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THE CHANGING MANAGEMENT OF RIGHT VENTRICULAR OUTFLOW TRACT DYSFUNCTION

IMPACT OF PERCUTANEOUS PULMONARY VALVE IMPLANTATION

By Philipp Lurz; Twin-Yen Lee; Louise Coats, MRCP; Johannes Nordmeyer; Philipp Bonhoeffer, MD

Introduction

Advances in cardiac surgery, intensive care and non-invasive imaging, over the last fifty years, have led to a substantial increase in life expectancy for many patients with congenital heart disease. Currently, more than 85% of children born with morphological or functional cardiovascular anomalies reach adulthood and it is likely that this will increase further over the coming decades [1].

One of the major problems for adults and children with repaired congenital heart is dysfunction of the right ventricular outflow tract (RVOT) either manifesting as an obstructive lesion or as pulmonary regurgitation.

Whilst for some time it was believed that these residual lesions were well tolerated, it is now increasingly clear that they are associated with right ventricular dysfunction, reduced exercise capacity and an increase in arrhythmia potential.

Conventional Management of RVOT Dysfunction

Growing evidence of the detrimental consequences of RVOT dysfunction have led to a strategy of re-operation designed to restore valvar competency and relieve residual obstruction. Importantly, surgical pulmonary valve replacement has been shown to halt, or in some cases, reverse this functional deterioration [2]. Homografts have gained in popularity as the optimal conduit for this purpose because of their superior longevity. However,

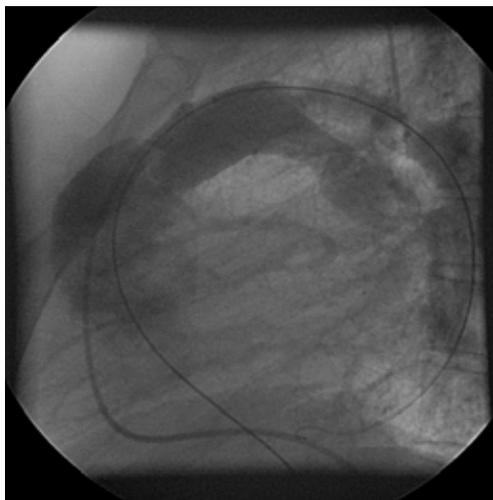


Figure 1. Lateral angiogram before PPVI shows moderate pulmonary regurgitation.

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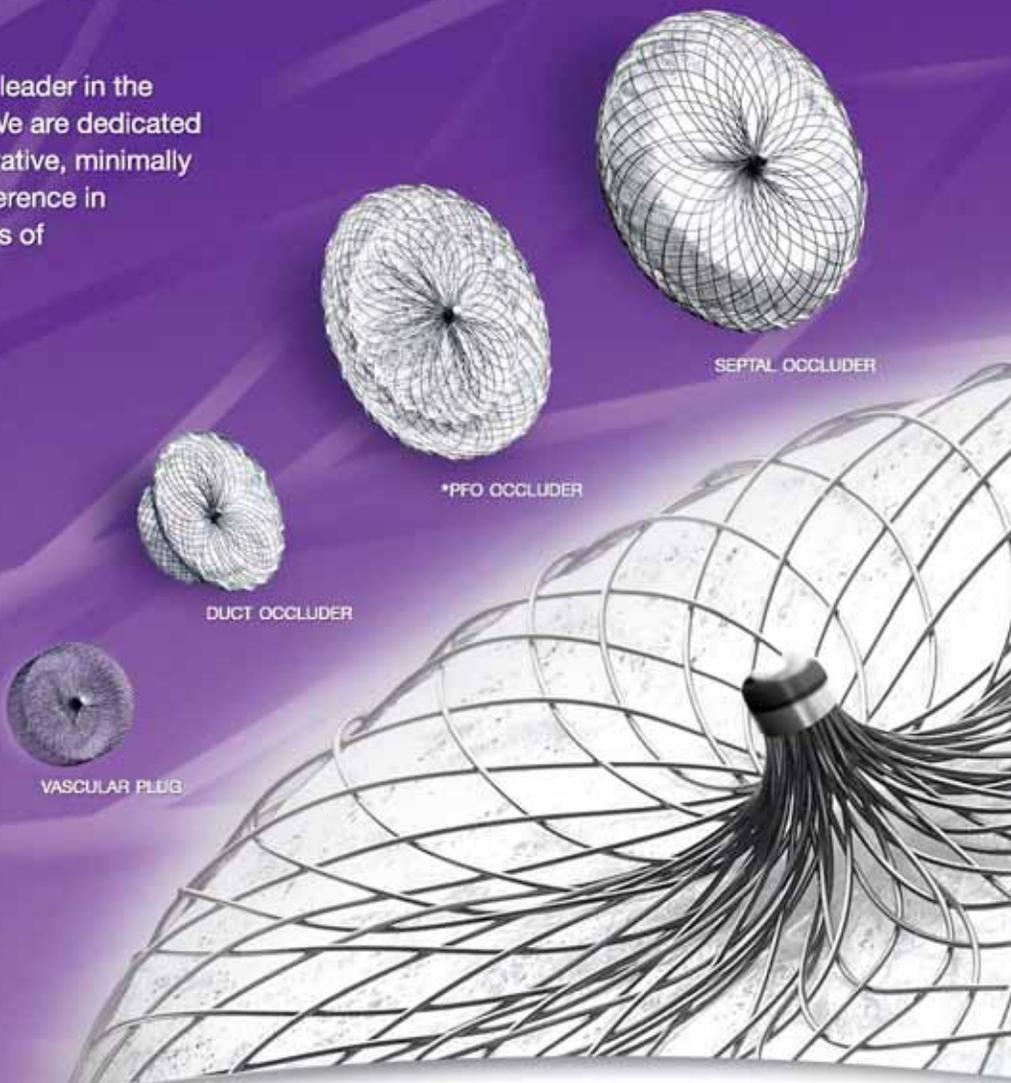
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repeat operations are associated with increased risk, and some investigators have found that subsequent conduits do not last as long. Increasingly, the timing of intervention to the RVOT is being called into question. There is some evidence to suggest that we are intervening too late, beyond the point at which right ventricular function is recoverable. Thus, whilst early intervention seems to be crucial to preserve right ventricular function, the decision to re-operate must balance this ideal against the risks of repeated surgery and the limited longevity of newly implanted conduits.

