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Role of Interventional Cardiology in Neonates – Part I - Non-Surgical Atrial Septostomy

By P. Syamasundar Rao, MD

"Role of Interventional Cardiology in Neonates – Part I" is the first in a series of three articles by P. Syamasundar Rao, MD, Professor of Pediatrics and Medicine; Director, Division of Pediatric Cardiology; University of Texas-Houston Medical School. The second and third articles will appear in future issues.

INTRODUCTION

Whereas the seeds of interventional pediatric cardiology were planted in the 1950s by Rubio-Alvarez and Limon-Lason by their work on transcatheter pulmonary and tricuspid valvotomy [1,2], by Dotter and Jedkins in the early 1960s by their gradational vascular dilatation techniques [3], by Rashkind in the mid-1960s by introduction of balloon atrial septostomy[4], by Porstmann in late 1960s by percutaneous closure of patent ductus arteriosus[5,6], and by King and Mills in mid-1970s by non-operative closure of atrial septal defects [7,8], it is not until Kan and her associates [9] adapted Gruntzig's technique [10] of balloon angioplasty with double-lumen balloon catheter for pediatric use in early the 1980s did transcatheter therapy in children become a reality [11-15]. These techniques were extended slowly but surely to treat neonates with congenital heart defects [16-20]. In this review, various catheter interventional techniques (Table I) that are currently being used in neonates will be discussed; in Part I, Non-surgical atrial septostomy will be reviewed, and the remaining items listed in Table I will be dealt with in subsequent issues of this publication.

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

In 1966, Rashkind and Miller [4] described a technique, now called Rashkind balloon atrial septostomy, which was extensively used to improve atrial mixing in neonates with transposition of the great arteries. It was subsequently applied to many other disease entities in which enlarging the atrial defect is beneficial [21]. In mid to late 1970s, Park and his associates extended the utility of balloon septostomy by introducing blade atrial septostomy to enlarge defects with

Table II. Septostomy Procedures

- Rashkind balloon atrial septostomy
- Blade atrial septostomy
- Balloon angioplasty
- Atrial septal perforation
- Stent implantation

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thick atrial septae [22]. A built-in retractable blade (knife) cuts the lower margin of the patent foramen ovale (PFO) which is followed by balloon atrial septostomy. More recently, balloon angioplasty [21,23,24], stents [25,26], Ross transseptal puncture [27], radiofrequency ablation [28-30] and cutting balloons [30] were applied to create and/or enlarge the atrial defects.

Cardiac defects in which atrial septostomy is likely to be useful will be reviewed followed by a description of septostomy procedures.

SEPTOSTOMY PROCEDURES

Various septostomy procedures that are currently used will be discussed hereunder.

TRANSPOSITION OF THE GREAT ARTERIES

In transposition of the great arteries (TGA), the aorta arises from the right ventricle and the pulmonary artery from the left ventricle. Consequently, the systemic venous return is pumped back into the body and the pulmonary venous return is ejected back into the lungs. Instead of having a normal in-series circulation, the TGA patients have parallel circulation. Without either an intra-cardiac or extra-cardiac shunt, the infants with TGA will not survive. The fetal circulatory pathways {PFO and patent ductus arteriosus (PDA)} will initially provide some mixing. In most neonates with TGA, the PFO and PDA tend to undergo spontaneous closure, resulting in a severely cyanotic infant. Rashkind balloon atrial septostomy has been extensively used in the palliation of the neonate with complete TGA. The improved mixing at the atrial level allows the neonate with transposition to grow up to an age (usually 3 to 6 months) at which time a venous switch (Mustard or Senning) procedure could safely be performed. With the introduction of arterial switch (Jatene) procedure which is usually performed at approximately one week of age, balloon atrial septostomy is not necessary in all babies. If naturally present PFO and/or Prostaglandin E1 (PGE1) infusion do not result in reasonably good oxygen saturations (60 to 70% without metabolic acidosis), balloon atrial septostomy should be performed, preparatory to arterial switch procedure.

TRICUSPID ATRESIA

Tricuspid atresia may be defined as congenital absence or agenesis of the morphologic tricuspid valve [31,32]. In tricuspid atresia an obligatory right-to-left shunt occurs at the atrial level. Usually, this shunting is through a PFO. Because of the obligatory nature of the shunt, this fetal pathway persists in the postnatal period; this is in part related to low left atrial pressure. But, the entire systemic venous return must pass through the patent foramen ovale. Therefore, interatrial obstruction is anticipated, but very few patients with tricuspid atresia have clinically significant obstruction [33]. The right-to-left shunt occurs in late atrial diastole with augmentation during atrial systole ('a' wave [34,35]. A mean interatrial pressure difference greater than 5 mm Hg with very prominent 'a' waves (15 to 20 mm Hg) in the right atrium is generally considered to represent obstructed interatrial septum [33,36]. Balloon atrial septostomy [37], if unsuccessful, blade atrial septostomy [22,38], and rarely surgical atrial septostomy, may be necessary to relieve the obstruction. Significant interatrial obstruction requiring atrial septostomy in the neonate is rare and unusual although this can be a significant problem later in infancy [36,39].

PULMONARY ATRESIA WITH INTACT VENTRICULAR SEPTUM

Pulmonary atresia with intact ventricular septum is a complex cyanotic congenital heart defect characterized by complete obstruction of the pulmonary valve, two distinct ventricles, a patent tricuspid valve and no ventricular septal defect. The right ventricle is usually, but not invariably, small and hypoplastic. Because of atretic pulmonary valve, there is no forward flow from the right ventricle and the blood regurgitates back into the right atrium. Therefore, an obligatory right-to-left shunt occurs across the atrial septum. The objectives of any treatment plan are to achieve a four-chamber, bi-ventricular, completely separated circulation [40-43]. This aim may be achieved only in the absence of: a) right ventricular dependent coronary circulation b) severe right ventricular hypoplasia, and c) infundibular atresia. In the subgroup of neonates with unipartite or extremely small right ventricle with infundibular atresia and/or right ventricular dependent coronary circulation, a modified Blalock-Taussig shunt to provide pulmonary blood flow and atrial septostomy to decompress the right atrium should be performed. The usefulness of atrial septostomy in improving outcomes of systemic-to-pulmonary artery shunts in pulmonary atresia patients is demonstrated in early studies [44]. Balloon atrial septostomy, if unsuccessful blade atrial septostomy, and rarely surgical atrial septostomy, as described in tricuspid atresia section, may be necessary to promote egress of right atrial blood. However, it should be noted that no atrial septostomy should be undertaken in patients in whom transcatheter or surgical opening of the atretic pulmonary valve is contemplated; the objective in this scenario is to encourage anterograde pulmonary flow across the opened pulmonary valve.

