

CONGENITAL CARDIOLOGY TODAY

Timely News and Information for BC/BE Congenital/Structural Cardiologists and Surgeons

January 2017; Volume 15; Issue 1
International Edition

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Editorial and Subscription Offices

16 Cove Rd, Ste. 200

Westerly, RI 02891 USA

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Official publication of the CHiP Network

Cyanosis from Portosystemic Shunt after Fontan Completion

Ege Ozdemir, MD; Saadeh B. Jureidini, MD; and Renuka E. Peterson, MD

Introduction

Heterotaxy may be associated with various forms of venous anomalies. We describe here anomalous venous drainage from a portosystemic communication that resulted in severe cyanosis in a heterotaxy patient after Fontan completion.

Case Report

A newborn male was diagnosed shortly after birth with Heterotaxy Syndrome, asplenia and Complex Congenital Heart Disease (CCHD). His cardiac anatomy consisted of dextrocardia, common atrium, unbalanced atrioventricular canal, double outlet right ventricle with subpulmonary and pulmonary valve stenosis, and obstructed infradiaphragmatic Total Anomalous Pulmonary Venous Return (TAPVR). His systemic venous anatomy demonstrated a right-sided inferior vena cava with right hepatics draining to the inferior vena cava while the left hepatics drained separately to the common atrium. A left superior vena cava drained to the left superior portion of the common atrium; a right superior vena cava was absent.

He initially underwent repair of the anomalous pulmonary venous return in the neonatal period, and then subsequently had a left-sided bidirectional Glenn shunt with division of the main pulmonary artery. Fontan completion was achieved with an extracardiac, fenestrated conduit on the left with incorporation of the hepatics. Postoperatively, his saturations remained unusually low for a fenestrated Fontan, in the high 60s to low 70s. A

postoperative echocardiogram suggested residual venous drainage inferiorly to the atrium (Figure 1), prompting cardiac catheterization.

The catheterization demonstrated a newly opened right superior vena cava draining to the common atrium (Figure 2A). Prior catheterizations with injection in the innominate vein and at surgery had not shown any evidence of patency. Since an additional venous source of blood flow inferiorly was also suspected, the catheter was passed into the atrium from the right superior vena cava and the atrium was probed. An unusual accessory vein was shown by angiography draining directly to the inferior aspect of the common atrium (Figures 2B, 2C) and this vessel was remote from the pulmonary veins. Further characterization by abdominal CT demonstrated that the accessory vein arose from the portal vein (Figure 3).

The right superior vena cava was occluded with a transcatheter device. The patient then underwent exploratory laparotomy and a large vessel from the portal vein was confirmed that drained to the inferior aspect of the atrium, again noted to be away from the pulmonary veins. The portosystemic vein was surgically ligated and the patient had improvement in his oxygen saturations to the high 80s to 90s on room air and was discharged.

Discussion

Heterotaxy Syndrome is a failure of lateralization during embryological development leading to bilateral right-sidedness (asplenia) or bilateral left-sidedness (polysplenia), often accompanied by CCHD. Proper cardiac surgical management of patients with heterotaxy syndrome is contingent upon recognizing associated

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complex venous anomalies. Variations in both systemic venous return and pulmonary venous return have been well-described in the literature.^{1,2} Many patients with heterotaxy and asplenia have bilateral superior vena cavae, however only a portion of these may be patent.² Our patient, despite documented absence of a right superior vena cava previously, displayed recanalization of this persistent embryologic structure, which accounted for some of his desaturation.

Since this patient had infradiaphragmatic TAPVR, the additional aberrant vessel connecting to the portal system was thought to possibly represent a persistent vertical vein, which has been described in the literature.⁹⁻¹² However, on cardiac catheterization, the vessel was easily engaged directly from the atrium as opposed to through the pulmonary venous anastomosis and the vessel was not seen on levophase or pulmonary capillary wedge injection. This is in contrast to prior reports of persistent vertical vein after TAPVR repair, including a persistent vertical vein post-Fontan¹³ with right to left shunting where the vertical vein drained via a pulmonary vein to the atrium. On multiple imaging modalities and direct visualization, the aberrant vessel in our patient was remote from the pulmonary veins and entered separately at the base of the atrium.

