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ACC.15 and TCT@ACC-i2 March 14-16, 2015; San Diego, CA USA http://accscientificsession.acc.org/ACC.aspx

10th International Workshop on Interventional Pediatric & Adult Cardiology (IPC Workshop) March 19-21, 2015; Milan, Italy www.workshopioc.com/main.php

> PICS-AICS AP 2015 (Asia Pacific) April 1-4, 2015; Taipei, Taiwan http://www.picsymposium-ap.org

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> 25th International ACHD Symposium June 3-6, 2015; Toronto, Canada www.torontoachdconference.ca

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Right Aortic Arch and Isolated Left Subclavian Artery Arising from a Large Patent Ductus Arteriosus: Successful Non-Surgical Device Closure

By Howard Weber, MD, FSCAI; Khushboo Parikh, MD

Introduction

Isolation of the subclavian artery is a rare congenital cardiac anomaly of the aortic arch system, wherein the subclavian artery loses its connection with the aorta and arises from the pulmonary artery by way of the ductus arteriosus.1 Most often the isolation occurs on the left side with a right aortic arch and is frequently associated with Tetralogy of Fallot.4,10 This anomaly can produce a distinct pattern of flow through the brachiocephalic arteries. There is reversal of flow in the ipsilateral vertebral artery (vertebral steal) into the subclavian artery and pulmonary vessels via the ductus arteriosus.6 This may result in left heart volume overload and congestive heart failure symptoms if the ductus arteriosus is widely patent. We present a 9-month-old infant with a right aortic arch, and isolated left subclavian artery arising from a large ductus arteriosus resulting in a vertebral steal and, consequently, left-ventricular volume overload.

Case Report

A 9-month-old full-term infant was referred for evaluation of a heart murmur. She was

demonstrating slow weight gain (7.7 kgs) but no other symptoms of congestive heart failure. Physical examination was remarkable for a grade 2/6 continuous murmur and non-bounding peripheral pulses in all four

"Isolation of the subclavian artery is a rare congenital cardiac anomaly of the aortic arch system, wherein the subclavian artery loses its connection with the aorta and arises from the pulmonary artery by way of the ductus arteriosus.¹ Most often the isolation occurs on the left side with a right aortic arch and is frequently associated with Tetralogy of Fallot^{4,10}"

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extremities. Chest X-ray demonstrated mild cardiomegaly, increased pulmonary vascular markings and a probable right aortic arch. Echocardiography confirmed the presence of a right



Fig 1. Right aortic arch with mirror image branching, with foreign body in the esophagus. RCCA: Right common carotid artery, LCCA: Left common coratid artery. RSCA: Right subclavian artery, VA: Vertebral artery, MPA: Main pulmonary artery.

aortic arch, large Patent Ductus Arteriosus (PDA) with exclusive left-to-right shunting, elevated pulmonary artery pressures and left heart dilation. Cardiac magnetic resonance imaging demonstrated a right aortic arch with isolation of the left subclavian artery arising from a large ductus arteriosus. There was reversal of flow within the left vertebral artery into the isolated left subclavian artery during systole, with additional collaterals from the left thyrocervical trunk consistent with a steal phenomenon.

Under general anesthesia, the patient was brought to the catheterization lab for test occlusion of the ductus arteriosus and simultaneous assessment of left arm perfusion via angiography and blood pressure measurements to determine if transcatheter device closure of the large ductus arteriosus was feasible. Angiography demonstrated a right aortic arch with mirror image branching and isolation of the left subclavian artery which was perfused via the left vertebral artery with subsequent opacification of the branch pulmonary arteries via a large patent ductus arteriosus (Figure 1). Selective angiography transvenously in the isolated left subclavian artery demonstrated a large tubular (Type C) patent ductus arteriosus measuring 7mm in diameter and 20mm in length (Figure 2).

PDA

At this time, the left arm blood pressure recorded manually was 63/23mmHg. A long #6 French Cook sheath was then exchanged for the diagnostic catheter and advanced into the left subclavian artery through which a 10mmAmplatzer vascular plug II was introduced and positioned within the ductus arteriosus, but not released from the delivery cable. Selective left carotid artery arteriography was then performed and demonstrated excellent perfusion of the left subclavian artery via the left vertebral steal and absence of flow into the pulmonary arteries via the ductus



Fig 2: Left panel: Frontal projection of the left subclavian artery with faint retrograde opacification of the left vertebral artery which opacifies the main pulmonary artery via a large patent ductus arteriosus. Right panel: Lateral projection of the origin of the subclavian artery from the ductus arteriosus. LSCA: Left subclavian artery, PDA: Patent ductus arteriosus, MPA: Main pulmonary artery, VA: Vertebral artery.



Fig 3: Left panel: Frontal view with the 10mm Amplatzer Vascular Plug II positioned within the proximal aspect of the ductus but distal to the insertion of the left vertebral artery. Right panel: Lateral projection demonstrating the Amplatzer device in place and catheter in the left common carotid artery. LSCA: Left subclavian artery, VA: Vertebral artery, LCCA: Left common carotid artery, AVP: Amplatzer vascular plug.

arteriosus (Figure 3). At this time, a simultaneous manual blood pressure in the left arm remained normal and in fact slightly higher (79/38mmHg) when compared to baseline. The 10mm AVP II was subsequently released from the delivery cable without difficulty and follow-up angiography continued to demonstrate excellent left subclavian artery perfusion and complete closure of the ductus arteriosus (Figure 3). Repeat manual left arm blood pressure was once again reported as normal (80/39mmHg). The patient was discharged home the following day on no cardiac medications and has remained completely asymptomatic at latest follow-up, with no cardiovascular complaints or symptoms consistent with hypoperfusion of the left arm. Follow-up echocardiography has also demonstrated normal left ventricular dimensions with complete closure of the ductus arteriosus.

