by illustrations by Paul and Jasper Burns that are simply superb. The next chapter, on Congenital Heart Defects, offers an excellent series of descriptions of the most common congenital heart problems, again with Burns' illustrations. These pages provide precise descriptions of the abnormal anatomy, the resulting pathophysiology, and the suggested treatment that are clear and precise. Having these illustrations available for teaching purposes or for parent explanations is strongly suggested, as I have never seen clearer depictions of what has gone wrong anatomically and what subsequently results in the neonate.

Chapters on echocardiography, cath lab procedures, congenital heart surgical approaches, cardiac ICU issues, electrophysiology, and common cardiac drugs complete the list of sections of the book. I especially found the chapters on echocardiography, written by Howard Gutsegell, and the one on cardiac surgical repair, authored by Benjamin Peeler and Luca Vricella, to be especially valuable. The myriad methods of surgical intervention have never been more clearly presented than they are in this text, both from the perspective of indications and the resulting post-operative cardiac anatomy. One of the niceties of this chapter is the inclusion of some of the historical repairs that are rarely used today (e.g., Mustard procedure), but have enormous historical importance in the history of cardiac surgery. One suggestion that I would offer for the chapter on electrophysiology is to have the treatment approaches outlined on the same page as the common rhythm disturbances that one encounters in the NICU or in the post-op cardiac surgical patient. This chapter, however, is still a terrific review of the common abnormalities of heart rate and rhythm that are seen in the NICU.

In summary, this is just a terrific book for anyone who treats infants with congenital heart disease. I would strongly urge every neonatal intensive care unit to have a copy handy, both for the purpose of assisting with diagnosis as well as for the demonstration of abnormal anatomy and physiology. I only wish that it had been around earlier in my career so that residents, fellows, and parents would not have had to suffer through so many of my "artistic" renditions of the abnormal heart.

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Commentary: Physicians Slow in Adopting Expensive and Inefficient EMRs

By Matthias Muenzer, MD

The following commentary was originally published on Dr. Muenzer's blog, "A Physician on Job Search and Practice - What I Wish I had Known as a Student." http://obgyntips.blogspot.com/

The original posting may be found at: http://obgyntips.blogspot.com/2007/07/it-seems-to-be-fashionable-to-complain.html

It seems to be fashionable to complain about doctors and present them as old fashioned and technophobic. Here we have Scott MacStravic ("Low Adoption of Electronic Medical Records:Hidden Reasons?" www.worldhealthcareblog.org/wondering why on earth physicians seem to have difficulties transitioning to electronic medical records. Wise and heavy words are being used, concerns are expressed, motives speculated. Academic reasons are considered. Oh, my, oh my. We physicians are the same as everybody else. We are just a little more independent and demanding. We want things to be done quickly and easily. If you present to us something that is easy, we'll do it. Scott MacStravic writes about "The hidden reasons"... Scott, you know what, do us all a favor, use those things for a few days and the reasons will no longer be "hidden."

Why are we not running to adopt EMRs? We all have seen the websites where doctors ask for help in deciding which EMR will be the least damaging to their practice and their pocket book! We are not rushing to buy them, because most EMRs today are clumsy, klutzy, slow and expensive systems. None of these software people has had the smarts to start with the consumer. Nobody has studied what physicians do in everyday practice, how exactly they do it, studied it down to the smallest detail, studied the exact work and documentation process. That is what they should do, and then, please take that process and take all, but all of the routine work out of it, leave only the "presidential decider" part in, throw in a little help in the deciding department too, give the system some AI (Artificial Intelligence), make it adaptable, so that we can have it "our way" - like Burger King. Then make it smart, build in "favorites" everywhere, make the system able to learn our specific style, our specific preferences in diagnoses, billing codes etc. Make it able to link to literally everything and put it on a graphical surface, maybe one that you can also click on with your finger or your regular pen or with one of those fancy computer pens. And you will have a system would sell like the proverbial hot cakes.

Look at what we have in reality? We have overpriced systems that look more like Windows 3.1! Programmers, have you ever heard of MAC or have you seen Vista? Have you ever been to Yahoo.com? Have you thought about "ease of navigation?" I doubt it.