Percutaneous Pulmonary Valve Implantation (PPVI)

In 2000, the first implantation of a transcatheter pulmonary valve was reported by us [3]. This new technological approach to the treatment of RVOT dysfunction is likely to have important consequences for the management of this condition.

Composed of a bovine jugular venous valve, sewn into a balloon-expandable platinum iridium stent, the device is delivered by a catheter via the venous circulation under general anaesthesia. The size of the delivery system limits the procedure to those older than 5 years and greater than 20 kilograms in weight. The valved stent is deployed within the existing degenerated conduit and acts both to relieve obstruction and restore a competent pulmonary valve.

Clinical experience now exists in over 140 patients (age 7-58 years, UK and Canada), most of whom have undergone two or more surgical interventions in the past. The relief of right ventricular volume and pressure overload in these patients is associated with improved cardiac performance and an increase in objectively measured exercise capacity. The procedural complication rate is 5% and includes homograft rupture, device instability, coronary artery compression and branch pul-



Figure 2. Lateral angiogram after PPVI shows well seated device in RVOT with trivial pulmonary regurgitation.

monary obstruction. Death occurred only in the critically ill patients and was not device- or procedure-related. One patient died of pulmonary oedema related to a concomitant left-sided problem also treated during the same procedure. The other died 6 weeks after the valve implantation due to sepsis in the context of a failed defibrillator implant. The majority of patients were discharged home the following day with no requirement for intensive care. Few complications occur during follow-up, with the most evident being stent frac-

ture, which if detected early can be treated with a second interventional procedure.

Percutaneous pulmonary valve replacement therefore, provides a new approach for the management of RVOT dysfunction. It is minimally invasive, patients recover rapidly and there is low morbidity and mortality. The impact of this new procedure on the conventional surgical strategy is beginning to emerge.

Impact of PPVI on the Conventional Management of RVOT Dysfunction

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PPVI should not be seen as an alternative to surgery, rather as a complementary treatment that can be used to prolong conduit life and reduce the number of re-operations a patient may require during a lifetime. With this aim, lower device durability may be acceptable, particularly in view of the success of repeat PPVI (stent-in-stent), if the negative effects of cardiopulmonary bypass are avoided,

Furthermore, a less invasive approach could allow earlier intervention to the RVOT satisfying current clinical inclination to preserve right ventricular function. In addition, patients who are conventionally considered too high risk for surgery could benefit from intervention.

At present, a major limitation for PPVI is the size of the RVOT as bovine jugular venous valves are only available up to 22 mm in diameter. Implantation in humans is therefore limited to those patients with an RVOT that does not exceed that maximum diameter and preferably exhibits some degree of circumferential calcification as this promotes device stability. Unfortunately, the most common group of patients requiring pulmonary valve replacement are children and adults who underwent surgery for tetralogy of Fallot during infancy and had patch augmentation of their RVOTs. The consequence of this repair is free pulmonary regurgitation and an aneurysmal RVOT that is unsuitable for PPVI.

The availability of PPVI is, therefore, now influencing the initial strategy for primary repair in patients with congenital heart disease. Surgeons are increasingly placing smaller patches or, where possible, suitably sized homograft conduits that prepare the patient for a future percutaneous approach when RVOT dysfunction ensues. A novel approach, which so far has only been tested in the experimental setting, is the implantation of an expand-

able-valved conduit that can be sequentially dilated by balloon angioplasty as the patient grows. When valvar incompetence occurs a percutaneous pulmonary valve can be implanted into the conduit [4]. If this strategy can be translated to the clinical setting, it could have a major impact on patients with congenital heart disease perhaps bringing to an end repeated open heart surgery altogether.

Future Directions

PPVI is now on the threshold of wider clinical use. The challenge remains to adapt this approach to all RVOT sizes and morphologies. Development of new devices that can downsize the RVOT or hybrid approaches incorporating minimally invasive surgery without cardio-pulmonary bypass may provide potential options [5]. Close co-operation between cardiologists, surgeons, imaging specialists and biomedical engineers is needed to bring these ideas forward; the management of RVOT dysfunction will continue to evolve.

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LEVERAGING TECHNOLOGY FOR IMPROVED SUPPLY AND DEVICE MANAGEMENT

By Ziyad M. Hijazi, MD, MPH

Introduction

Medical device and supply utilization has become a critical part of effectively treating congenital heart problems and other cardiovascular conditions in the pediatric environment and elsewhere. With the advancements in therapeutic catheterization devices and supplies such as drug-eluting stents, we have made tremendous strides in improving the outcomes of the patients that receive treatment through percutaneous coronary interventional procedures.