In addition, at the time of catheterization, the pressure in the aberrant venous vessel was identical to the pressure tracing in the common atrium, whereas the direct pulmonary venous pressures were higher due to mild pulmonary vein obstruction bilaterally. We would expect that if the aberrant vessel were related to a persistent vertical vein, it should have the same pressures as the pulmonary venous system. If there was direct communication with the pulmonary venous system from this vessel, then shunting in this patient should be left to right given the higher pressure in the

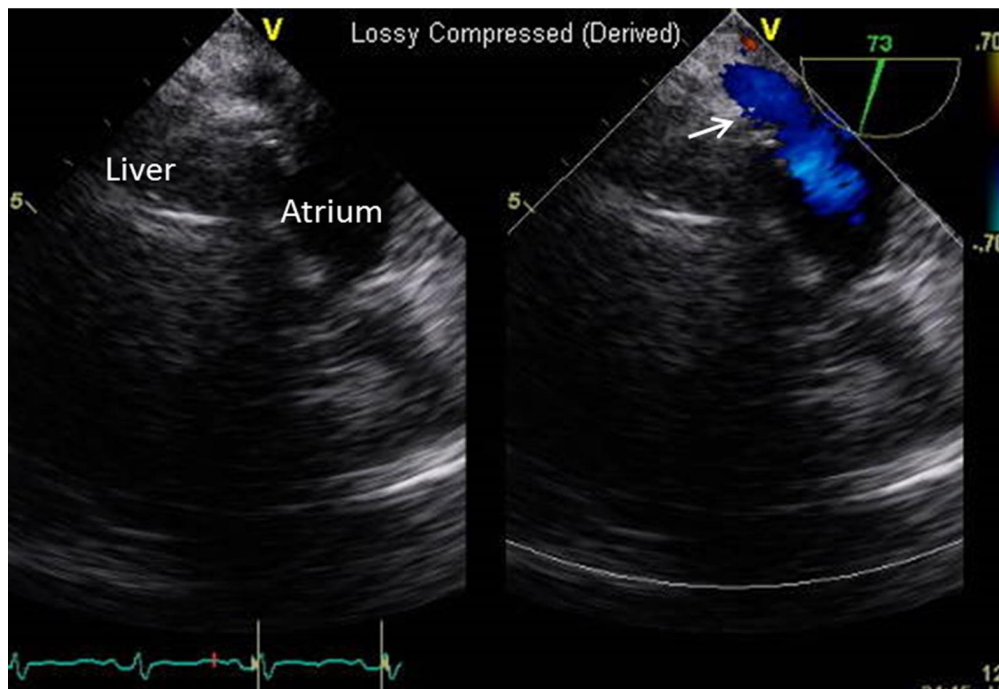


Figure 1. Transesophageal echocardiogram image showing residual venous drainage directly to the atrium (arrow) inferiorly; this drainage is separate from where the pulmonary veins drain.

pulmonary veins. For these reasons, the aberrant vessel seems less likely to represent a persistent vertical vein. Despite well-documented pulmonary and systemic venous variations in heterotaxy patients, the importance of anomalies involving the portal circulation has only more recently been recognized.³⁻⁵ Normal venous embryological development consists of paired cardinal, vitelline, and umbilical veins which ultimately develop into the systemic, portal, and hepatic venous structures of the neonate.⁶ The timing of development of the portal circulation coincides with that of cardiac embryogenesis and there has been a reported increased incidence of Congenital Heart Disease in patients with a congenital portosystemic shunt.⁷ The potential embryologic causes for such shunts may

include primary failure of critical anastomoses of the vitelline veins leading to complete absence of the portal system, persistence of the ductus venosus, or agenesis of the ductus venosus.⁸ In heterotaxy patients, these shunts have been reported in patients with polysplenia and an interrupted IVC where the connection is generally between a renal vein and the portal vein.^{3,5}

Although systemic and pulmonary venous circulations are routinely visualized during preoperative evaluation for single ventricle palliation, portosystemic shunts may be missed with echocardiography and even venography, unless there is a high index of suspicion. In our patient, multiple veins entering the atrium also made this difficult to diagnose preoperatively. This case points