HYPOPLASTIC LEFT HEART SYNDROME

In hypoplastic left heart syndrome (HLHS), there is hypoplasia of the left heart structures. Similar to other congenital heart defects, HLHS also shows a spectrum of severity. In the most severe form, aortic and mitral valves are atretic with a diminutive ascending aorta and markedly hypoplastic left ventricle [45,46]. The left atrium is usually smaller than normal. Because of obstruction at the mitral valve, pulmonary venous blood must cross the atrial septum via a PFO and mix with desaturated systemic venous blood in the right atrium. In some patients the PFO may be restrictive and occasionally the atrial septum may be intact. In the neonate, obstruction at the level of the PFO may be treated with conventional Rashkind balloon atrial septostomy [4]. However, since the left atrium is small, Rashkind septostomy may not be feasible. In addition, the septum may be too thick to be torn by balloon septostomy; therefore, Park blade septostomy [22] has been considered. But again, because of left atrial hypoplasia, blade septostomy may not be feasible. Static dilatation of the atrial septum [21,23,24] with a balloon angioplasty catheter may be used which may not only relieve the obstruction, but also keep some restriction such that there is no rapid fall in the pulmonary vascular resistance. Static balloon dilatation is preferred by the author. In some patients the atrial septum may be intact or have a tight patent foramen ovale which may not even allow passage of a catheter. In such situations, puncture of the atrial septum by Ross technique [27] or radiofrequency perforation of the atrial septum [28-30] followed by static balloon atrial septal dilatation [21,23,24] or stent implantation [25,26] may become necessary.

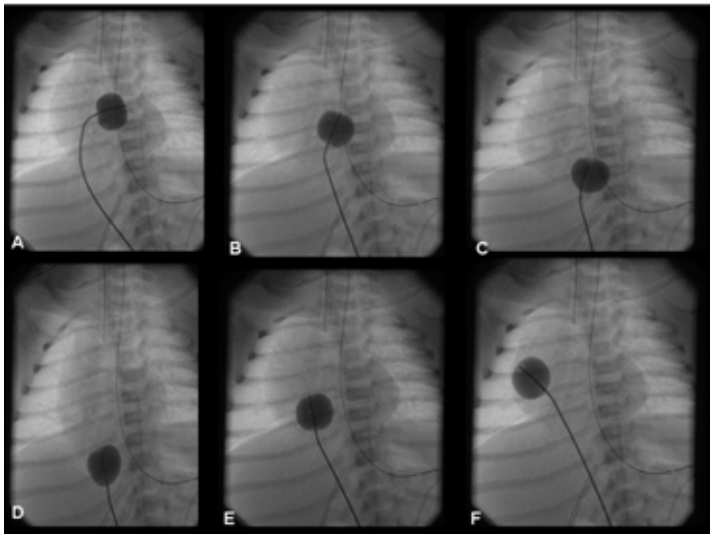

Figure 1. Selected cinfluroscopic frames of the Rashkind's balloon septostomy procedure. Note the position of the inflated balloon in the left atrium (A) and in right atrium and inferior vena cava in successive frames, as it is rapidly and forcefully withdrawn across the atrial septum (B,C, & D). After it reaches the inferior vena cava (D), it is rapidly advanced into the right atrium (E & F) in order not to inadvertently occlude the inferior vena cava in case of failure to deflate the balloon (which is quite rare).

MITRAL ATRESIA

The considerations for mitral atresia are similar to those described for HLHS and the utility of balloon septostomy in this group of patients has been well documented [47,48].

TOTAL ANOMALOUS PULMONARY VENOUS CONNECTION

In this entity, all the pulmonary veins drain into systemic veins, most commonly they drain into a common pulmonary vein which is then connected to left innominate vein, superior vena cava, coronary sinus, portal vein or other rare sites. Occasionally individual veins drain directly into the right atrium. Irrespective of the type, all pulmonary venous blood eventually gets back into right atrium, mixes with systemic venous return and gets redistributed to the systemic and pulmonary circulations. The systemic flow is through the PFO. Consequently, restrictive PFO will cause decreased systemic perfusion and may indirectly result in pulmonary venous obstruction. In the neonate, the most common form is obstructive infra-diaphragmatic type causing severe pulmonary venous obstruction because the pulmonary venous return has to go through hepatic circulation. Occasionally, however, cardiac and supracardiac types may have restrictive PFO and in such patients balloon atrial septostomy is beneficial [49].

Rashkind Balloon Atrial Septostomy

In TGA patients who are stable, the usual hemodynamic data including cine-angiography, as needed, are performed. If the infant is unstable or has extremely low oxygen saturations, one may proceed directly with balloon septostomy. In such situations, aortic saturation and pressure pullback across the atria and echocardiographic size of atrial defect are recorded. The balloon septostomy procedure involves inserting a balloon septostomy catheter, usually via a sheath percutaneously placed in the femoral vein, into the left atrium via the PFO. The balloon is inflated with diluted contrast material to a sub-maximal amount (usually 3 ml) and rapidly pulled back across the atrial septum (Figure 1) after ensuring that the catheter tip is located in the left atrium either by lateral fluoroscopy or by echocardiography. Once the catheter is pulled back to the inferior vena cava, the catheter should be rapidly advanced into the right atrium; all this is done as a single motion. The balloon should be deflated as the catheter is repositioned into the right atrium. This jerking motion of the contrast filled balloon catheter produces a tear in the lower margin of the PFO (septum primum) which is very thin and frail in the newborn. We usually perform one additional septostomy following what may be considered good septostomy.