Discussion

Right aortic arch is classified into 3 subgroups:

- 1. Right aortic arch with aberrant left subclavian artery,
 - 2. Mirror image branching and,
 - 3. Isolated left subclavian artery.

Of these, right aortic arch with isolation of the left subclavian artery is the least common variety, occurring in only 0.8% of the 298 right arches reported by Stewart and colleagues.⁸

Embryologically, this defect occurs due to interruption of the left arch at two levels; one between the left common carotid and the left subclavian artery and the other distal to the attachment of the left ductus arteriosus.⁵ The isolated left subclavian artery is supplied by the ipsilateral vertebral artery and additional collateral vessels via the thyrocervical trunk. Theoretically this arrangement can produce symptoms of cerebral ischemia via a Subclavian Steal Syndrome, but, in fact, is similar to the physiology that occurs following a left subclavian flap repair for coarctation of the aorta.9 Nonetheless, it is only rarely seen in children.1 Symptoms of pulmonary overcirculation will be dependent on the size of the ductus arteriosus. If the pulmonary arterial pressures are elevated, then a right-to-left shunt via the ductus arteriosus will result in lower oxygen saturations in the left arm.⁴ If, however, the pulmonary pressures are low and the ductus arteriosus is large, then a significant left to right shunt into the pulmonary vascular bed may occur, resulting in left heart volume overload and congestive heart failure symptoms.5

In more than 50% of the reported cases, isolated subclavian artery is typically associated with other congenital cardiac malformations. Tetralogy of Fallot is the most common associated anomaly⁵ and microdeletions of chromosome 22q11 and Polyspenia Syndrome may also be associated.^{3,7} However, Luetmer and Miller described the lack of any associated intracardiac anomalies in 41% of the patients.



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The isolated left subclavian artery can be diagnosed via 2 dimensional echocardiography although additional non-invasive imaging via CT-angiography and cardiac magnetic resonance imaging should be diagnostic.⁴

In patients with associated congenital cardiac malformations, complete knowledge of the lesion is of utmost importance with respect to surgical repair. The subclavian artery cannot be used for patch angioplasty in aortic arch reconstruction and a modified left Blalock-Taussig shunt would likely be less effective due to low perfusion pressure.^{3,5}

In cases of isolated subclavian artery without associated cardiac malformations, surgical management includes reimplantation of the left subclavian artery to the aorta or surgical ligation of the ductus arteriosus.^{1,5} However, in our case catheter-based device closure of the ductus arteriosus with documentation of acceptable left arm perfusion appears to be the procedure of choice, thereby avoiding the need for a lateral thoracotomy incision and prolonged hospital stay/recovery.

Brief Introduction of Principal Author

Howard Weber, MD is a Professor of Pediatrics at the Penn State Hershey Children's Hospital and Director of the Pediatric Catheterization Lab. He completed his fellowship at Yale New Haven Hospital in 1989, and is a fellow of the American Academy of Pediatrics and the Society for Cardiac Angiography and Intervention.

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ССТ

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and management of patients with CHD.

Patrick W. O'Leary, MD

Overview:

- Describe the most appropriate use of these imaging modalities to treat complications of CHD in adults
- Assess the optimal indications for imaging guidance during percutaneous and surgical interventions for congenital heart disease
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Myocardial Infarction in Teenagers and Young Adults: A Case Series

Manoj Gupta, MD; Prasad Ravi, MD; Robert Gilkeson, MD; Ravi Ashwath, MD

Author's Statement: All the work was done at University Hospital, Case Western Reserve University, Cleveland, Ohio. There are no potential conflicts of interest, real or perceived – this includes: (1) study design; (2) the collection, analysis, and interpretation of data; (3) the writing of the report; and (4) the decision to submit the paper for publication. There are no sponsors for this study. The first draft of the manuscript was written by Manoj Gupta, and no honorarium, grant, or other form of payment was given to anyone to produce this manuscript. The final version of the manuscript has been seen and approved by all authors.

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Contributor's Statement

Dr. Manoj Gupta wrote the introduction, case description, discussion, conclusion and reference list sections. Dr. Prassad Ravi contributed to Case 2. Dr. Robert Gilkeson did the CT angiographic images. Dr. Ravi Ashwath did the MRI images and contributed to the cases, discussion and conclusion sections.

Abstract

Background: Acute myocardial infarction is rarely seen in healthy adolescents and young adults younger than 30 years of age. Differentiating myocarditis from acute myocardial infarction in healthy young adults and adolescents can be very challenging.

Aims: To delineate the specific findings which can help in differentiating acute myocarditis from acute myocardial infarction in healthy young adults and adolescents.



Figure 1: Initial electrocardiogram (ECG) for case 1 showing T-wave inversion in lead III, aVF (Black arrow) and q wave in lead III (Grey arrow).

Methods and Results

We reviewed the cases of three young males who presented to Rainbow Babies & Children's Hospital from April 2010 to June 2012 with the initial clinical diagnosis of myocarditis, but turned out to have myocardial infarction of various etiologies.

Conclusion

In patients with presumed myocarditis, focal ST segment changes on electrocardiogram (ECG) and segmental involvement on echocardiogram should be evaluated further to rule out coronary artery involvement. Further workup may include cardiac catheterization, or imaging modalities like cardiac magnetic resonant imaging (cMRI) or computed tomography angiogram (CTA). These imaging modalities play an important and complementary role in the evaluation of these challenging patients.