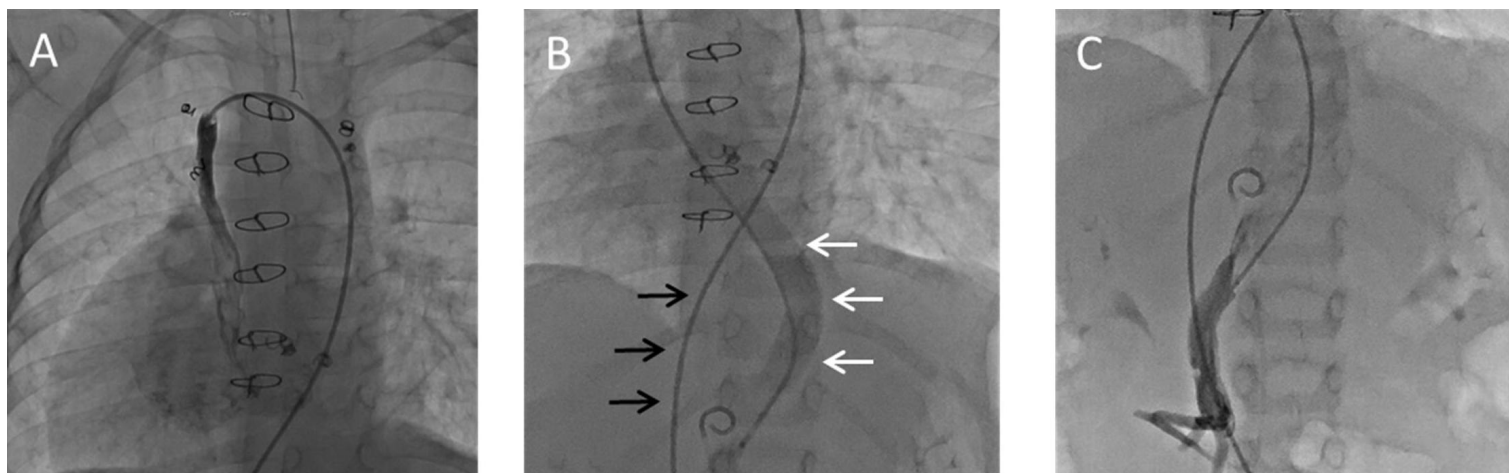


Figure 2: Catheter course through left-sided Fontan conduit, into innominate vein and passing through (A) recanalized right superior vena cava draining to the atrium and then (B) into abnormal venous drainage entering inferiorly to the atrium (light arrows) and separate from the Fontan conduit (dark arrows). (C) Injection more caudally into the abnormal vessel shows filling of vessels related to portal venous drainage.

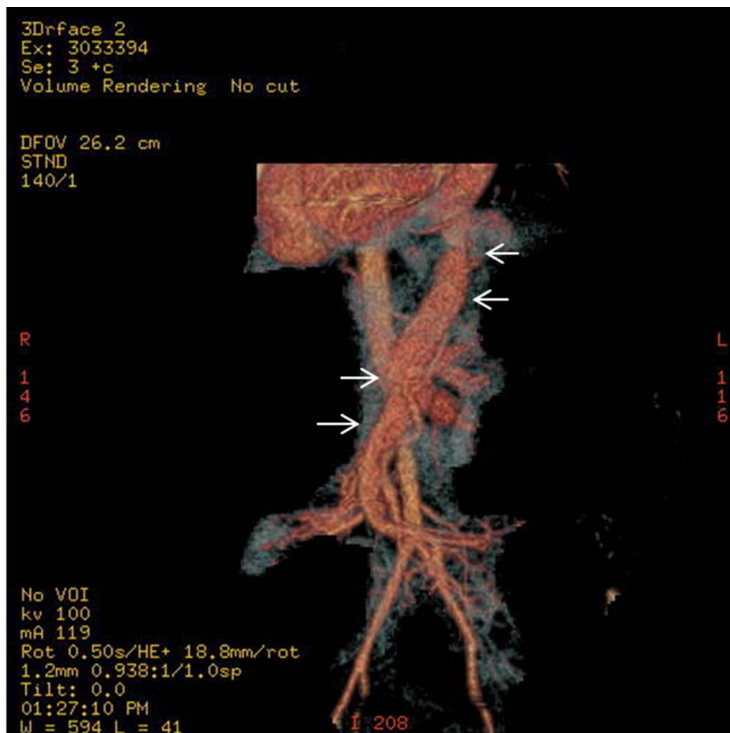


Figure 3. Three-dimensional CT reconstruction showing abnormal vessel that represents a congenital portosystemic shunt (arrows) draining from the portal circulation to the base of the atrium; this vessel is not connected with the pulmonary venous system.

to the importance of considering congenital portosystemic shunts in heterotaxy patients. Evaluation by CT or MRI may be a useful adjunct to delineate the complex venous structures in such patients prior to surgical intervention.