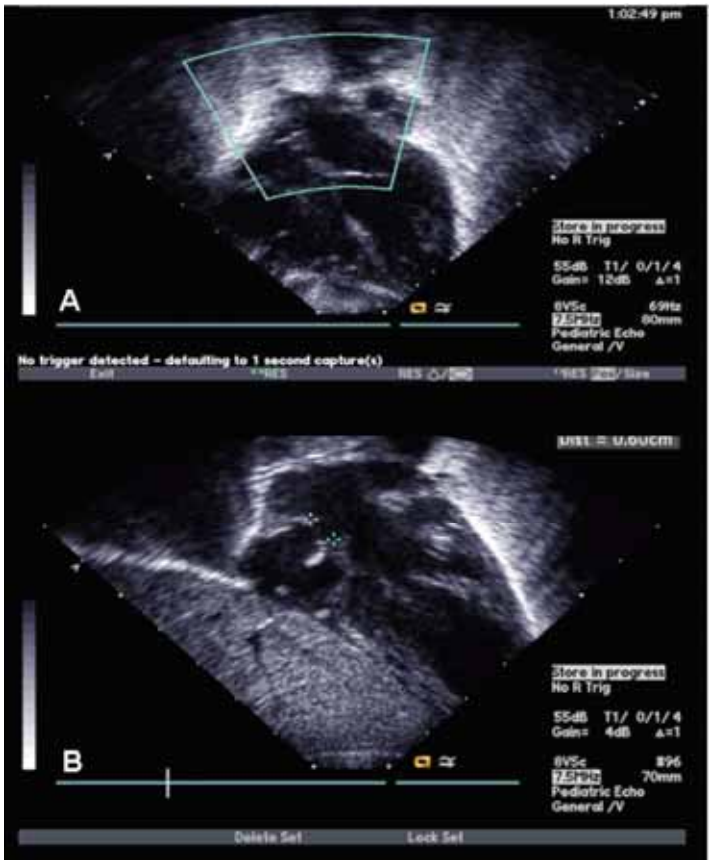

Figure 2. Selected video frames showing a very small inter-atrial opening (A) which became larger (B) following balloon atrial septostomy.

Increase in systemic arterial oxygen saturation, disappearance of pressure gradient across the atrial septum and echographic increase in the size of the atrial defect (Figure 2) with non-restrictive Doppler flow across the atrial septum (Figure 3) are demonstrated in successful procedures. In patients in whom atrial septostomy is performed to relieve interatrial obstruction, trans-atrial pressure gradient is reduced or abolished. Some cardiologists balloon-size the atrial defect both prior to and following balloon septostomy and this is another method of assessment of result of the septostomy.

Figure 3. Selected video frames showing a very small color flow jet across the inter-atrial opening (A) which became larger (B) following balloon atrial septostomy.

In the initial description of balloon septostomy by Rashkind [4], the catheter was introduced into the femoral vein by cut-down. To avoid femoral venous cut-down, insertion of the catheter and performance of balloon septostomy via the umbilical vein [50] has been advocated. When percutaneous technology became available, the balloon catheter was introduced via an appropriate sized percutaneously inserted femoral venous sheaths [51,52].

Our first choice is to perform balloon septostomy via the umbilical venous route. Therefore, we encourage our neonatology colleagues to place an umbilical venous line early on, with its tip well into the right atrium, before the ductus venosus constricts. At the time of septostomy, this line is exchanged over a wire with an appropriate-sized sheath.

The feasibility of performing balloon septostomy bedside, under echo guidance, has been demonstrated [53,54]. But, most cardiologists perform the procedure in the catheterization laboratory which is preferred.

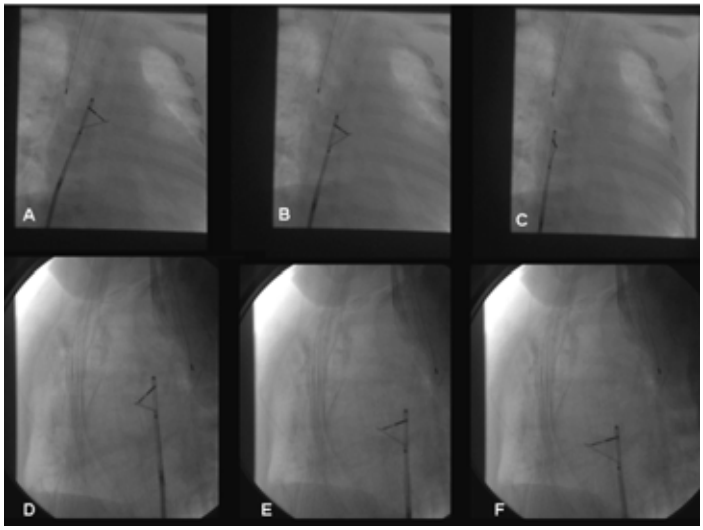

Figure 4. Selected cinfluroscopic frames of the blade septostomy procedure. The top three figures (A,B & C) show the position of the catheter with the blade open in the posterior-anterior projection while bottom three (D,E & F) show the lateral view. Note the position of the blade pointing to left and anteriorly. This procedure is performed by slow withdrawal of the blade catheter in contradistinction to very rapid pullback in the Rashkind's balloon septostomy procedure.

Initially, Rashkind balloon septostomy catheters (USCI, Boston, MA) were used. Because the catheters were straight, sometimes making it difficult to advance the catheter into the left atrium, and because of the limited volume of fluid that these balloons would take, most cardiologists have switched to Edwards septostomy catheters (American Edwards Baxter, McGow Park, IL). These catheters have a gentle curve at the tip, facilitating easy access into the left atrium and larger volume of fluid could be injected into these balloons. More recently, atrioseptostomy catheters (B/Braun, Bethlehem, PA) have become available. There are no studies comparing the relative effectiveness of the available catheters and therefore, the selection of the type of catheter used is at the discretion of the operator.

Blade Atrial Septostomy

In older patients and in some conditions such as hypoplastic left heart syndrome, the lower margin of the PFO is thick and can't be ruptured by conventional balloon septostomy. The septostomy may simply stretch and not tear the lower margin of the PFO. Park and his associates [22] developed catheters with build-in blade (knife) (Cook Inc., Bloomington, IN) to address such thick atrial septae. Three blade sizes are commercially available. The

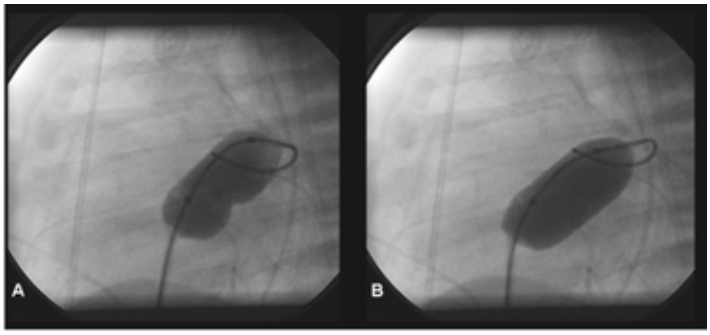

Figure 5. Selected cinfluroscopic frames of balloon angioplasty procedure (to enlarge the patent foramen ovale) demonstrating an inflated balloon in the lateral view showing waisting of the balloon (A) which was completely abolished following further inflation of (B) the balloon (B).

selected catheter (smallest size for the newborn) is positioned across the PFO, the position of the tip of the catheter is confirmed and the blade opened. While pointing the blade anteriorly and to the left (Figure 4), the catheter is slowly withdrawn (not a jerky motion as in balloon septostomy), thus cutting the lower margin of the PFO. This is repeated one or two more times, varying the angle slightly. This is followed by balloon septostomy. Evaluation of the results is similar to that described in the balloon septostomy section. Success rate ranged between 70 and 90% [55,56].