While the growth of percutaneous coronary interventional procedures has been prolific, having doubled over the past ten years, it pales in comparison to the growth rate for the utilization of certain devices and supplies to support those procedures [1]. Specifically, the utilization of coronary stents has increased by more than seven times since their initial introduction in 1995. As highlighted in a report from the Society for Cardiovascular Angiography and Interventions (SCAI), approximately 800,000 stents were estimated to be used in procedures performed during 2004 [2]. Given the two-year latency in the estimate, it is safe to assume this number has continued to rapidly increase.

As the utilization of devices such as drug-eluting stents has increased, they have also assumed a growing presence in the revenue and cost structures of most cardiovascular service lines. Per data provided by a 2005 study conducted by Goodroe Health Solutions, the

average cost of a procedure utilizing coronary stents was \$4,500 with an average of 1.63 stents used per case [3]. In further looking at the role of the stents in the cost structure, consulting firm KPMG reported that the average cost of a stent is \$2,400 [4].

would represent \$29.5 million to the healthcare organization.

Challenges Emerge with the Increased Role of Device Utilization

Given the significant presence these devices are playing in the economic



Figure 1. Mobile Aspect's iRISupply .

For an organization that annually performs 5,000 catheterization procedures in which stents are used, the cost incurred by the provider organization to acquire and stock these devices would total \$19.7 million annually. In addition, assuming a charge markup of 200% and an average reimbursement rate of 50% for billed charges, the revenues derived from these devices

structure of cardiovascular services, it is imperative that operational processes are followed that will mitigate the risk of unnecessarily adding costs or missing opportunities to document their utilization and in turn, capture the charges incurred. Sadly, it is quite common for organizations to follow less than optimal processes, often



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leading to the emergence of problems in two principal areas.

The first area of concern is with regard to the charges captured for the use of devices and supplies during a procedure. Many organizations employ manual, paper-based documentation processes to support the charge capture process. Often, this is augmented by the application of stickers to the paper documentation to provide more thorough information. Due to the realities of our busy clinical environments, many times the documentation of the charges for device and supply utilization are missed. Some sources have estimated the incidence of missed charges to range from ten to twenty percent. Using the example above, this represents between \$5.9 to \$11.8 million of missed charges.

The second area of concern deals with the ability to effectively manage the quantity and quality of the device and supply inventories. Unfortunately, health care organizations may lack the data to perform retrospective and prospective analysis of their device and supply utilization patterns to guide their inventory levels. For example, most organizations stock an unnecessarily wide variety of stent sizes when practice patterns would reveal that certain sizes are most commonly used, and others very seldom, if ever used. As such, most organizations use arcane estimating methodologies to determine how much stock to carry on their shelves, usually resulting in high volumes of inventory for certain items and low volumes or unavailable items for others. With a carrying cost to the organization of 25% for each stocked item, this ties up capital resources that could be deployed towards other areas of patient care delivery [5].

As another byproduct of the lack of detailed data for product inventories, often

the processes of managing those devices that are time-sensitive to expiration, such as drug-eluting stents, becomes a very manual, time-intensive exercise which is often prone to error. Catheterization laboratory staff, materials management staff, or other individuals spend several hours manually reviewing each item located on the shelves, seeking out product types, serial numbers, lot numbers or manufacturer's date ranges to identify expired items. Due to the potential oversight errors that can occur, many times items on the shelves are missed, leading to the expiration and disposal of the item. In turn, a sunk cost to the organization is realized. In the scenario above, if only one percent of the stents purchased by the organization result in expiration and waste, it will cost the healthcare organization nearly \$200,000 annually.

Finding Assistance through Technology

Due to our innovative and leading edge pursuits in interventional procedures, the University of Chicago Section of Pediatric Cardiology acknowledged the prevalence of our use of devices and supplies in our procedures and the problems related to our ability to effectively manage that utilization. In 2004, the Section sought to find a solution to the challenges of improving charge capture and better managing our device and supply storage and tracking. In addition to these areas of focus, there was importance in process improvement as we were opening a new facility on campus while continuing to perform procedures in our old location as well. At the time, all technicians were responsible for the management and replenishment of catheter lab inventory. Upon opening the new facility, the team's responsibilities would become more complex as

they managed inventory between two separate buildings.

“As the innovative developments in medical devices and supplies continue, it is likely we will see corresponding increases in the costs to purchase these critical items. As such, we look forward to leveraging technology to assist us in our efforts to continue providing world class pediatric care while demonstrating optimized financial and operational practices towards the utilization and management of these important devices and supplies.”

To address our needs, the Section engaged Mobile Aspects, a Pittsburgh, PA, based vendor that specializes in clinical resource management solutions for the cardiac catheterization laboratory environment. The vendor designs and installs cabinet-based storage systems (see Figure 1) that use radio frequency identification (RFID) technologies to automate the processes associated with managing and tracking medical devices and supplies. Items such as stents, balloons, guide-wires, catheters, and implantable devices such as ASD, PDA, VSD, and pacemakers are affixed with an RFID tag and then stored in the cabinets.

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Charge Capture Analysis for DRG Atrial Septum Defect—University of Chicago Hospitals and Health System – Comer Children's Hospital

item, and when the item is taken from the cabinet, it is automatically recorded without needing manual interaction such as pushing buttons or scanning bar codes. At the end of the procedure, any returned items are reconciled within the cabinet, and all items used during the procedure are detected to allow for charges to be captured and inventory levels to be appropriately decreased.

Results

To assess the results of implementing this technology in pursuit of our goals, the Section initially focused on improvements seen in our charge capture processes. We conducted an internal analysis related to the charges captured for cardiac catheterization procedures addressing Atrial Septal Defect (ASD) device closure. Over two eight-month time periods, one prior to implementing the system and one after implementing the system, we examined the charge capture levels associated with these cases. As illustrated in the chart summary above, by combining the implementation of the system with additional process changes for our staff, the Section realized a 30% increase in captured charges per case, or over \$5,600 of charges billed per case (see Table A).