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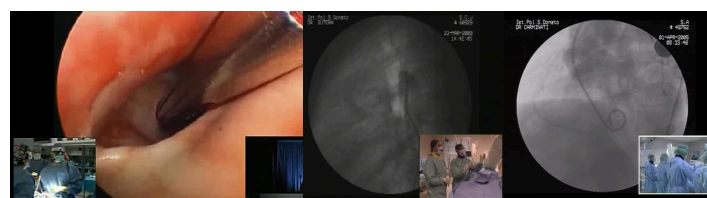
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Sports Cardiology & Sudden Cardiac Arrest in the Young
Jan. 20-21, 2017; Anaheim, CA USA
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PEDIRHYTHM VII: Pediatric & Congenital Rhythm Congress
Feb. 4-7, 2017; Thessaloniki, Greece
www.pedirhythm.org/

Adult Congenital Heart Disease Quality Care in the Era of Certification and Accreditation – A Practical Approach
Feb. 10-11, 2017; Los Angeles, CA USA
www.congenitalcardiologytoday.com/Ads/2016_ACHD_Brochure.pdf

Cardiology 2017
Feb. 22-26, 2017; Orlando, FL USA
www.chop.edu/events/cardiology-2017#.V-WXtaO-L5U

CSI Asia-Pacific 2017 Catheter Interventions in Congenital, Structural & Valvular Heart Disease
Mar. 2 - 4, 2017; Bangkok, Thailand
www.csi-congress.org/csi-asia-pacific.php

NeoHeart: Cardiovascular Management of the Neonate
Mar. 22-25, 2017; San Diego, CA USA
www.choc.org/neoheart

51st AEPC Annual Meeting
Mar. 29 - Apr. 1 2017; Lyon, France
www.aepc2017.org/en/

Catheter Interventions in Congenital, Structural & Valvular Heart Disease
Jun. 28 - Jul. 1, 2017; Frankfurt, Germany
csi-congress.org

7th World Congress of Pediatric Cardiology & Cardiac Surgery
Jul. 16 - 21, 2017; Barcelona, Spain
wcpccs2017.org/en

27th International ACHD Advanced Symposium, 2017
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Preview of NeoHeart - Cardiovascular Management of the Neonate, March 22nd to 25th 2017- Manchester Grand Hyatt Hotel, San Diego, California

By John Patrick Cleary MD; Amir H. Ashrafi, MD; Anthony C. Chang, MD

The second edition of *NeoHeart - Cardiovascular Management of the Neonate* will be hosted in San Diego in March of 2017. This meeting brings the Neonatology and Cardiology communities together to benefit from each others' knowledge. The need for shared meetings and research has accelerated as more neonates with Congenital Heart Disease receive surgery and cardiovascular management of term and preterm newborns has changed significantly. The need for neonatology input in the CVICU is increasingly recognized; cardiologists are contributing to important management topics in the fetus and newborn, and echocardiography is becoming a shared skill. *NeoHeart* was conceived to support practitioners, accelerate collaboration and share knowledge much like the Pediatric Cardiac Intensive Care Society (PCICS), which launched to meet the needs of cardiac critical care practitioners in 2003. Dr. Anthony Chang was the key catalyst in both of these events. One success of 2017's *NeoHeart* will be establishing the Neonatal Cardiac Society (NCS) to support the growing number of international neonatology practitioners involved in complex cardiovascular management of neonates.

On Wednesday, March 22nd, we recognize and honor Dr. William I. Norwood as our Keynote Speaker. The *NeoHeart* chairs see our opening dinner as symbolic of the need for collaboration, and a chance to thank leaders who have impacted both Neonatology and Cardiology. At our first meeting, we honored Dr. Jacqueline "Jackie" Noonan, MD, who recognized the syndrome which bears her name, and contributed to the education of countless neonatologists, cardiologists and surgeons. Dr. Noonan's words and presence at the first *NeoHeart* displayed what is possible through passion and collaboration. For 2017, we could imagine no physician with greater impact on neonatal cardiac care than Dr. Norwood. His reflections on a career in congenital heart surgery will inform, inspire and prepare our minds for the provocative discussions which follow.