Balloon Angioplasty

Mitchell et al [57] and Sideris et al [58] performed static dilatation of the atrial septum successfully in animal models. The first clinical application was reported by Shrivastava and her colleagues. [23]. The procedure involves advancing either an end-hole or a multipurpose catheter from the right atrium to the left atrium across the PFO and from there into a left pulmonary vein (we prefer left lower). An exchange length, extra-stiff Amplatz guide wire is positioned in the pulmonary vein via the catheter and the catheter removed, leaving the guide wire in place. Selected balloon angioplasty catheter is advanced over the wire, positioned across the atrial septum and the balloon inflated to 3 to 5 atmospheres of pressure (Figure 5), taking care not to inadvertently dilate the pulmonary vein. The balloon inflation is repeated once or twice. The recommended duration of inflation is 5 seconds with a 5-minute interval in between each dilatation. Waisting of the balloon during the initial phases of balloon inflation and the disappearance of the waist indicates that the PFO is stretched beyond its initial size. Lack of waist in subsequent balloon inflations indicates that there is enlargement of the PFO. There are no data to indicate the most appropriate size of the balloon that should be used; 8 to 20 mm balloons have been used [21]. Based on theoretical considerations, the final diameter of the balloon should be three to four times the echographic size of the PFO is a good choice [21]. The balloon size should not exceed the size of the atrial septum. We usually end up with a balloon diameter of 14 to 15 mm. Evaluation of the results, again, is similar to that described in the balloon septostomy section. Increase in the size of the defect (similar to Figure 2) and in color Doppler flow width (Figure 6) demonstrates success of the procedure. There are only anecdotal reports of success, but no systematic studies to evaluate the results are published.

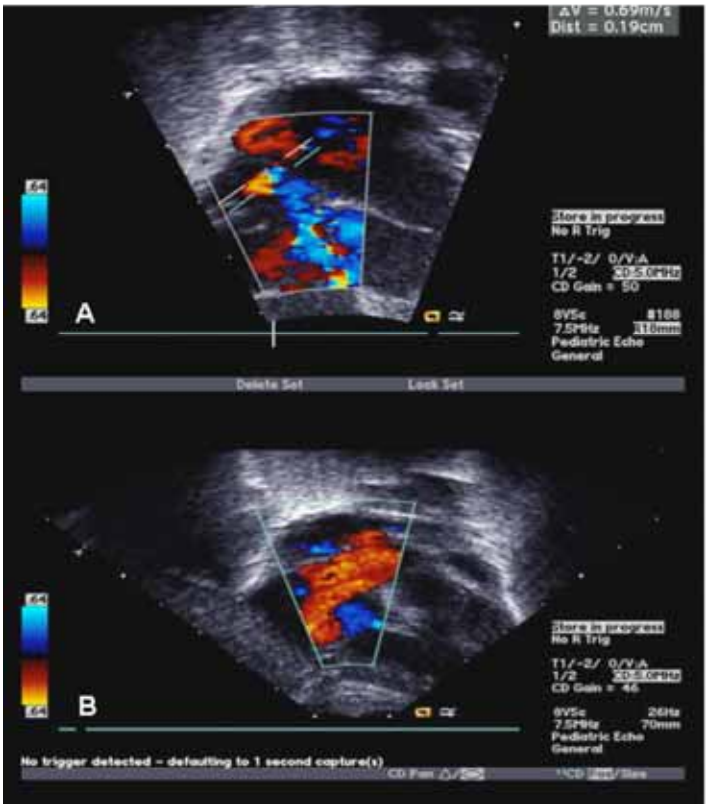

Figure 6. Selected video frames showing a very small color flow jet across the inter-atrial opening (A) which became larger (B) following balloon angioplasty of the atrial septum.

Atrial Septal Perforation

In a small percentage of patients, the atrial septum is intact (no PFO), particularly in HLHS. In such situations the septum can't be crossed with conventional catheters. Traversing the septum either by Ross/Brockenbrough's transseptal technique or radiofrequency perforation may be required.

Transseptal catheterization was initially described by Ross, Brockenbrough and their colleagues [59,60]. This was subsequently adapted to pediatric patients [61,62]. More recently, the technique was extended to neonates [27]. In the Ross technique, initially an end-hole or multipurpose catheter is advanced from the femoral vein into the superior vena cava through which a guide wire is introduced and the catheter removed. The transseptal sheath assembly (Cook, Bloomington, IN) is advanced over the wire and the wire removed. The tip of the transseptal catheter should be pointing posteriorly and to the left (medial) and slowly withdrawn under fluoroscopy in the lateral view. As the tip of the catheter enters the right atrium, it flips suddenly; at this point the position of the tip of the catheter against the atrial septum is confirmed by echocardiography, indenting the atrial septum. The needle of the transseptal assembly is gently advanced across the atrial septum; a slight "give" indicates entry into the left atrium. The cannula is advanced slightly and the needle removed and the pressure recorded, confirming the left atrial position. Once confirmed to be in the left atrium, the dilator and the sheath assembly is advanced into the left atrium and the dilator removed leaving the sheath in place.

In the radiofrequency (RF) perforation procedure, the technique is similar except that the RF wire is used instead of the needle. Once in the left atrium, static dilatation of the atrial septum as described in the preceding section or stent implantation (to be described in the next section) is performed.

Stent Implantation

Because of tendency for closure of dilated atrial septal openings, stents to keep the defects open may have to be used [25,26]. Stents should be implanted only across the highly restrictive PFO or after septal perforation by one the above described techniques. Initially the guide wire is positioned into the left lower pulmonary vein and an appropriately sized delivery sheath is positioned across the atrial septum. The stent-mounted balloon catheter (large coronary or small peripheral stent of approximately 10 to 15 mm length) is advanced over the wire, but within the sheath. Based on boney land marks the stent is positioned in such way that it is centered across the atrial septum. The delivery sheath is withdrawn into the right atrium while keeping the stent catheter in place. A combination of test injection via the side arm of the sheath and echocardiogram (trans-thoracic or transesophageal) is used to ensure correct position of the stent. The balloon is inflated at the manufacturer's stated pressure, thus expanding the stent. The balloon is deflated and removed, taking care not to dislodge the stent. This is followed by the removal of the guide wire. Recording of pressures across the atrial septum, via the stent, is not recommended to reduce the probability of stent dislodgement. Echo is used to record Doppler flow velocity across the stent. Low velocity flow indicates good result.