Key Words

Acute Myocarditis Acute Myocardial Infarction Teenage and Young Adults Cardiac Imaging

Introduction

Myocarditis results from inflammation of the heart muscle. It progresses through stages and has various manifestations. Patients with presumed viral myocarditis, which is the most common etiology in children, frequently have a prodrome of fever, myalgia and malaise for several days prior to the onset of myocardial dysfunction. The signs and symptoms which brings them to medical attention are: chest pain, dyspnea, exercise intolerance, syncope and palpitations.

Myocellular damage results in troponin-I leak, elevated cardiac enzymes, high



Figure 2: Coronary Computed Tomography Angiogram (CTA) showing segmental ectasia of the left anterior descending coronary artery (White arrow).

creatine kinase levels (CK-MB), ECG changes and decreased ejection fraction on the echocardiogram. The endomyocardial biopsy (EMB) has remained the gold standard for the diagnosis of myocarditis,¹ but is not performed as frequently in the current era. Most cases of myocarditis in children and young adults are diagnosed based on clinical findings along with ECG changes and elevated cardiac troponin levels.

We conducted a retrospective study at our institution where we reviewed the cases of chest pain and presumed myocarditis in healthy young adults and adolescents which turned out to be myocardial infarction of various etiologies on further investigation.

Methods and Results

We conducted a retrospective database search for the patients who were admitted with presumed myocarditis and turned out to have myocardial infarction on further workup, between the period April 2010 to June 2012. We found three cases which matched the inclusion criteria and here are these cases in brief:

Case 1

A 24-year-old, previously healthy male was admitted with chest pain. He had some shortness of breath, nausea and vomiting of one day duration. The initial ECG showed T-wave inversion in leads III, aVF and presence of q wave in lead III (Figure 1). Troponin-I levels were elevated at 13.82 nanograms per milliliter (ng/ml) (Normal < 0.06) and CK-MB Sponsored by



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was 132 ng/ml (Normal < 7 ng/ml). He was admitted for treatment with clinical myocarditis. The echocardiogram showed mildly depressed left ventricular ejection fraction at 50% and a hypokinetic inferior wall. Due to the segmental involvement on echocardiogram, heparin infusion was started and he was taken to the cardiac catheterization laboratory (Cath lab) for coronary angiogram. Coronary angiogram showed proximal aneurysmal left anterior descending coronary artery (LAD) dilatation along with occluded right coronary artery and multiple left-to-right coronary artery collaterals. Rheumatology was consulted and workup was negative for any vasculitis or connective tissue disorder. A diagnosis of inferior wall myocardial infarction (MI) was made, possibly secondary undiagnosed Kawasaki during infancy/childhood. A cMRI performed for assessing viability and better anatomic delineation of aneurysmal coronary artery size showed segmental akinesia and transmural enhancement myocardial delayed suggestive of inferoseptal wall infarction. Coronary CTA performed to further delineate his coronary artery system showed diffuse ectasia of left coronary artery system (Figure 2). No stents were placed in view of the high risk for aneurysmal rupture and he was treated medically. He improved with medical



Figure 3: Cardiac magnetic resonant imaging (cMRI) showing an area of delayed enhancement in the infero-apical region of left ventricle (White arrow).

management and was discharged home after three days of hospital stay in stable condition. No complications were noted on follow-up visits. An exercise stress test (EST) performed at one month follow up showed no evidence of ischemia at maximal workload and normal blood pressure response to exercise.



Figure 4: Coronary Angiogram showing filling defect due to dissection (Black arrow).

Case 2

A 17-year-old obese male presented with severe non-radiating retrosternal chest pain of one day duration which aggravated after pushups in gym. The symptoms started with nausea, one episode of vomiting, mild dizziness and shortness of breath a day prior to admission. On further interrogation he revealed a history of chest trauma two months prior to presentation (bars dropping over chest) during



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weightlifting with excruciating chest pain, which was diagnosed as musculoskeletal injury in the emergency department (ED). His troponin-I levels were slightly elevated at 0.66 ng/dl in ED and ECG revealed ST segment elevation and deep q waves in lead III and aVF. He was admitted, and troponin I levels were trended which peaked on Day 2 of admission to 16.7ng/ dl. Initial echocardiogram failed to show any wall motion abnormalities, secondary to the poor acoustic windows. His chest pain improved within a few hours after admission. With rising troponin levels and concerns for myocarditis vs myocardial infarction, cMRI was performed, which showed severe hypokinesia of the apical and inferior region of the left ventricle. Delayed contrast enhancement suggested discrete infarcted area (Figure 3). Due to the segmental involvement he was taken to the cath lab and coronary angiogram revealed intramural dissection of the proximal LAD with distal thrombus and multiple filling defects even in the left main coronary artery (Figure 4). Heparin infusion was started and he was managed conservatively. He was discharged home in stable condition and he has been doing well since then.