With these results, it's become clearly apparent that the introduction of this technology to automate our medical de-

vice and supply utilization processes has been extremely beneficial. Moving forward, we intend to leverage the data available within the system to analyze for optimal par levels of inventory based on our practice patterns. We anticipate that this will add to the benefits we've experienced in using this technology.

Conclusion

As the innovative developments in medical devices and supplies continue, it is likely we will see corresponding increases in the costs to purchase these critical items. As such, we look forward to leveraging technology to assist us in our efforts to continue providing world class pediatric care while demonstrating optimized financial and operational practices towards the utilization and management of these important devices and supplies.

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HIGHLIGHTS FROM THE 15TH INTERNATIONAL PARMA ECHO MEETING

By Sommi Marcello, MD

In late June, between 28th and 30th, the Section of Pediatric Cardiology of Parma University, hosted the 15th International Parma Echo Meeting, at the University campus in Parma (Italy).

Over a hundred professionals in neonatal and pediatric cardiovascular disease from over sixteen different countries attended the Meeting.

Different sessions were held reviewing the echocardiographic assessment of the cardiac function including some new techniques such as the strain and strain rate imaging, the evaluation of the Fontain patient and the assessment of the valvular lesions with the traditional 2D echo, but also with the new 3D echo imaging.

Some lectures were dedicated to specific subjects such as, ARVD, Perinatal cardiology, Sudden death in the young, and the

“Dr. Nava updated the audience on the new concepts of the genetic contribution about ARVD (Arrhythmogenic Right Ventricular Dysplasia). He made a convincing argument for the clinical diagnosis and assessment of the 1st degree relative of a proband, in a fashion similar to the Long Qt syndrome.”



The Nativity by William G. Congdon – The cover of the Program.

Cardiac Stem cells and myocardial regeneration.

Dr. Coleman and Dr. Sanders opened the meeting discussing the Conventional methods for the assessment of Ventricular systolic and diastolic function, and the methods for measuring and evaluating the ventricular size and volume. These two lectures and the related discussions pointed out the importance of evaluating diastolic function, not only in adult patients, but also, in children as the routine echocardiographic examination. Other lectures were given by Dr. Mertens who reviewed the “Strain and Strain Rate Imaging in Assessing Systolic Function,” and during the morning session of the 2nd day, the “Doppler Tissue Imaging and Strain Rate Imaging in Assessment of Diastolic Function,” relatively new techniques which offer a very complex, but complete data about both ventricular movements and function, globally but particularly in segments. The data offered by these techniques allow us to study the complex systolic movement of the two

ventricles, evaluating the shortening/lengthening movement, the thinning/thickening movement and the twist/untwist movement which compose the systole and diastole of the cardiac cycle.

In the morning session of the 2nd day, the “Assessment of Diastolic Function Using Doppler Methods” was reviewed by Dr. Hagler, who presented the traditional way for evaluating diastolic function with Doppler, and also explained how all these parameters change with the worsening of the ventricular diastolic function. He later also reviewed the Diastolic stress testing, and its possible clinical application. Later, during the morning session Dr. Hagler discussed the methods for the assessment of the left atrium and their echocardiographic uses. Dr. Coleman updated the attendees about the echo evaluation and clinical treatment of Dilated Cardiomyopathy and Myocarditis with great echo video clips and images in his lecture.

During the afternoon session Dr. Sanders and Dr. Mertens reviewed the evaluation of the Fontan patient preoperative and postoperative, but also the clinical management and strategies in patients who present a failing Fontan.

In the morning session of the last day a very complete review of the echo assessment of the valvular heart lesions was given by Dr. Sanders. An innovative way for studying these kind of diseases is 3D echocardiography presented also by Dr. Sanders who discussed the possibilities of this technique which offers a wide range of post-processing the imaging obtained from the examination.

Dr. Hagler then updated the attendees on the clinical application and uses of intraoperative TEE field aiming to reduce

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the complications and reoperations particularly in children.

Dr. Galal reviewed his personal experience in Jeddah about congenital heart disease in adults proposing a number of cases with related discussion with the attendees.

In the afternoon session, before abstract



Prof. Umberto Squarcia, Director of the Meeting.

and case presentations, Dr. Vogel presented the assessment of VSD with 3D echo, a technique which offers images and also clips of high definition.

During the three-day meeting among the lectures scheduled some magistral lectures were given, particularly Dr. Nava updated the audience on the new concepts of the genetic contribution about ARVD (Arrhythmogenic Right Ventricular Dysplasia). He made a convincing argument for the clinical diagnosis and assessment of the 1st degree relative of a proband, in a fashion similar to the Long Qt syndrome.

Dr. Huhta talked about his personal experience in perinatal cardiology presenting also some interventional techniques such as valvuloplasty in the newborn with very interesting iconography and real time imaging.

Two lectures were given by Prof. Thiene who presented the discovery of blood circulation during the opening ceremony at the suggestive Aula Magna, and also discussed the sudden death in the young, updating all of us on the genes which seem to be involved in the inheritance of this disease condition.

The last Magistral Lecture was given by Prof. Quaini, who updated the audience on the uses of cardiac stem cells for myocardial regeneration and for possible future treatment of congenital heart disease.

Two sessions were held to discuss clinical trials, research and cases studied, in addition to the display of five posters by physician, residents and nurses from around the world.

Some cases were then examined live with echocardiographic complete examination and discussed together in the tradition of our Parma Echo Meeting.