CONCLUSIONS

There are a number of cardiac defects in which an atrial septal defect is beneficial. But, the naturally occurring PFO undergoes spontaneous closure, causing poor mixing and/or obstruction to systemic or pulmonary venous flow. In such situations, the PFO may be enlarged or an atrial septal defect created by transcatheter methods. The selection of the method used is largely based on the atrial septal anatomy and left atrial size. In the vast majority of the patients, the septostomy procedures are successful in creating an appropriate sized opening. In the rare cases, surgical septostomy may be required.

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* J of Neuroimaging, Vol 14, No 4, Oct 2004.

Interview with Richard Van Praagh - Part 2: Family Life

By Bradley W. Robinson, MD

This is the last in a series of two articles drawn from an interview by Dr. Bradley W. Robinson with a pioneer in the field of pediatric cardiology, Richard Van Praagh. The first article "Academic Career," appeared in the October 2007 edition. It is available on the web in a PDF file.

Q: So you grew up in Toronto? Tell me about your family.

I was actually born in London, Ontario and moved to Toronto at the age of 2 with my family… and grew up in Toronto. I went to school there and went to … the University of Toronto.

My father was a stockbroker from London, England. His dad had a seat on the London Exchange and… my Dad came to Canada in 1920 and was doing very well as a stockbroker. Then 1929 came along, which was the great crash. I was born in 1930 and my brother Ian in 1931. Ian is also a physician. He is the sensible member of our family. He is an obstetrician-gynecologist in New York.

Well, in order to go to university, this is very likely to require a little bit of money, so we started working in the summertime. I started probably when I was 12, and … I started to work in Toronto's biggest cemetery, Mount Pleasant Cemetery, raking grass then cutting grass with a hand mower. We would walk, oh, 15-20 miles every day. It was hard work and these were early post Depression times. If you were caught talking on the crew, you would be fired immediately, for example. Then I got a power mower after that and then I became a gravedigger, which was when it was done by pick and shovel and not a backhoe digger the way it now is done. Then they decided that they were going to raise the pay of everybody in our cemetery except for high school kids like us.

So that's when I started working on construction. And again, it was a non-union crew and started often around 6-6:30 am in the morning and we worked until 8 or 9 pm at night doing pick and shovel labor building roads, bridges, dams, sewers. Then I became a dump truck driver and Ian was the roller operator. I also ran a small bulldozer, something called a front-end loader and this was right after the war. We got to know people from all over the world. I felt like Homer listening to the heroes come home from the war.

Q: What else did you do in the Summer?

Oh, we were able to make our fees, books, clothes, instruments a lot more and able to save money too doing this and for us it was an escape from the prison of privilege. We went to wonderful schools. We went to the Conservatory of Music. But we always worked incognito. Nobody ever knew we were medical students. We wanted to be treated just like everybody else, as we were, and English was seldom spoken on the crew. That's when Ian and I started to use our high school French. .

Q: So how did this help you in medicine?

Well, it was a real world experience out of a very privileged home, with excellent schools, the Conservatory of Music, and so on. The combination was the thing. A physician's job, as much as anything else is people, and this was a marvelous introduction to people from all over the world. For example, we had people on our crew who fought on both sides at Stalingrad.

Q: I understand you sold brushes?

I became a Fuller Brush man selling Fuller brushes door to door and I became the Canadian champion at selling Fuller brushes. My stakes were probably quite a bit higher than most other peoples' were, but this was all business. You know, you did your own sales. You handled your own complaints. You did your own deliveries. I would find myself telling people, "No, no, don't buy this. Get this. It's cheaper, and it is better," you know?

Q: Did you show an interest in science in undergrad and college?

Yes, I have always loved science…[and] people. Our neighbor said, "Dick, it is no surprise that you went into pediatrics. Chil-

dren and dogs all love you." Oh I love all kinds of sports too such as skiing and swimming and sailing. I used to be a member of the baseball team. I got a broken thumb, and as a result, it was a bad catch.

Q: How did you get interested in medicine?

My great-grandfather was a speech therapist. He was the Dutchman. His name was Willem, which is William, and Willem van Praagh was the person who introduced the system of teaching the congenitally deaf, and consequently dumb, how to speak by lip reading and vibrations, rather than by signing. In other words, how to do what Helen Keller did. This was known as the Continental Method. He wasn't a physician. He was a speech therapist who came to Britain and came to know the royal family quite well because they had a terrible problem with speech impediments, which has run in their family. For example, George VI, King George VI, during World War II, would make broadcasts to the Empire, to the world, etc., and his stuttering was so bad that it was really painful to listen to.

My grandfather and father were both stockbrokers. Then after 1929, my dear father went into the car business. He was the best Chrysler products salesman in Canada for years and years and years. He was a wonderful salesman who had renounced stocks and bonds for the reasons I mentioned. I wanted to do the best thing that I possibly could do with my life. So at late 14 or thereabouts, I came home and announced to my parents that I was going to become a minister, an Anglican minister, church of England. My dear mom, who was a Scottish Canadian, born a Presbyterian, said, "Well now, Richard, that's very interesting. But don't you think it might be a good idea, before you make a final decision, to go to university, study a little philosophy, a little history, a little comparative religion, and then make up your mind." So I did that, and then I finally decided that I would go in to medicine, in which I would be able to minister to the body as well as the soul. And here I am now, a cheerful agnostic and terribly pleased because of what my dear mother ever so gently and perceptively suggested to me.

Q: So by taking those different courses in the university, you developed an interest in medicine?

Oh, in our family, we had always regarded medicine as the noblest of the professions, the finest thing that one could do was the feeling. You know that one of the tragedies in life is that you have to make decisions - I decided to apply to medical school. Amazingly, in retrospect, I only applied to the University of Toronto, not to any other medical school. If I hadn't been accepted, I don't know what I would have done.

Q: What did your mother do?

Well, she was the second university graduate in her family. She graduated in 1924 from University College at the University of Toronto in liberal arts and then she taught French and art in St. Catherine's for about two years before getting married to this entrancing Englishman.