Case 3

A 16-year-old male was admitted for severe retrosternal chest pain. The pain started after about 20 minutes of hockey practice, with no improvement after several hours of rest. His symptoms started with sore throat and cough two days prior to admission. His initial ECG in the ED was normal; however, his troponin levels were high at 0.28 ng/ml. He was admitted with presumed myopericarditis. His chest pain subsided after admission. Troponin-I levels were trended and they peaked to 16.38ng/ ml next day. Echocardiogram showed mild left ventricular dysfunction with regional dyskinesia of the basilar septum. He was taken to cath lab and angiograms showed normal left ventricular contractility but hypokinetic apex and anterolateral wall. The coronary anatomy was right dominant. The left main coronary artery was normal along with normal circumflex and left anterior descending coronary artery branches. A 30-mm-long segment muscle bridge was seen in the mid-left anterior descending coronary artery. TIMI flow grade was suggestive of a long segmental intramyocardial bridge in mid LAD. cMRI performed to evaluate myocardial viability and regional wall motion revealed mild dyskinesia of apex consistent with apical MI (Figure 5). He was managed medically after a detailed discussion involving surgeon, interventional cardiologist and the primary team. He had an uncomplicated

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Opportunities exist for clinical research and collaboration through the Stanley Manne Children's Research Institute of Chicago; teaching of housestaff is an important role.

Ann & Robert H. Lurie Children's Hospital of Chicago is ranked among the nation's top 10 children's hospitals. Our Heart Center includes 33 attending cardiologists, nine categorical cardiology fellows, two senior CICU fellows and several additional advanced fellows, three pediatric cardiac surgeons, an accredited congenital heart surgery fellowship program, and a dedicated cardiac anesthesia service. Our cardiac surgeons perform over 400 cardiac operations per year and achieve outcomes that rank among the best in the nation (STS-CHS Database). We also have one of the highest volume heart transplant programs in the country and a busy mechanical cardiac support program (VAD, ECMO & E-CPR). Our cardiac program is the largest in Illinois and provides expertise in echocardiography, electrophysiology, interventional cardiac catheterization, heart failure/transplant, adult congenital heart disease, cardiac critical care and preventative cardiology. Cardiac intensive care services are provided in the state-of-the-art 36-bed Regenstein Cardiac Care Unit.

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Proposed starting date is July 1, 2015. Applications will be accepted until the position is filled. Interested applicants should forward letter of intent, curriculum vitae, and three (3) references to:

Elfriede Pahl, M.D. Medical Director, Heart Transplantation Co-Director of Academic Affairs and Marvin E. Wodika Research Chair of Cardiology Ann & Robert H. Lurie Children's Hospital of Chicago 225 East Chicago Avenue, Box 21 Chicago, Illinois 60611-2605 312-227-4389 Email: epahl@luriechildrens.org

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hospital stay and was discharged home in stable condition. The final diagnosis was myocardial bridge with coronary spasm leading to MI. A coronary CTA performed two months later, revealed a shallow intramyocardial segment (Figure 6). Follow up EST showed normal cardiopulmonary response to sub maximal exercise.

Discussion

Myocarditis is the acute inflammation of the myocardium resulting in myocellular damage. Classically, diagnosis of myocarditis has been confirmed based on the Dallas criteria of EMB1. Microscopic findings of myocarditis are characterized by an inflammatory infiltration with



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necrosis and/or degeneration of myocytes. It is usually asymptomatic with complete resolution in most cases. However, it may progress to fulminant cardiac failure resulting in death or requiring cardiac transplantation. Clinical and experimental data suggest that in myocarditis, elevated troponin levels reflect myocardial injury and



Figure 5: cMRI showing an area of delayed enhancement suggestive of myocardial infarction (White arrow).

are frequently measured whenever myocarditis is a clinical concern.^{2,3}

The evaluation of adolescents and young adults with chest pain, elevated cardiac enzymes and focal ECG changes poses a diagnostic dilemma, since myocardial infarction is uncommon in this population.⁴

We reviewed the records of three young males who came in with chest pain and were admitted with a clinical suspicion of myocarditis, along with elevated troponin levels; focal and segmental ECG and echocardiographic changes led to further investigations which revealed myocardial infarction as the cause of their symptoms.

Although myocarditis should be considered in the differential diagnosis of adolescents & young adults with acute chest pain, the diagnosis of myocardial ischemia secondary to coronary involvement should be considered as well.

cMRI has recently emerged as a robust imaging method for evaluation of myocarditis.5 With ECG-gating, high-temporal resolution imaging provides comprehensive evaluation of wall motion abnormalities and myocardial tissue abnormalities such as edema and necrosis. In myocardial infarction, myonecrosis propagates outward from the subendocardium while respecting vascular territories. However, in myocarditis, myonecrosis is frequently patchy with subepicardial or mesomural involvement, not restricted to a vascular territory.6,7,8 On contrast and delayed enhancement imaging, cMRI can differentiate viable from nonviable myocardial tissue and also can differentiate between epicardial or endocardial involvement.



Figure 6: Cardiac CTA showing a short shallow intramyocardial segment seen in the mid left anterior descending coronary artery (White arrow).

Conclusion

We reviewed a series of three young males with initial clinical diagnosis of myocarditis which later turned out to be myocardial infarction of various etiologies. Monitoring of troponin levels is important in any patient who presents with chest pain and elevated troponin levels. In patients with presumed myocarditis, the presence of focal ST segment changes and/or segmental wall motion abnormalities on echocardiogram should be evaluated further to rule out coronary artery involvement. In the presence of regional myocardial abnormality, cMRI can play an important and complementary role in the evaluation of these challenging patients.

If despite these studies the disease process remains unclear or symptoms persist, then coronary angiography, CTA or EMB should be considered to differentiate myocarditis from coronary artery involvement as a cause of acute chest pain.