The core of the meeting includes 4 sessions on Thursday and Friday which address key areas and concepts. All sessions are structured with brief didactics and maximal time for moderated discussions between our outstanding faculty. These conversations between leaders and with the audience are



The authors (back row from left-to-right), Drs. John P. Cleary, Anthony Chang and Amir Ashrafi presenting an award at the first *NeoHeart* to Dr. Jacqueline Noonan.

uniquely *NeoHeart* - think *Ted Talk* meets *Talk Show*.

In Session 1, we focus on The Neonatal Myocardium and Hemodynamics. Key Faculty in this session include: Andrew Redington, MD, Patrick McNamara, MBBS, Keith Barrington MBBS and Wyman Lai, MD. Dr. Redington's talk on unique aspects of The Neonatal Myocardium is relevant to all sessions within the meeting. Dr. McNamara is a *NeoHeart* alumnus who returns to help lead this session. He has been given the challenge of "Defining and Treating Shock in the Newborn." Dr. Barrington and others will join the stage to discuss such topics as permissive hypotension, the status of medical therapy for shock and controversies in treatment of the ductus arteriosus. We will then have case-specific teaching and discussion differentiating treatment of septic shock, the hypertrophic heart, shock in the setting of arrhythmia, etc.

The final hour of Session 1 will have key leaders discuss "Expanding Point of Care Echocardiography into the hands of NICU and PICU physicians."

Session 2, Thursday afternoon focuses on "Controversies in Congenital Heart Disease." This session features pioneering surgeon Dr. Frank Hanley, who will open with "Tetralogy of Fallot -- Pulmonary Atresia with MAPCAs, Past and Future

Management." Leaders from multiple disciplines will have in-depth discussions of management of specific lesions including: Tetralogy of Fallot, Pulmonary Atresia and Hypoplastic Left Heart Syndrome. In addition, within this session, Dr. Mjaye Malawi will present "How Computational Medicine Helps Predict Cardiovascular Collapse." To close the session, key leaders will present and discuss care models including: the concept of a CV-NICU, and the role of neonatologists in the CVICU.

Thursday evening will feature a poster session and symposium displaying original research and team-based quality improvement impacting neonatal cardiac care. Presenters will be guaranteed good attendance as the session is positioned with a view of San Diego harbor and timed with a cocktail reception and appetizers. There will be a faculty walk and featured abstracts. The hotel is located within walking distance to San Diego's Seaport Village and Gaslamp District to facilitate team-building and catching up with colleagues.

Friday morning's Session 3 turns our attention to "The Pulmonary Vascular Bed." This session was so well-received at our first *NeoHeart*, and the research in the field so active, that it had to be repeated. Topics such as "iNO in the Preterm," "Combination Therapy for Pulmonary Hypertension," and

GUEST FACULTY

Neonatology

Keith J. Barrington, MBBS
Shazia Bhombal, MD
Christine Bixby, MD
Vijay Dhar, MD
John Kinsella, MD
Anup Katheria, MD
Ganga Krishnamurthy, MD
Victor Levy, MD, MSPH
Annie Janvier, MD, PhD, FRCPC
Patrick McNamara, MBBS
Denise Suttner, MD

Anesthesia

Dean B. Andropoulos, MD, MHCM

Cardiothoracic Surgery

Richard Gates, MD
Frank Hanley, MD
John Lamberti, MD
William I. Norwood, Jr., MD (*Keynote Speaker*)

Cardiology

Mitch I. Cohen, MD, FACC, FHRS
Wyman Lai, MD
Daniel J. Penny, MD, PhD
Andrew Redington, MD
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Peter Laussen, MBBS, FCICM
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Nursing

Dorothy M. Beke, CPNP-PC/AC
Dawn Tucker, DNP, RN, CPNP-AC

"PH in Chronic Lung Disease and Heart Disease" will be featured. So many of our faculty are expert in this area that expansive discussion is assured. Dr. Steve Abman will open with "The Neonatal Pulmonary Vascular Bed - Science Behind our Therapies," followed by Dr. John Kinsella describing "State-of-the-Art Management of PPHN." Later in the session, Dr. David Wessel reviews "Pulmonary Hypertension in Congenital Heart Disease."

After a break, Session 3 will close with a review of our biases and cultural practices within each discipline, provocatively titled, "It Drives Me Crazy When...."