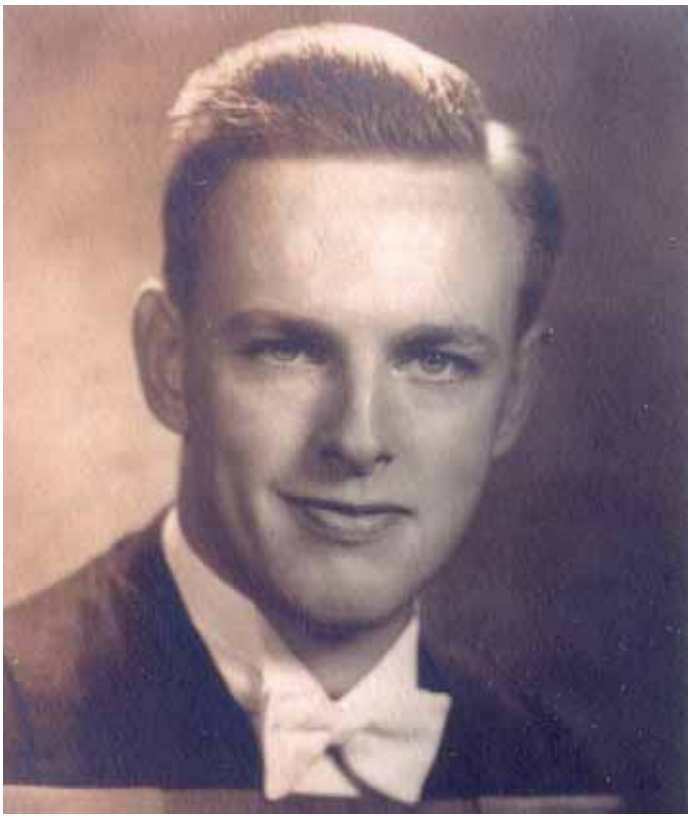
My mom had me singing French songs before I went to kindergarten. She was charming, highly educated, sophisticated…one of our very best friends, to my brother Ian and me.

Q: Where did your parents get married and why did they move to Toronto?

They got married in St. Catherine's and then lived in London, Ontario for a while, and then moved to Toronto in 1932 when I was two. Even at that time, it was obvious that Toronto was going to become the economic capitol of Canada, which it now is, with all due respect to Montreal, which is still a marvelous place, but Toronto is now economically preeminent in Canada.

Q: What were your favorite extracurricular activities?

Oh gosh, I was on the gym team for example. Gymnastics. I think my height of gymnastic accomplishments was doing a front flip, a running front flip, which I thought was pretty interesting. Of course it is fairly rudimentary for real gymnasts, which I never was. This was in high school. Scouting was fun, particularly the camping bit. I love camping and canoeing,



canoe tripping. I love anything that has to do with the out-of-doors. I love skiing. My parents had the strange idea that I shouldn't play football, which I would have loved to do, because they thought I should be careful not to hurt my hands if I was thinking about going into medicine. I used to play the piano but I am rusty now.

Q: What would you discuss at the dinner table?

Everything and anything. We were intensely interested in international affairs. Well, you know that World War II really began in 1939, not in 1941 as many of my friends here think. We were listening to the declaration of war over the radio and my brother Ian and I were very excited. We thought it was just wonderful. But I'll never forget looking into my dad's face and he looked so incredibly sad because, as a native Englishman, he understood what this meant, that the Great War was being resumed and that this was a tragedy.

Q: would your family all eat together?

We would all eat together and my mom was a wonderful cook. Early on, there were also my grandfather and grandmother Anderson, Alexander and "Teeny" (her name was Clementine and she was quite small, so they called her "Teeny"). We lived in their home in Toronto during the early years of the Depression to save money because there were no jobs. So, those grandparents were very important and our dad's mother, whom we called 'Grandma with the Biscuits'. Her name was Gertrude (my paternal grandmother who made nice biscuits). She was from southern Ireland, from Cork City actually. She was, again, fluent in French, knew Europe well and she was Roman Catholic and we were raised as Protestants. That was, for a period of time, quite a problem because of the Protestant-Catholic divide. You know the story of Northern Ireland.

At that time, it was a very real problem because since my mom and dad were not married in a Roman Catholic Church. We were Episcopalians. For a period of time, Ian and I were regarded by that side of the family as little bastards. Now we may have been, in a certain sense, but not in a religious sense. I am joking of course.

Q: So what religion did your parents practice?

My mom is a Scottish Canadian who was Presbyterian, which would make her a Protestant, you see. My dad became an Anglican, Episcopalian - Church of England, which was the church that his dad had belonged to, in order to be able to marry my mom. That's why Ian and I were raised as Protestants, which wasn't very popular with the other side of our family. But this was something that we all outgrew and that became less and less and less important as everybody, I think, matured. It is now a complete non-issue, but it was quite real during our early childhood, unfortunately.

Q: Anything else you care to comment on?

I was the president of our graduating medical year in 1954. This was a huge honor. It was just another fascinating experience. I had to arrange the farewell banquet, you see, and we did it at one of the big downtown hotels. Apparently, every year all kinds of liquor would be stolen by the hotel employees and I listened to these stories and said, "By George, it's not going to happen to us!" I assigned various people to look after our liquor very carefully and sure enough, apparently during the height of the festivities, attempts were made to take whole cases of scotch, etc., and replace them with empties. Our guys immediately jumped on this and that didn't happen.

Sir Robert Watson Watt agreed to be our graduation speaker. He was the inventor of radar. He told us the story

of the Battle of Britain, in the summer of 1940. How, with a string of radar stations across the south coast of England, they could spot the Luftwaffe air fleets, as soon as they had cleared the French Coast line and were heading across the channel. Then he told us, the story of the battle of the Atlantic where we used sonar, or ASDIC, which is of course a radar modification, to expose the U-boat packs. As soon as the U-boats became other than invisible, we started to win the Battle of the Atlantic. That made possible the invasion of Europe.

Q: When did you get married?

Nineteen hundred-sixty. We had three children in three years because neither of us was terribly young and as pediatricians both, we wanted to avoid nondisjunction and things like that, and we were very pleased. Everybody was beautiful and acyanotic and everything worked out nicely.

Q: What are your children doing now?

Well, our son Andrew is a PhD microbiologist working for a pharmaceutical company here called Cubist, which is named in honor of Picasso. You know, cubism and Picasso were famous for looking at things in a different way and this is what they have been doing. They have a compound called Cubicin, which is the trade name, and daptomycin is the generic name, and it is the only thing that we presently have against otherwise totally resistant Staphylococcus aureus. This is hugely important and if you look at say the Journal of Thoracic and Cardiovascular Surgery, sometimes it comes wrapped in advertisements for this, and Andy is part of the team who is developing that.

Then, our second child, dear Helen, was a teacher of French and a mother of two beautiful boys, and she, alas, died of malignant melanoma in 2001. Our third child, Alexander, is an MIT architect. He graduated from MIT and he is now helping to plan a whole health-care city in Dubai. So everybody is gainfully employed and each of them has two children; so we now have six grandchildren, which means that Granddad has heavy baby-sitting responsibilities.