We therefore conclude that chest pain in adolescent and young adult patients with elevated cardiac enzymes and abnormal ECG without risk factors should not always be attributed to myocarditis, although it is a more probable diagnosis in this population. On the contrary, cMRI should be considered to support the diagnosis in these clinical settings. If the diagnosis is not clear or there is a suspicion for myocardial infarction; other testing modalities like CTA, coronary angiogram and EMB may be needed as warranted.

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CHP NETWOR

WHAT IS THE CHIP NETWORK? - The CHIP Network, the Congenital Heart Professionals Network, is designed to provide a single global list of all CHD-interested professionals in order to:

- Connect pediatric and adult CHD-interested professionals to events, conferences, research opportunities and employment
- Keep members up with the literature through the monthly Journal Watch service
- Increase education and provider awareness of new developments
- Bring the pediatric and adult congenital heart communities into closer contact
- Offer a communication tool for critical issues

WHO SHOULD PARTICIPATE? - The CHIP Network is all inclusive and is comprised of everyone who considers themselves a congenital heart professional or administrator, including:

- Pediatric cardiologists
- ACHD cardiologists
- **RNs and APNs**
- Cardiac surgeons
- Cardiac care associates
- Trainees/fellows
- Administrators
- Psychologists and mental health professionals
- Researchers/scientists
- Intensivists
- Anesthetists Industry representatives

- OUR SUPPORTING PARTNERS:
- Adult Congenital Heart Association
- Asia Pacific Society for ACHD Children's Hospital of Philadelphia Cardiology meeting
- Cincinnati Children's Hospital
- Congenital Cardiology Today (official publication of the CHiP Network) Congenital Heart Surgeons Society
- International Society for Adult Congenital Heart Disease
- Japanese Society of ACHD Johns Hopkins All Children's Heart Institute North American ACHD program
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- PCICS
- PICS
- Specialty Review in Pediatric Cardiology
- World Congress of Pediatric Cardiology and Cardiac Surgery

JOIN US - Membership is Free!

The CHiP Network management committee invites the participation of other organizations who want to communicate with all or some of the congenital heart professionals on this list. Please contact Dr. Gary Webb (gary.webb@cchmc.org) to ask that your organization's or institution's name be added to the list of partner organizations.

HOW TO REGISTER

Register at www.chipnetwork.org. It takes only a minute and you can unsubscribe at any time.

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Highlights of the 2nd Bangkok International Fetal Echocardiography Conference

Mark Sklansky, MD and Alisa Limsuwan, MD

The 2nd Bangkok International Fetal Echocardiography Symposium, held January 14-16, 2015, proved to be even more successful than the inaugural symposium held in 2014. Like the first symposium, this conference was held at the majestic Shangri-La Hotel, located on Bangkok's famous Chao Phraya River. Both years, this pioneering international fetal echocardiography symposium in Thailand has attracted a truly international group of attendees, composed predominantly of physicians (pediatric cardiologists, maternal-fetalmedicine subspecialists, and trainees), but also included sonographers and representatives from industry.

The symposium, directed by Drs. Alisa Limsuwan and Suthep Wanitkun, and with organizational support from Drs. Katunyuwong, Poomiporn Patama Promsonthi, and Boonsri Chanrachakul, featured international speakers (Dr. Mark Sklansky-pediatric cardiologist at UCLA, Dr. Giuseppe Rizzo-maternalfetal-medicine specialist from Rome, and Dr. Tze Kin Lau-maternal-fetalmedicine specialist from Hong Kong), as well as widely respected pediatric cardiology, maternal-fetal-medicine and pathology experts from Thailand. The symposium provided a comprehensive series of didactic lectures from experts in pathology, pediatric cardiology, maternalfetal-medicine, and radiology. Woven seamlessly into the didactic schedule were clinically compelling case presentations,





a series of hands-on opportunities for registrants to scan actual patients with guidance from Drs. Sklansky and Rizzo, and live scanning by Dr. Sklansky of a fetal patient with heterotaxy.

The symposium's didactic line-up began with formal presentations on fetal cardiac pathology, genetics, and physiology, followed by a discussion of first trimester evaluation and the role of nuchal translucency thickness evaluation. Next, speakers presented a series of talks on current guidelines for fetal cardiac screening, and basic and more advanced techniques for fetal cardiac evaluation. Following these background discussions, experts presented a broad series of detailed, clinically-oriented lectures on abnormalities of the fourchamber view and outflow tracts. The third and final day of the symposium included formal presentations and case presentations of fetal arrhythmias and of fetal 3D/4D cardiac imaging, an overview of fetal cardiac tumors and, finally, a discussion and summary of take-home pearls for all those involved with fetal cardiac imaging.

Throughout the conference, registrants enjoyed the incredible beauty and cuisine of the lavish Shangri-La Hotel, with regular breaks and daily lunch at Shangri-La's world-class Next2 Cafe restaurant. During additional breaks, registrants enjoyed interacting with representatives from Philips, Life Vision/GE, and Berli Jucker (Aloka), who demonstrated their latest equipment and software.

Given the tremendous success of this second international symposium, plans are already underway for the 3rd Bangkok International Fetal Echocardiography Symposium. Dates will be announced soon; please contact Dr. Alisa Limsuwan



for additional information at alimsuwan@ yahoo.com or bkkfetalecho.com.

ССТ

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Medical News, Products & Information

Complied and Reviewed by Tony Carlson, Senior Editor

3-D Printed Heart Could Reduce Heart Surgeries in Children Doctors can perfect procedures on a model before the intervention

Vienna, Austria - 5 December 2014: New 3D printed heart technology could reduce the number of heart surgeries in children with Congenital Heart Disease, according to Dr Peter Verschueren who spoke on the topic today at EuroEcho-Imaging 2014. Dr Verschueren brought 3D printed models of the heart to his lecture including models used to plan real cases in patients.