The EMR system my health care system has presented me is a prime example of a clunker. The core was programmed 20 years ago, and you see it and feel it. History and tradition are a good thing, but not in software. It is so old fashioned, you see the Windows 3.1 still peeking through the creaks. It is crystal clear that it is a patchwork of not very well integrated components. It is embarrassing. Amount of work that has gone into investigating consumer needs and making it easier to use: Minimal. Price: Maximal.

> ***"It seems to be fashionable to complain about doctors and present them as old fashioned and technophobic."***

And, talking about money, the clumsy "Centricity" that I am using has a completely separate billing component. The billing component knows nothing about what goes on in the EMR. This is the biggest stupidity I have ever seen. Billing should be done fully by the software based on the documentation. And should you fail to immediately understand this, you do not belong here in this discussion. We document what we do, and we bill according to what we do. Billing is 100% dependent on what we do, straightforward. So simple, a caveman could do it. And the famous software package Centricity of the famous American company GE should be able to do it too. It should be designed to do it in the first place. It should not even be separate from the documentation part, it should be a completely integrated part of documentation.

With all due respect, Scott is not a physician and has never used an EMR in daily life. I just finished implementing an EMR in my practice. As a hospital employed physician I did not have to buy the system, I just received the hardware and software and started using it. I am a computer enthusiast. And I was very, very disappointed by the EMR (Centricity from

GE). It slows me down, it drains my productivity, it makes simple tasks complicated, every little thing takes clicks and click and clicks and more clicks and then some more clicks. It does not provide good access to data, it does not give me the same quick overview of a patient that I had in my paper chart. upon opening my paper chart I had the "summary," a kind of history of the patient with some personalizing remarks and notes and reminders - all on the left side. One glance and I remembered the patient and knew what was going on. My EMR does not allow that, it only gives me the stupid ICD 9 codes, uncoded comments, notes and remarks are "forbidden." When I protested about the lack in functionality I heard the sadistic comment "We try to keep the system standardized." Hey, that works in big corporations, not in private practice. Another one is "We have to do this for patient safety" of "it is a HIPPA requirement." Patient safety is such a fabulously chic buzzword at the moment. But it is a very bad excuse for a clumsy, klutzy system that makes you confirm and confirm and confirm again the most simple steps!

I drive a Volvo for security, and it drives as well or better as any other car. Security happens behind the scene. My Volvo does not force me to stop every 100 feet to look around, and it does not limit my speed to 25 mph in the name of safety. My car does not force me to stop before making a right turn, and confirm that I really plan to make a right turn and so on.

Everybody out there, please understand. The sole idea of software is efficiency and ease of use.

The idea is the “Three Click Visit.” First click to confirm the history entered by the patient or the nurse, second confirming the template that the system chooses for you and third confirming the prescriptions that will be faxed to the pharmacy, the education leaflet printed for the patient and the automatic letter being faxed to the PCP. That would be a system everybody runs to adopt. Please do not try to find contorted far-fetched theoretical reasons for "lack of adoption."

It is the ease-of-use and the cost. And that, my dear concerned observers, is the reason that physicians are slow in adopting EMRs! EMRs on the market today are complicated, user-unfriendly, inflexible and expensive. What a winning combination! We can't wait to buy one of those systems. Did I mention that they drain productivity, but we get paid less instead of more? Physicians are just a tougher clientele. We are not employees in a big corporation where you can simply slap a computer on each desk and say: *put up with it or leave*. We actually (still) have the freedom to choose (still). We would love to have EMRs, but we are not going to put up with crappy ones. So, make some good ones, and keep the price down. Is that so hard to understand? If Yahoo was as difficult and clumsy to use as my EMR, it would already have vanished from the net.

Can someone please design a system with a surface like Vista or Mac OS, a system that is built after careful user studies and user analysis, after studying what physicians do all the time, systems that physicians can adapt and mold exactly to the way *they* want.

And then make those systems cheaper. Forget the abusive purchase prices and the high maintenance costs. Doctors are not rich anymore!

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