The Organizing Committee is already actively planning the 16th International Parma Echo Meeting for next year, which will be held on the 27th, 28th and 29th of June 2007.

You may look at the "Echoes" from the past editions of the Meeting at our web site <http://www.unipr.it/arpa/echomeet>.

Additional ideas, or advices for the next meeting can be sent to umberto.squarcia@unipr.it. We hope to see you next year in Parma!

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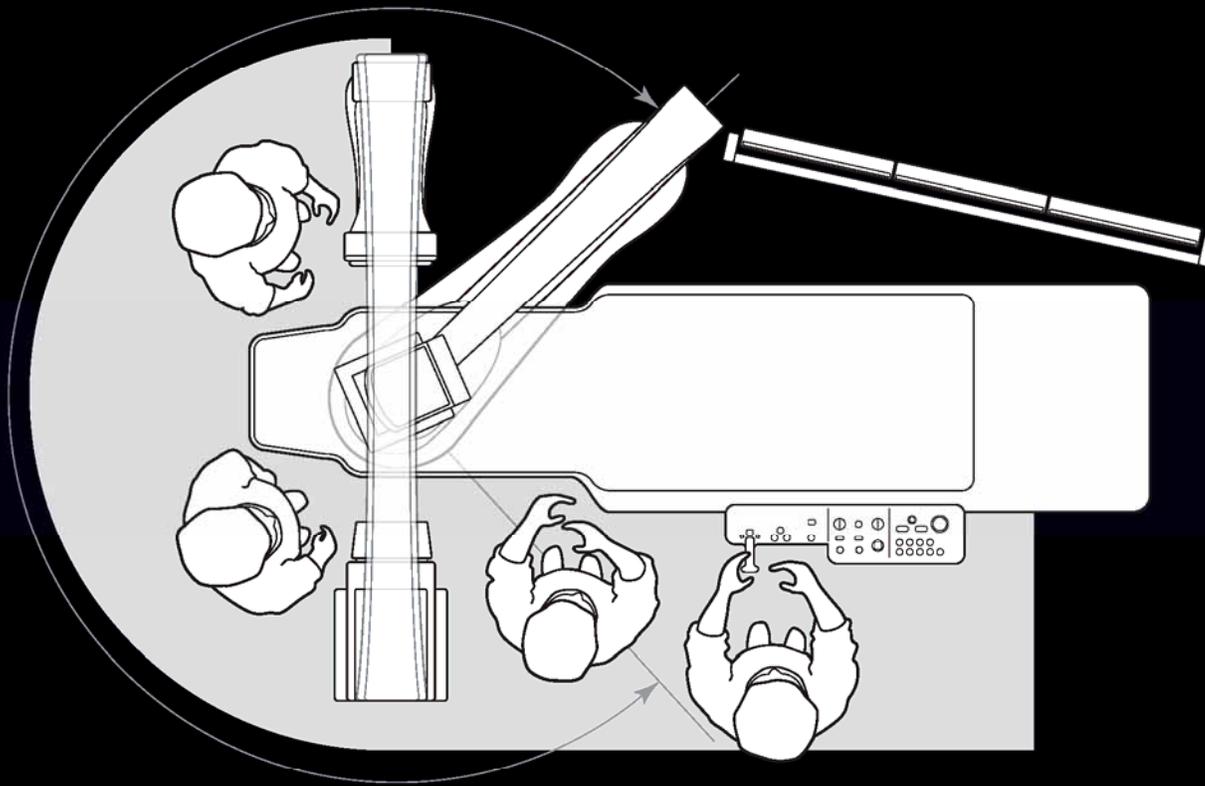
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SENT: SUNDAY, MAY 08, 2005 6:37 AM
 SUBJECT: FIELD UPDATE #7: WHY WE ARE HERE: SHE WOKE UP

By Major Joseph D'Angelo, MD

Major Joseph D'Angelo, MD is a pediatric cardiologist from Hawaii, who served a tour of duty as a combat physician in Iraq. A series of Field Updates were originally sent to his family and friends during his tour. One such Field Update is reprinted here with Dr. D'Angelo's permission.

Congenital Cardiology Today published one other Field Update: "Field Update #3: Convoy to Baghdad" by Joseph D'Angelo, MD; Congenital Cardiology Today (North American Edition); Apr 05, pgs. 6-8; Vol. 3, Issue 4.

"Field Update #7: Why We Are Here: She Woke Up" was the last update Dr. D'Angelo wrote before coming home. The addendum at the end was written this year, a year after his entering Iraq.

As I start this Field Update, it is the eve of my finally leaving Iraq. With my usual provisos about security, I will not be sending it until I actually have left. The subject however, is not my leaving, but my recent experience at the Combat Support Hospital (CSH, "cash"). As a point of clarification and perhaps disclaimer, recently my updates were incorrectly referred to as a "blog." Since it was from a leader I respect, I assume he



had been misinformed. These are not "web logs," but just letters home to my friends and acquaintances; since they are in e-form, it is not surprising they get sent around cyberspace, but my intent has always been to an audience I know personally. Anyway, if someone "official" is reading these and would like me to "register" them, please forward me the information on how to do so. I of course will continue to write in accord with the standards of operational security.

Now, on to my recently revealed purpose for coming to Iraq. As you may recall, in a previous update I described a situation where I flew to the CSH on a Medivac helicopter with a child. While I

was there, I met some staff members and offered my pediatric services if needed. Actually, it was after that visit that I had considered extending my tour by another 3 months in order to volunteer there to take care of any children and assist with the traumas and outpatient clinics.