EuroEcho-Imaging is the annual meeting of the *European Association of Cardiovascular Imaging (EACVI),* a branch of the *European Society of Cardiology (ESC),* and is held 3-6 December in Vienna, Austria.

Dr. Verschueren said, "Children with congenital heart disease often need up to four open-heart surgeries at different times of life. The 3D printed copy of the heart could reduce this to one or two because doctors can choose and practice the best interventional approach and device beforehand. This will avoid children spending months in intensive care."

Three dimensional (3D) printing uses a machine to print objects layer by layer. Instead of ink the printer uses plastics, metals and other materials. The technology was first used in the automotive and aerospace industries to make prototypes. Dr. Verschueren said, "You can make complex, unique things, which is useful in medicine because each patient is different."

3D printing entered the medical field around two decades ago in craniomaxillofacial and orthopaedic surgery. 3D reconstructions of a patient's bone were made from a computed tomography (CT) scan. Today the technology is also used to make hearing aids. Printing 3D hearts was made possible with flexible materials for printing and fast scanners that can trace the beating heart. A CT or magnetic resonance imaging (MRI) scan is used to print muscles and valves which can be beating or static.

The models are used to plan surgeries in children with congenital heart diseases such as double outlet right ventricle or Tetralogy of Fallot. Dr. Verschueren said, "Until recently, doctors would look at an image and then try to visualise the heart in 3D. Now they can use a 3D copy of an individual patient's heart to plan the procedure in detail before they go into the operating theatre."

He added, "This is still a relatively new technology but there is increasing interest in using 3D printed models to plan heart valve interventions in adults. This could include complex bicuspid aortic valve cases that doctors want to treat with transcatheter aortic valve implantation (TAVI) and new transcatheter interventions for repairing or replacing the mitral and tricuspid valves." Today at *EuroEcho-Imaging*, biomedical research engineer Helen O' Grady from Galway, Ireland, presents a novel 3D printed model of tricuspid regurgitation she developed to test a new device and train interventionists in the implantation procedure. Ms. O'Grady used CT scans of tricuspid regurgitation patients to build a 3D software model which she then used for 3D printing of a right heart and tricuspid valve annulus model.

She took the additional step of using the 3D printed model to mould a more flexible model that is compatible with echocardiography and fluoroscopy. It is housed in a cardiac anatomy rig that replicates the anatomical conditions of the heart in the body as well as the leaflet motion of the valve. Doctors can use the model to practice implantation of the device on a patient's exact anatomy before the procedure.

Ms. O'Grady, said, "There is a variation in normal anatomies and more so in diseased anatomies such as tricuspid regurgitation. Being able to practice on the model allows for better surgical planning and doctors can optimise the interventional procedure pre-operatively. Cardiologists, surgeons and physicians say there's nothing like having a tangible model in your hands as it gives such invaluable insight into the patient anatomy involved." She added, "3D models can be used to discuss the intervention with the medical team, patients and, in the case of congenital heart defects, with parents. It helps everyone affected to better understand what the procedure will involve."

Professor Patrizio Lancellotti, EACVI President, said, "3D imaging is a main theme of *EuroEcho-Imaging* this year and 3D printing of the heart is particularly exciting. It allows us to make a perfect model of a patient's anatomy and decide the optimal device and procedure in advance."

Aiken Regional Medical Center Selects Digisonics Cardiovascular Information System

Aiken Regional Medical Center in Aiken, S.C. has selected the Digisonics Cardiovascular Information System (CVIS) for their echo and cardiac/vascular catheterization studies. The Digisonics CVIS provides the hospital's clinicians with the ability to quickly review images and create structured reports for their cardiovascular studies. WebView, an easy-to-use universal viewer application, will allow users to quickly access their patient images and reports from HTML5 capable web browsers and a variety of operating systems and devices including iPads, tablets and Macs.

The Digisonics Cardiovascular Information System will significantly streamline Aiken Regional Medical Center's cardiac catheterization structured reporting workflow. A HemoLink interface will connect the hospital's GE MacLab hemodynamics system to the Digisonics CVIS, autopopulating demographics, hemodynamic measurements, medications and other data directly into the study. Users will also have access to cardiac



THE UNIVERSITY OF MARYLAND CHILDREN'S HOSPITAL

Welcomes MICHAEL C. SLACK, MD, AS

Director of Pediatric and Congenital Interventional Cardiology

Dr. Slack, who has been appointed to the faculty of the UM School of Medicine, joins the Children's Hospital from Children's National Medical Center where he has been since 1999. There, he served as director of the cardiac catheterization laboratories. He also established the Adult Congenital Interventional Cardiac Catheterization



Program at MedStar Washington Hospital Center.

Educated at the Uniformed Services University of the Health Sciences, Dr. Slack completed a pediatric residency at Walter Reed Army Medical Center. This was followed by a tour of duty as a pediatrician in Germany. He continued his training with fellowships in pediatric cardiology and congenital interventional cardiology at Texas Children's Hospital and Baylor College of Medicine. He then served as faculty at Walter Reed. At the end of his Army service, Dr. Slack entered private practice in Arizona serving as director of Congenital Interventional Cardiac Catheterization at Phoenix Children's Hospital and St. Joseph's Medical Center.

Dr. Slack's clinical interests are numerous, including intravascular stents and occlusion of complex septal defects. An avid researcher, he has been principal site investigator on many device trials and continues to study the use of MRI imaging over ionizing X-rays.