Session 4 includes some of the most important areas where the *NeoHeart* creators believe we can make progress through collaboration across disciplines. Dr. Wayne Tworetzky will raise questions as he reviews the "Status of Fetal Cardiac Interventions." Dr. Annie Janvier has been asked to help expand our thinking as to, "How Do We Include Families in Complex Decision-Making?" Annie makes complex topics practical, and will lead group conversations in how we speak to families about life and death issues, and the provocative question, "When should we provide surgery in the setting of Trisomy 18 or 13?" After a break, Dr. Dean Andropoulos will present "Neurodevelopment Outcomes in CHD: What are the Opportunities for Improvement?" Roundtable discussions will include: potential brain-protecting strategies, the negative impact of anesthetics and sedatives, and the optimal timing of cardiopulmonary bypass.

The final hour of *NeoHeart* is forward-looking as we bring partners from Industry and the Hospital C Suites along with families to help us ask, "How Are We Defining and Measuring Success?" and, "Are the Present Metrics Misleading?" We know we can make progress in the future, and finding the right data to measure will be key.

The core sessions described above are surrounded not just by the beauty of Southern California, but by opportunities for focused education. Pre- and Post-conference workshops on the afternoon of Wednesday, March 22nd are repeated the morning of Saturday, March 25th. Workshop A offers didactic and hands-on experience with "Targeted Neonatal Echocardiography," Workshop B, "Essentials of Neonatal Cardiology," and Workshop C, a Nurse Practitioner-led session designed to provide value to NP, PA and RN attendees titled, "Advanced Care for the Neonate with Heart Disease."

We hope that the readers of *Neonatology Today* and *Congenital Cardiology Today* will join us in San Diego for *NeoHeart* and contribute to advancing this important area of care. The research presented, questions generated, protocols developed and the

growth of a Neonatal Cardiac Society should be seen in this space in the future.

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Highlights from the 2016 “Specialty Review in Pediatric Cardiology” Board Review, CME Course - Chicago

By Maria Serratto, MD

Sunshine and mild temperatures greeted the 21st *Specialty Review In Pediatric Cardiology*, which took place in Chicago September 19th-23rd. The course is sponsored by the American Academy of Pediatrics Section on Cardiology and Cardiac Surgery in collaboration with the Society of Pediatric Cardiology Training Programs Directors (SPCTPD).

The attendees were physicians seeking board certification or re-certification, and established specialists interested in updating their knowledge in the specialty. The curriculum was structured to meet Board certification and MOC requirements, as well as to provide an updating in this rapidly evolving specialty offering CME accreditation. To this end, sessions were held with structured lectures, board simulation sessions and informal discussions with faculty members. New for this course was the presence of a moderator whose main functions were to

introduce the speakers, and to make sure the time schedule was maintained since the daily schedule was demanding running from 8:00am to 6:30 pm.

“The curriculum was structured to meet Board certification and MOC requirements, as well as to provide an updating in this rapidly evolving specialty offering CME accreditation.”

However, 10 minutes breaks with refreshments were scheduled every 2 hours, and one hour sponsored lunch was offered daily. The course was well-attended as indicated by the fact that the attendees came from every corner of the US and Canada.

At the end of each hard-working day, the participants had an opportunity to enjoy the cultural entertainment, shopping facilities and culinary experiences Chicago offers.

From the post-course evaluations, we were gratified to learn that our efforts provided a rewarding and significant educational experience for the attendees with 100% of them satisfied with the faculty, content and organization of the course. The very favorable rating was reinforced by the