Q: Is there something else you would like to do after your medical book?

The most, I think, urgent human problem at the present time is not congenital heart disease. It is mass murder. It is war, particularly, given our thermonuclear toys. Well you see, I developed the segmental approach to the diagnosis of congenital heart disease that is now used worldwide, the method of diagnosis. Now, if we can get a similar understanding, that, all living human beings are in fact members of the same family. We are all brothers and sisters, which the molecular geneticists have proved. If we can taboo murder, mass murder, like we have managed to taboo, oh say, cannibalism, which used to be very common, then we will have a much better chance of surviving to inherit our future. In other words, a modern approach to diagnosis and management in the field of politics and economics that is non-ideologic and data-based and that taboos mass murder, this is what we need most urgently.

Q: So how would you plan to pursue that?

I wonder, I am open to suggestion. It is an extraordinarily important idea. Given time and strength, perhaps I can write another book but it is very important that all kinds of people get involved in order to avoid the extinction of the human family – and many other life forms. You remember Bernie Lown who did this wonderful thing called "Physicians Against Nuclear War." There was only one thing wrong with that. It has got to be more than physicians. It has got to be politicians, economists; it has got to be people; it has to include all ethnic and religious subgroups.

Q: It strikes me how children in the Middle East are taught so early to hate their enemies.

Trying to distinguish between education and indoctrination is very, very, very important. Coming to understand mythology, religion, and culture is also very, very, very important. Mythology should be understood, not believed. Only when that happens is it likely for us to be able to take the step beyond ideology, to a data-based, evidence-based approach to things. Let people believe whatever they want in private but they shouldn't force it on their neighbors, or kill them if they don't accept their little stories, their beliefs, whatever they happen to be. You know, this is, again, the separation of church and state idea, but with the understanding that, the whole idea of right versus left is absurd. It should be right versus wrong. Correct versus incorrect. Can you imagine if the politicians of the world were to approach things like, say, cardiologists do. And we'll have a meeting in six months or a year to see how this or that is working out. How can we do this better?

In other words, the medical model of how major human problems can be diagnosed and managed is both scientific and humanistic. We have to understand other peoples' cultures, religions, fears, and biases. Science won't do it alone. This is why we need a medical approach. You see, a bio-

medical approach is much more than science. There is a lot of art and humanism involved.

Q: What books are on your nightstand?

"The Journey of Man" by Spencer Wells. Then there is another one called "Before the Dawn", by Nicholas Wade which is again, the early history of homo sapiens. In my bagis "The Story of Civilization" by Will Durant, who wrote an 11 volume account of The Story of Civilization. I finished reading recently a book called "Parallel Worlds, A Journey Through Creation Higher Dimensions, and The Future of the Cosmos" by Michio Kaku. It's enthralling, particularly if you like Physics (which I do). So, I hope you see a pattern here. These interests are both scientific and humanistic – not either one alone. At its best, this is what modern medicine is: both scientific and humanistic.

We physicians have a huge and very important "SECRET." By trial and error, we have learned how to understand and manage successfully many important potentially fatal human problems. Once understood, the "medical model" is very widely applicable to major human problems.

Q: And you are working at the Registry now?

No, I am working at 21 Autumn Street. That is where they send retired gentlemen, Autumn Street. I am wondering where Winter Street is. Actually, bad jokes aside, the two buildings on Autumn Street, 1 and 21, which used to be Deaconess buildings, have been purchased by Children's Hospital and the floor I am on now, the fourth floor, is entirely cardiology, which is nice. But unfortunately, I am separated from the lab. But that is appropriate because my successor is there, you see.

Q: How has life been for you without Stella?

Very, very different. My cooking, by comparison with my bride's culinary savoir faire, can only be described as embryonic. It is scarcely fetal. But I manage. I make my own lunches and I make my own dinners. I am not as good at dusting as I should be. Dear Stelly, you know they are dedicating this whole meeting in Washington to her. I have to give a memorial lecture in her honor, which is also not going to be easy for me. I often ask myself, what would Stella say or think about this? Or that? Because we discussed everything of course.

Q: So do you have any advice for young pediatric cardiologists or young surgeons?

I think that one should get as well-trained as possible, and that one should adhere to the truth. For us, this is the only thing that matters. Everything else is just conversation. Getting well-trained at the best places by the best people and trying to do literally, the very best that one possibly can in all situations. It is the old Boy Scout motto, "Do your best." It really is, and it comes to that. Not just in every case, in your training, in each and every paper.

Q: What is your most important paper?

The paper that we published in 1972 about the segmental approach to diagnosis, many people tell me they think that is our most important paper because it turned out to be the diagnostic approach that people use worldwide, with or without minor modifications.

All of the others are as good as we could do too. So I would say to people, just do the very best that you possibly can. In other words, for me, science is not an occupation. It is a way of life. It is a way of looking at everything. It is a way of thought. It is a way of living. What a privilege it is to be a physician.

~ CCT ~

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New Products, News and Information

Adding Rapid Response Medical Team in a Children's Hospital Helps Reduce Risk of Death, Rates of Cardiac and Respiratory Arrest

CHICAGO – A children's hospital that added a rapid response medical team for patients not in the intensive care unit saw an 18% decrease in the death rate, and about a 70% decline in the rate of cardiac and respiratory arrests, according to a study in the November 21, 2007 issue of JAMA.

Introduction of a rapid response team (RRT; medical emergency team) has been shown to decrease death and cardiopulmonary arrests outside of the intensive care unit (ICU) in adult inpatients, according to background information in the article. An RRT is a multidisciplinary team frequently consisting of ICU-trained personnel who are available 24 hours per day, 7 days per week for evaluation of patients not in the ICU who develop signs or symptoms of clinical deterioration.

"The RRT intervention was developed in response to research that revealed adult patients on general medical and surgical hospital units often have evidence of physiological deterioration several hours before cardiopulmonary arrest, and that after a cardiac arrest occurred, survival rates were poor. Given that there appears to be a window of opportunity to identify and proactively treat 'prearrest' adult inpatients effectively, the Institute for Healthcare Improvement recommended RRTs be implemented nationwide in an effort to decrease inpatient mortality rates," the authors write. Limited data exist evaluating the effectiveness of RRT implementation in pediatric inpatients.

Paul J. Sharek, MD, MPwww.H, of Stanford University School of Medicine, Palo Alto, Calif., and colleagues evaluated whether RRT implementation was associated with decreases in hospital-wide mortality rates and code rates (respiratory and cardiopulmonary arrests) outside of the ICU in pediatric inpatients at a 264-bed academic children's hospital. Pediatric inpatients who spent at least one day on a medical or surgical ward between January 2001 and March 2007 were included. A total of 22,037 patient admissions were evaluated pre-intervention (before September 1, 2005), and 7,257 patient admissions were evaluated post-intervention (on or after September 1, 2005).