In this new role, Dr. Slack will oversee the hybrid pediatric cardiac catheterization suite where he will continue his 31-year career treating patients of all ages with congenital heart problems.

To reach Dr. Slack or to schedule an appointment, please call 410-328-4348.



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catheterization image analysis and quantitation capabilities via seamless integration of the Digisonics CVIS with Medis QAngio XA. A single click launches the Medis advanced cath image analysis software directly from the Digisonics workstation and the results of the analysis performed are saved back into the study for a fully integrated workflow.

The facility will also implement the Digisonics Search Package, a comprehensive, user-configurable search engine. This

powerful tool allows the facility to quickly set up search criteria to extract clinical information for use in research, compile statistics required for accreditation and generate management reports to target areas for productivity and efficiency.

Aiken Regional Medical Center will seamlessly integrate their Cerner EMR with the Digisonics CVIS via HL7 interfaces for Orders In and Results Out. A DigiLink add-on to the HL7 Results Out interface provides their clinicians with access to PDFs of the finalized cardiovascular reports within their EMR. The hospital will also utilize Digisonics DigiConnect, a new application allowing users to launch any 3rd party systems (such as EMR/HIS, PACS or ECG management software) directly from the Digisonics cardiovascular information system workstation. Users benefit from the convenience of a single sign-on as user credentials and patient information are passed directly to the 3rd party systems.

Integration with Aiken Regional Medical Center's GE and Philips ultrasound machines will autopopulate the patient demographics and measurements directly into the Digisonics structured report, reducing manual entry time and eliminating the potential for entry errors. DICOM Modality Worklist will automate transfer of patient demographics to the facility's imaging modalities, creating a list of scheduled patient studies and significantly reducing manual data entry time. Legacy images will be migrated and forwarded to Aiken Regional Medical Center's vendor neutral archive. Access of archived images will be via Digisonics DICOM Query & Retrieve with Prefetch module.

As a result of implementing the Digisonics CVIS, Aiken Regional Medical Center will enjoy a seamless digital workflow with improved efficiency, greater reporting accuracy and faster report turnaround times.

For further information, visit www.digisonics.com

Revolutionary Software Helping Overhaul Inefficient Healthcare Delivery, Improve Patient Safety and Outcomes

Challenged with cutting expenditures while delivering better care within the world's most expensive healthcare system, U.S. hospitals are increasingly turning to time-motion studies (TMS) - a technique that reveals how inefficiencies and irregularities in workflow impact costs and patient outcomes.

Despite the introduction of dozens of TMS software programs in the last decade, no single platform has gained traction, primarily because many were developed for individual projects with limited features that offered little benefit over the traditional TMS method of capturing data with a stopwatch, pen and paper.

"Issues in existing TMS software programs make the data from them questionable, difficult to analyze and impossible to compare across institutions," said clinical workflow expert Marcelo Lopetgui, MD, MS in The Ohio State University College of Medicine Department of Biomedical Informatics. "TMS are such powerful tools for guiding resource and training decisions, but the current software really holds back their potential for providing insights into healthcare delivery problems."

Stunned at how an efficiency-driven process had become so inefficient, Lopetegui, a physician-turned -biomedical informatics researcher, decided TMS software needed more than an upgrade, a complete overhaul that would change the way it looked, functioned and performed was needed.

Having honed his programming skills developing websites for friends in medical school, Lopetegui developed a software platform called TimeCaT (Time Capture Tool) that solves existing software problems with mobility, user interface, and data collection, analysis and validation – areas that had never before been standardized in TMS, ultimately threatening the accuracy and usefulness of previous studies. "If you conduct a study on how long ICU staff takes to sanitize their hands between patients in order to help reduce infection rates and your observers are clocking the same activity from different start points the data will be wrong. It sounds simple, but if resources are allocated or changes made based on inaccurate information, you haven't solved the problem and have potentially made it worse."

With an open access, web-based platform, TimeCaT has relied on user feedback to help the program evolve and improve. Since 2010 the team has been releasing new versions of TimeCaT to what they call the "TimeCAT community," a consortium of approximately 50 users spanning ten major universities on three continents.

TimeCaT's supporters continue to grow as Lopetegui and others have given presentations and published studies about the software's use in areas ranging from ambulatory care to emergency medicine, proving that TimeCaT is flexible enough to apply to a diversity of clinical settings.

Department of Biomedical Informatics Chair, Philip R. O. Payne, PhD, who recruited Lopetegui from Chile and was his post-doc mentor, says that TimeCat's greatest accomplishments have been to raise the bar on what scientists can expect from TMS, and offer reliable data that can shape and improve medicine worldwide.

"TimeCaT is allowing us to systematically and rigorously collect data on how people perform their jobs while interacting with technology, their environment and their coworkers in a way that wasn't possible before," said Payne, who is also the inaugural Director of the Data Analytics Collaborative, which is part of the Discovery Themes initiative at Ohio State. "It represents the best of what biomedical informatics has to offer: a human factors approach to making sense out of massive amounts of data in order to improve the delivery of safe and cost effective health care." Making TMS, technology work harder – and smarter, Lopetegui's first step to improve TMS software was to make the data collection process easier and less error-prone. He made TimeCaT a web-based platform that was able to work on any internet-capable device, harnessing mobile and touch-screen technology that lets observers keep their eyes on the activity.

He included other features that many digital TMS systems don't have, such as: a simple graphical user interface, the ability to correct an order collection error in the field, automated time stamps to make workflow analysis more accurate, and cloud-based data collection that allows off-site researchers to track incoming data from around the world in real time.