By way of recent background, my Schindler-complex was in high gear as I came down to the end of my deployment. I made reference to this in my last Update, where I spoke of feeling like I had not done enough and that I could have done more. Fortunately for my unit, they were not in very much need of combat medicine, and my only



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source of professional stimulation outside my own unit was in an environment not very "healthy" to the practice of medicine. Most of the docs I came through training with, including myself, were very motivated, glad to be here and to serve and wanted to keep busy. Unfortunately, this atmosphere did not exist around me after we parted ways to our various assignments and this contributed to my sense of professional isolation. Although intellectually I know I made a difference in the care of particular patients throughout my deployment, I guess I still felt, well like Herr Schindler: "I could have done more." Even my Texas cohort of docs expressed a bit of helplessness at times with "the system" regarding doing the most they could for patients; one major theme for our deployment was mis-utilization of medical resources (us). Words of gratitude from my Executive Officer about him knowing that I was there if I was needed, receiving an honor in the form of his coin from a General regarding the care of the Iraqi child, plus the words of encouragement of others, as well as the realization that just like most of the soldiers, I came here and did my job, all helped to assuage my feelings that I had not done enough. The "Big One," however, was yet to come.

I received a message one day that there was a child at the CSH who was critically ill. Although I will share more details with those I relate the tale to in person, since there is a real risk to some of the locals involved, I will have to delete entire "characters," even though they were "leads" in the story. Hence, although this will come across as a "me" story, it took an ensemble of those with great strength, skill, compassion and courage to take care of a very sick child.

After reviewing her case by phone with

some of the personnel involved, I began to formulate a list of possible diagnoses. Of course, this would be seriously revised when I actually saw the child, but I felt that much of my job would be not so much medicine, but "hand-holding," reassurance and support of a staff that were uncomfortable taking care of a toddler in what was suppose to be a hospital for combat injuries. Although this was an important aspect of my being there, her actual care turned out to be at a pretty high level of complexity for pediatric ICU medicine. In fact, the specter of one of my ICU attending physicians was constantly over my shoulder. I would never expect him to directly say he was proud of me, but I could almost hear him in my mind questioning and challenging me, which drove me to "do the right thing," which basically consisted of everything I could possibly think of.

So, with the icing on the cake being another round trip helicopter ride on the Blackhawk, my chain of command approved the CSH's request for my services and I flew over to begin what was supposed to be 2 days of Pediatric Neurology consultation, but which turned into a 3 day stint as a Pediatric Intensivist.

Having re-written this sentence about 30 times, I am challenged by the inevitable need to be somewhat medically technical (so my non-medical readers may just skim it), while at the same time providing a "safe" degree of details. Alas, it is past midnight, and the challenge too great, so I will take this up later. Goodnight.

A few hours of sleep later; let us see if this gets any easier.

When I arrived, after preliminary introductions with the staff, I went right to the



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patient's bedside. Although she appeared as billed, I was reminded how much of a far cry it is from hearing a description over the phone and seeing for oneself. She was comatose, had a breathing tube in and was on a ventilator with multiple lines of access into her vascular system, as well as a nasogastric tube and urinary catheter. I performed an initial exam and then dove right in to review her records. She was a reasonably well child, who had been taken to the doctor a few times, and then basically, "all of a sudden" began to have uncontrollable seizures.

At some point in transit between local health care systems, she encountered U.S. soldiers. As I had experienced before with such situations, the compassion of the soldiers to the heart-wrenching site of a seizing child in a parent's arms prevented them from allowing her to remain "out there" and they were directed to the CSH. We then pretty much became committed because as one might imagine, there would be difficulties getting her back into the Iraq

healthcare system for reasons of practicality, cultural and political variables, as well as security and risk to those involved. Hence, her pediatric ICU care began in a US combat hospital.

Highly trained for what their job was supposed to be, caring for trauma casualties, the staff were justifiably apprehensive about a tiny tot to care for, even though they had done so on previous occasions (recall from a previous Update that most of the patient's on the ward at my first visit were children). I was called because of the recollection that there was a pediatrician somewhere in theatre and the staff needed some support since they felt over their head with this critically ill child. As it turned out, the ICU staff members were the finest I had ever had an opportunity to work with. Throughout my medical training and subsequent practice, my experience with ex-military nurses was that they always excelled, both in their skills, discipline and ability to work as a team. Those in this unit appeared to be the cream of the crop and were well suited

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to their location in the middle of a war zone. Even as they cared for our patient, I did not detect much of the apprehension with caring for the child that had been noted to me. It was not until I read a review of my involvement later that I realized the impact of our working together. In other words, they were extraordinarily professional and did not show the fear that contributed to bringing me there in the first place. In addition, we were blessed with a diligent family practitioner who was her doctor prior to my arrival and remained my partner throughout the management of her care.

Like I said, I had the specter of my ICU days over my head, and basically realized I was no longer the resident with the attending, or even without one, but I was the attending. In the beginning I summarized her care to date, provided some input on possible causes of her state, and "tweaked" her therapy, basically doing the "doctor thing." It should come as no surprise that just as in medical school, I produced progress notes of epic proportions: the first was 7 pages long. Eventually, we hit the inevitable wall as to what we could further do in country. There were just not the resources present to complete her care or more precisely the testing she required, and given her status as a national, she could not be transferred further "up" the U.S. system. Given her actual clinical situation, she was not really a candidate for one of those situations with a pushy doctor with the senatorial connections back home trying to get her flown to the U.S. for further care. The discussion of the problematic nature of such international care from a medical conference the previous day was also fresh in my mind.