A significant decrease of 18% occurred in the hospital-wide mortality rate after implementation of the RRT. The rate of codes outside of the ICU setting per 1,000 eligible admissions declined by 71.7%, with pre-intervention and post-intervention rates of 2.45 vs. 0.69, respectively. The rate of codes outside of the ICU per 1,000 eligible patient-days decreased by 71.2% after RRT implementation.

The RRT intervention, using statistical modeling, was associated with a decrease of 0.178 deaths per 100 discharges or 1.78 deaths per 1,000 discharges. During the 19-month post-intervention period, the RRT intervention is estimated to have resulted in 33 lives saved at this hospital.

"Implementation of an RRT in our free-standing, quaternary care academic children's hospital was associated with statistically significant reductions in hospital-wide mortality rates and code rates outside of the ICU setting. These reductions cannot be explained by differences in patient characteristics or severity of illness between the control and post-intervention populations," the authors write. For more information, see (JAMA. 2007;298(19):2267-2274.

Improving Doctor-Patient Communication Yields Significant Health Benefits

A UCSF research team has developed a simple tool that can improve the effectiveness of communication between doctors and patients about prescribed medications and result in dramatic improvements in health and safety.

The new communication tool involves a computer-generated weekly calendar with color images of the medication to be taken each day, combined with instructions written in English and in a patient's native language if the patient does not speak English. The researchers call it a VMS, for visual medication schedule.

"Improving communication has often been thought of as soft science, but our study shows significant clinical benefits when the information gap between physician and patient is bridged in the right way," says co-lead investigator Edward Machtinger, MD, assistant professor of medicine and director of the Women's HIV Program at UCSF.

Machtinger and co-lead investigator, Dean Schillinger, MD, associate professor of medicine at UCSF and director of the

UCSF Center for Vulnerable Populations at San Francisco General Hospital Medical Center, developed the tool and conducted a study on its effectiveness. Research findings are reported in the October 2007 issue of the "Joint Commission Journal on Quality and Patient Safety."

The research team selected patients taking an anticoagulant (clot preventing or blood thinning) medication for stroke prevention known as warfarin. Most patients in the study suffered from atrial fibrillation, a common heart condition in which the heart pumps irregularly, leading to formation of clots in the heart that travel to the brain and result in stroke.

Atrial fibrillation affects over 2.5 million adults in the US and is responsible for 20 percent of all strokes. Treatment with warfarin, if taken correctly, can reduce the likelihood of stroke by 80 percent.

However, warfarin is a notoriously challenging medication for doctors and patients to manage, and complications from warfarin are the most common cause of adverse medication events in community settings, according to the lead investigators.

In previous studies, Schillinger and Machtinger found that nearly one half of patients on anticoagulants were not taking their medication accurately, but did not realize it. When describing the dose and frequency of the medication, patients and doctor often had two completely different understandings. These misunderstandings were more frequent among patients with limited literary skills, those for whom English was not their first language, and those with memory problems. Patients who had misunderstood their prescriptions were more likely to be under-anticoagulated and at risk for stroke, as well as over-anticoagulated and at risk for life-threatening bleeding.

Based on these findings, the researchers developed a three-step communication approach for their current study and selected patients whose lab tests showed that their blood was not in the target range of anticoagulation. The three-step approach involves (1) having the patient describe how much medication he/she is taking and how often (to identify misunderstanding), (2) giving the patient a VMS along with written instructions both in English and the patient's native language, and (3) asking the patient to "teach back" what he/she has just learned so as to ensure common understanding.

The study involved 147 patients, with half of the participants being randomized to receive the VMS along with brief, scripted medication counseling each time they came to clinic over 90 days, in addition to their standard care in an anticoagulation clinic. The other half received standard care, which includes medication counseling using non-standardized verbal and written instructions.

Study findings showed that the blood anticoagulation status of patients in the VMS group reached the target, safe level almost twice as fast as those patients who were in the standard group -- 28 vs. 42 days. In addition, the researchers found that the effect of the VMS tool was principally among those patients who, at the start of the study, had misunderstood their prescription instructions.

Among this "at-risk" subset of patients, the VMS worked even faster (28 vs. 49 days), presumably by helping to correct the original misunderstanding that led to them initially being out of target range, the researchers say. One notable finding, they add, was that the VMS tool was especially effective among Spanish-speaking patients, again suggesting that the tool is most effective for those with communication barriers.

Miscommunication between doctors and patients with regard to medication is common and often goes unnoticed, according to Schillinger. He and Machtinger began looking at the link between miscommunication and poor health about eight years ago when they realized that miscommunication could be a key, remediable cause of poor health outcomes and medication errors among
vulnerable populations of patients.

"It was amazing to us that the final crucial step in a long pipeline of science and disease intervention--communication around the actual taking of medications--was being largely ignored," says Machtinger.

Their previous studies showed that problems at this final step were far more serious than the field had realized. These early studies were among the first to show a direct link between miscommunication and poor health, Schillinger says.

This approach, says Schillinger, provides the clinician with immediate feedback on the patient's understanding of his medication and the opportunity to correct misinformation, along with a visual aid-the take-home calendar and verbal reinforcement.

The idea for the visual part of the communications tool is not novel, the researchers say. For decades, doctors and pharmacists have often taped actual pills to hand-written sheets of paper to help educate their most vulnerable patients. This approach, however, is too time-consuming and impractical to carry out for every patient at every appointment.

The VMS is fast and inexpensive, can be printed in any language, and facilitates communication that happens naturally

in the doctor's office, the researchers emphasize, and can be adapted to other clinical settings, including pharmacies.

The next step for the research team is to find ways to integrate the VMS and 3-step approach into everyday practice. "Having health systems adopt this communication tool on a long-term basis for anticoagulant care could translate into lots of strokes being avoided and lots of bleeding being prevented," says Schillinger.

"We hope, in the near future, that all vulnerable patients will have a VMS tacked to the refrigerator so they, and their caregivers, will know which pills they should be taking and how they should take them," says Machtinger.

In the meantime, the researchers emphasize that patients should be educated about the dangers associated with medication miscommunication and discuss how they are taking their medications with their doctor at every visit. While there are other reasons besides miscommunication that might affect whether a patient takes medication as prescribed, Schillinger believes that "for high-risk medications, we need to focus our energies on implementing standardized visual communication tools that accompany any prescription to ensure safety and quality."

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