Another major flaw TimeCaT addresses is observer validation, which among TMS is often challenging. TimeCaT is programmed with one of the first-ever inter-observer validation algorithms. The tool allows researchers to perform a test run of their study to gauge the accuracy of the eyewitnesses and to conduct on going validity tests throughout the data collection.

Lopetegui was also the first to try to introduce a standard taxonomy, or language, to TMS, that would prompt researchers to use a common set of terms to describe tasks, which enables scientists – for the first time – to accurately pool data from multiple studies.

"The action of "hand-washing" has literally been described a dozen different ways," said Lopetegui. "On the website researchers can find out what terms have already been used, or share their own for others to use. This and other features make it possible for researches to reliably aggregate and compare data across thousands of study locations."

Lopetegui says that the team will continue to roll out new versions of TimeCaT with expanded features, many of which have Watch over 300 Live Case Videos, Presentations and Workshops Online from International Congenital and Structural Medical Meetings

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Resources for Professionals

The ACHA website offers resources for ACHD professionals as well as for patients and family members.



UF FLORIDA

Florida – Pediatric Cardiology

The Department of Pediatrics at the University of Florida College of Medicine-Jacksonville is recruiting a full-time faculty member to the Division of Pediatric Cardiology (# 00023622) as a clinician-educator on the non-tenure, multi-mission academic track. We seek an excellent general cardiologist who will divide duties between attending on the inpatient service at Wolfson Children's Hospital and participating in our expanding outpatient satellite clinics. Night and weekend call responsibilities will be shared equitably with other division faculty. The successful candidate is expected to provide outstanding clinical care in a patient and family centric environment. The successful candidate must be able to evaluate and manage children with complex congenital heart disease and to interpret transthoracic echocardiograms accurately. Excellent interpersonal and communication skills are essential. Prior experience in telemedicine is desirable. The Division follows approximately 7,500 children per year. Full participation in all other divisional activities such as the education of residents, fellows and medical students and attendance at divisional conferences are required. The appointment will be at the Assistant/Associate Professor level depending upon experience and qualifications. The congenital heart program at consists of 9 pediatric cardiologists and 2 congenital heart surgeons who provide care to children from northeast Florida, southeast Georgia as well as children in the international community. Jacksonville is a vibrant, young, and growing community. The catchment population for Wolfson Children's Hospital exceeds 1.5 million.

Applicants must possess a MD/DO degree, be BE/BC in pediatric cardiology, and be eligible for Florida medical licensure. Applications will continue to be considered until the position is filled.

To apply for this position visit https://jobs.ufl.edu/ and search for requisition number 0907275.

Attach curriculum vitae, the names and addresses of three references and a letter of intent addressed to: Frank J. Genuardi, MD, Search Committee Chairman University of Florida College of Medicine - Jacksonville 653-1 West 8th Street Jacksonville, FL 32209

The University of Florida is an equal opportunity institution dedicated to building a broadly diverse and inclusive faculty and staff. Please see our website at www.hscj.ufl.edu/pediatrics.

been suggested and then tested by the community – which has grown beyond the healthcare realm.

"We have had a professional soccer team use TimeCaT to see if they could improve their game," said Lopetegui. "I'm not sure if it worked for them, but it was the perfect validation for me that we had created something truly accessible, functional and adaptable."

TimeCaT was developed with support from Ohio State's Center for Clinical and Translational Science (CCTS). Collaborators include Philip Payne, PhD,FACMI Professor and Chair, Department of Biomedical Informatics and Director of the Data Science Cluster for the Ohio State CCTS; Po-Yin Yen, RN, PhD, Assistant Research Professor of Biomedical Informatics; Albert Lai, PhD, Assistant Professor of Biomedical Informatics; Peter Embi, MD, MS, Associate Professor and Vice-Chair, Department of Biomedical Informatics and Chief Research informatics officer for Ohio State's Wexner Medical Center.

For more information, visit osumc.edu.

MAVIG INNOVATIONS FROM RSNA 2014

To help address the longtime of concern tableside exposure to scatter radiation, MAVIG introduced to RSNA 2014 a new innovation in personal protective shielding. The WD261 is designed for protection optimized against scatter X-ray with zero installation cost and footprint.

Interventionalists will appreciate the ability to:

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The Barth Syndrome Foundation

P.O. Box 974, Perry, FL 32348

Tel: 850.223.1128 info@barthsyndrome.org www.barthsyndrome.org **Symptoms:** Cardiomyopathy, Neutropenia, Muscle Weakness, Exercise Intolerance, Growth Retardation





Procedures involving fluoroscopy are becoming more complex, longer and can require the interventionalist to change the patient access point away from conventional access points, thus increasing the risk of radiation exposure. To address this concern, the WD261 provides a portable protective barrier where it's needed. The WD261 offers flexible, portable radiation protection that differs from the conventional table attachable shields. When used in tandem, the scatter radiation exposure is decreased to the physician, as well as to the ancillary staff.

The WD261 can also be easily moved from room to room and due to its compact

design and portability, the clinical staff can have their own personal protection device to reduce X-ray exposure.

Technology is optimizing dose output and new features are enhancing measuring and tracking dose exposure. Combining these advancements with the WD261 provides clinicians the ultimate non-intrusive protective barrier, allowing allows clinicians to work freely around the patient and shield against scatter radiation, heightening overall safety while allowing the utmost in patient care.

For more information: http://www.mavig. com/system-solutions/mobile-shields/ wd261/

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