So, we were the end of the road as far as what we had to offer, and parallel to our medical management were the he-

roic efforts made at trying to get her back into the Iraqi health care system. In the interest of the personal safety of those involved alluded to above, perhaps one of the more exciting parts of this story has to now consist of the proverbial "black pen" passages. Suffice it to say, I was witness to Iraqi strength, courage and heroism. I was supposed to only stay for two days. As it turned out, her condition stabilized and improved as I aggressively tried to "wean" her off as much support as I could. Although I was trying to leave on the eve of my second day / third night there, the "air bridge" system (helicopter "buses") had been closed down and there were no flights out. My partner was glad, and considering how welcomed I had been made to feel, I could not be too disappointed. I told him I would not be offended if I were hoping to get out and he were wishing for my being unable to. Although I did miss 2 nights of Tae Kwon Do, and my last opportunity for Mass and to say goodbye to my church choir friends, I did not have much of a reason to return back to my camp. In addition, it turned out to be a very violent weekend, particularly for the Iraqis. One sad but cogent bit of news was a sign of hope in the burgeoning healthcare system of the Iraqis: we received word that the excessive number of attacks that weekend had stretched their own trauma system to the max, but they were able to handle it on their own without yet diverting to the CSH. It was a sign they were on their way to independence. Nonetheless, I saw all manner of combat trauma and felt much closer to the war than I did in my own camp, where everything seemed to occur outside the walls.

Anyway, back to the child. We stabilized her and were confident that we could arrange transfer to the Iraq system, so began making preparations. At the

same time, I was still frustrated by the lack of a diagnosis. I contacted a pediatric neurologist in Hawaii by phone, and the neurologist among my Texas colleagues via email. In the interest of brevity (yes, believe it or not, I know what that means!), I am leaving out a lot; we ultimately made the diagnosis of sepsis (blood infection) when the blood grew out bacteria (*Enterococcus* for the medical folk). After 60 or so hours of care with meal breaks, 3 or 4 hour clips of sleep, and even "movie night," it was the last 2 hours of my care with her that turned out to be a real nail biter.

The night before, practicing the "art" and not the science of medicine, I decided to start steroids which are usually given for preparing to take the breathing tube out. I did not think I would actually do this because she was still comatose and although she was breathing well, I was concerned she could not protect her airway. I was acting on instinct, and the thought of what-if the tube came out during the transport was concerning. As it turned out, because of the danger involved, the transfer would be made at a specific location from our Humvee ambulance to the Iraqi one. I had volunteered to go on the former, but because of the situation, there would only be a driver and family member on the Iraq side, and the family member we were actually teaching how to "bag" the baby (breath for her with the breathing bag). This just did not sit well with me. Since I had already missed Mass, I felt like I had no reason to rush back home, and was planning on going on the transfer. Unlike how I was made to feel about "going outside the wire" in my camp, my offer to go on the transfer was not questioned, but I could not go on the second part of the trip to see that she arrived at the Iraqi hospital safely. I jested not unless I could look more middle-eastern,

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and someone else joked about it then being more of a "special forces" mission with me being on my own, but the ominous reference was made about not wanting to see me on Al Jazeera TV.

Unfortunately, at 1100 I found out my only way out would be at 1300. I had only 2 hours to basically get her to the most optimal point for transferring her in light of me not actually being there. Transportation was another thing so easily taken for granted in the U.S. I only had to go 8 or so miles, but going by land was out of the question: setting up a transport convoy involved multiple vehicles and was very complicated to arrange and the armored "bus" was recently taken offline and was not recommended for a doc anyway. So, I was at the mercy of hopping on whatever bird I could to take me "home." As I learned later, these were frequently shot at as they flew by, but this was not often noticed during the day (since it was easier to see the tracer fire at night) unless there was a bad hit, or holes were discovered in the bird later. Well, I had no choice; I was flying and doing so before I felt I was really finished with the patient.

She had done reasonably well, and basically she no longer needed the ventilator to breathe, but I was still worried about her airway. Even disconnecting the vent and having her breath through the tube on her own did not tell me if she would be able to maintain her airway when she had the tube pulled. I was glad I started the steroids the night before and gave a few more doses. Then, she did something I thought I would not see prior to my parting ways with her forever: she woke up. She had moved throughout her hospitalization with me, but it was seizure activity. She was gradually improving because she was withdrawing to pain, but this was the first time she moved her limbs purposefully and opened her eyes. So, faced with one of the most difficult clinic decisions of my professional life, and one made essentially in isolation, I decided to take the tube out, and this was just 45 minutes before I had to leave. I could not stay long enough to observe her, although I had the whole tube set-up ready to go if I needed to put another back in immediately. So, with everyone holding their breath (except her, thank goodness), I pulled the tube out.

She coughed and gagged which was normal, but it was clear she was breathing on her own and she maintained her own airway. I had just 15 minutes to observe her and write up the final notes, before I had to go and get all my body armor on for the ride home. I was able to check on her one more time after I was in full "battle rattle" with my ride reminding me, "sir, we have to go now," and she looked more like a baby should laying in a bed: peaceful, serene, and much better off than when we started our relationship 3 days earlier. Although I was still worried about possible residual brain damage, and was distracted by the rush to get me out of there and on the bird, I could not help but reflect on my connection to her. I would likely never see her again, and it was possible I might never know what happened to her, but I wondered what her life would be like, what kind of little girl, young lady she would grow into. My grounded realism still could not help but idealistically contemplate a future when I could meet her again in a peaceful Babylon.

Profundities pushed aside by the urgency of my departure, my whirl-wind weekend ended on the whirly-bird as quickly as it started, and I was back to a changed camp in my eyes, fully satisfied I could prepare for my departure. I said to several people, about the cliché, "The Lord works in mysterious ways," which is often used to describe when people cannot explain why things go bad, but I felt this had occurred with The Lord acting in poetic ways. Although this was not the only one, this was "the Big One;" why I had come to Iraq, or as the public relations people put it, "Why We Are Here."

I even got a sort of an "award" for the whole thing. Despite the romanticism of the Purple Heart, it is not really desirable in the sense you have to get hurt before you receive it. In my case, a lesson in



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cultural architectural differences gave me my own unique purple anatomic "award." The Iraq hospital shower was a faucet coming out of the wall of the bathroom; basically the whole bathroom became a shower. As such, the floor was very slippery on the day I finally caught up with bathing. To top things off, the step off into the room was the height of two regular steps. Thus, when I slipped and became airborne off that step, it should come as no surprise that as the entire weight of my body landed on my 4th left toe, I experienced the sensation like that of having it ripped off. Later, as I un-booted myself back "home" I noticed the toe was all purple. Although it was the first and smallest, it would not be the first bone I would break during this deployment (but that is another story!) Ergo, I earned my Purple Toe for my ordeal at the CSH.

I was very pleased to finally work with a real solid medical system with a great group of professionals that welcomed me as one of their own and tried very hard to convince me to stay. Alas, it was time for me to go and not just leave them, but leave the war. As such, I was neither ordered to stay nor were there hard feelings. I also later learned that the patient had been transferred the day after I actually left and was doing well.

I am a bit disappointed by the choppy nature of my recounting this experience and not being able to acknowledge the role of everyone, but I wanted to share it anyway despite the fact I had to leave a lot out. I am sure in the re-telling over the years, I will be able to tell more, particularly about the Iraqi heroes, as well as this child's name. As for me, one thing made it all particularly worthwhile: **she woke up.**

Aloha.

Joseph



Major Joseph D'Angelo, MD
HHC, 2nd Bn-299th INF

hiheart@shaka.com

Addendum 2/13/2006

On this, the one year anniversary of me entering Iraq on the 2nd of a 3 day convoy, I am again disappointed by the choppy nature of the tale, as well as the fact I left out a lot of the medically exciting details (like the spinal tap where the pressure just kept a-rising, and the follow up CT to satisfy my concern I might have herniated her), the absence of one of the real Iraqi heroes, and my lack of ultimate follow up, especially on the said Iraqi hero. Many months later, I will hint that the father and his family were also heroes, as was the Iraqi General in the ICU after his recently surviving an assassination attempt. As for the one person who acted basically as mediator between two cultures, I still feel it is too life-threatening to give the credit where it is due. Well, I am already considering going back later in the year, so maybe I will have an opportunity for in person follow up. Finally, and most importantly, I have kept in touch with my Iraqi counterpart who reports that a follow up call from the child's father indicated that she was doing fine. Considering all that she, and her country, have been through, I do not think we could ask for much more than that.

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Dearani, MD, cardiovascular surgeon at Mayo Clinic, Rochester, Minnesota and Children's HeartLink Medical Director.

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~CCT~

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The University of Michigan Congenital Heart Center is recruiting a full-time Pediatric Cardiologist at the Assistant or Associate Professor level (Clinical or Instructional Track based upon the credentials of the candidate) with a major interest in Pediatric Cardiac Intensive Care.

Responsibilities include patient care, teaching and research. Administrative opportunities exist and are commensurate with the level of interest and experience of the applicant. The University of Michigan Congenital Heart Center is a world renowned state-of-the-art treatment facility within the C.S. Mott Children's Hospital at the University of Michigan Health System. Care is provided by a team of over 20 highly specialized Pediatric Cardiologists, 4 Cardiac Surgeons, 15 Pediatric Cardiology Fellows, Pediatric Residents, Nurses, Anesthesiologists and Allied Health Professionals. The Pediatric Cardiothoracic Intensive Care Unit is a 15 bed unit and one of only a handful of intensive care units in the country dedicated entirely to children with congenital and acquired heart disease. Candidates should be B/C in Pediatrics and BC/BE in Pediatric Cardiology. Prior experience or advanced training in cardiac intensive care is highly desired. The University of Michigan is an Equal Opportunity Employer. Women and Minorities are encouraged to apply.

Interested physicians should contact or send CV to:

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**Pediatric Cardiologist
Outpatient Services
Columbus Children's Hospital
Heart Center**

The Heart Center at Columbus Children's Hospital, the pediatric teaching facility for the Ohio State University, is seeking a board certified or board eligible pediatric cardiologist to join the faculty at the assistant or associate professor level. This exciting full-time position calls for an individual with general pediatric cardiology skills focused on outpatient services. This position also has the potential to eventually assume a leadership role in outpatient services. This individual will report to the division chief of Pediatric Cardiology and will participate in programmatic growth encompassing all aspects of the Heart Center's mission including clinical service, education and research, either clinical or basic science. Currently, the Heart Center has nearly 9000 clinic encounters per year both on campus as well as at local and regional satellite clinics. The echocardiography laboratory performs 8000 studies annually using state-of-the-art transthoracic, transesophageal, fetal, intracardiac, intravascular, and 3D techniques. 450 surgical procedures are performed each year in the Heart Center. There are numerous opportunities to engage in translational research, quality assurance initiatives or cutting edge informational services. For additional information or to submit curriculum vitae please contact: Trish Leavitt at 303-670-2086 or tlevitt@faheyassociates.com.

The Ohio State University is an Equal Opportunity, Affirmative Action Employer. Women, minorities, veterans, and individuals with disabilities are encouraged to apply.

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