21st Specialty Review In Pediatric Cardiology Faculty

- **Christopher S. Almond, MD, MPH**, Assistant Professor of Pediatrics-Cardiology, Stanford University School of Medicine; Pediatric Advanced Cardiac Therapies Service, Lucile Packard Children's Hospital
- **Laurie R. Armsby, MD, FAAP, FSCAI**, Associate Professor of Pediatrics; Interim Division Head, Pediatric Cardiology; Director, Pediatric Cardiology Fellowship Program, Oregon Health & Sciences University School of Medicine
- **Carl L. Backer, MD**, Division Head, Cardiovascular-Thoracic Surgery, and Surgical Director, Cardiac Transplant Program, Ann & Robert H. Lurie Children's Hospital of Chicago; A. C. Buehler Professor of Surgery, Northwestern University Feinberg School of Medicine
- **David W. Brown, MD, FAAP**, Associate Professor of Pediatrics, Harvard Medical School; Associate in Cardiology and Pediatric Cardiology Fellowship Training Program Director, Boston Children's Hospital; President, Society of Pediatric Cardiology Training Program Directors
- **John M. Costello, MD, MPH, FAAP**, Associate Professor of Pediatrics, Northwestern University Feinberg School of Medicine; Director, Inpatient Cardiology, and Medical Director, Regenstein Cardiac Care Unit, Ann & Robert H. Lurie Children's Hospital of Chicago
- **Dunbar Ivy, MD, FAAP, FACC, FAHA**, Professor of Pediatrics, Chief and Selby's Chair of Pediatric Cardiology, University of Colorado School of Medicine and Children's Hospital Colorado
- **William T. Mahle, MD, FAAP**, Marcus Professor of Pediatrics, Emory University School of Medicine; CEO, Sibley Heart Center Cardiology; Director, Cardiac Service Line, Children's Healthcare of Atlanta
- **Amy N. McCammond, MD**, Assistant Professor, Oregon Health & Science University School of Medicine; Medical Director, Pediatric Cardiac Intensive Care, Doernbecher Children's Hospital
- **Shaji C. Menon, MD, FAAP, FASE, FACC**, Associate Professor of Pediatrics, Adjunct Associate Professor of Radiology, Pediatric Cardiology, University of Utah School of Medicine
- **Seema Mital, MD, FACC, FAHA, FRCP(C)**, Professor of Pediatrics, University of Toronto; Staff Cardiologist, The Hospital for Sick Children
- **Stephen Paridon, MD, FAAP, FACC**, Associate Professor of Pediatrics, Perelman School of Medicine at the University of Pennsylvania; Attending Cardiologist and Director, Exercise Physiology Laboratory, The Children's Hospital of Philadelphia
- **Andrew J. Powell, MD, FAAP, FACC**, Associate Professor of Pediatrics, Harvard Medical School; Senior Associate in Cardiology, Boston Children's Hospital
- **Albert P. Rocchini, MD, FAAP**, Professor, Department of Pediatrics and Communicable Diseases, University of Michigan Health System
- **Maria Serratto, MD, FAAP, FACC, FCCP**, Professor of Pediatrics-Cardiology, University of Illinois at Chicago College of Medicine; Attending Physician, Children's Hospital University of Illinois
- **Lloyd Y. Tani, MD**, Professor of Pediatrics; Chief, Division of Pediatric Cardiology, University of Utah School of Medicine and Primary Children's Hospital
- **Anne Marie Valente, MD, FACC, FAHA, FASE**, Associate Professor of Medicine and Pediatrics, Harvard Medical School; Outpatient Director, Boston Adult Congenital Heart Service, Boston Children's Hospital, Brigham and Women's Hospital
- **Paul M. Weinberg, MD, FAAP, FACC**, Professor of Pediatrics and Pediatric Pathology and Laboratory Medicine, Associate Professor of Radiology, Perelman School of Medicine at the University of Pennsylvania; Senior Cardiologist, The Children's Hospital of Philadelphia
- **Gary M. Weiner, MD, FAAP**, Associate Professor, Neonatal-Perinatal Medicine; Director, Neonatal-Perinatal Fellowship Training Program; University of Michigan Health System, C.S. Mott Children's Hospital
- **Frank J. Zimmerman, MD**, Assistant Professor of Pediatrics and Medicine, University of Chicago Pritzker School of Medicine; Co-Director of Pediatric Electrophysiology, Advocate Hope Children's Hospital

attendees comments as shown by the following samples:

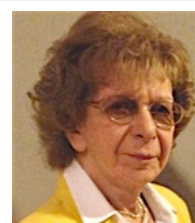
- "The course was above my expectation! I would attend yearly."
- "The course was amazing and very helpful"; "Excellent course for board preparation. Worth going to"; "Great course."
- "This was a wonderful course that was well organized and executed. The speakers were fantastic, and I have no complaints. Will recommend the course to others"
- "Excellent!"
- "Will recommend the course to all of my colleagues!"

Buoyed by the positive responses we are already starting preparations for *The 2018 Course!*

For those who could not attend the course, there is the possibility to review it electronically by purchasing "Watch It Again!" the archived unedited streaming of the course at: AAPOnDemandCME.com. Call 800-338.5901 for details.

The edited version of the course will be available at a later date. This version can be purchased from ESI (www.edusymp.com). It is produced in DVD or USB format, and offers CME credits.

CCT



Maria Serratto, MD, FACC, FAAP, FCCP Course Founder & Director Professor of Pediatrics-Cardiology Children's Hospital of the University of Illinois at Chicago Chicago, IL USA

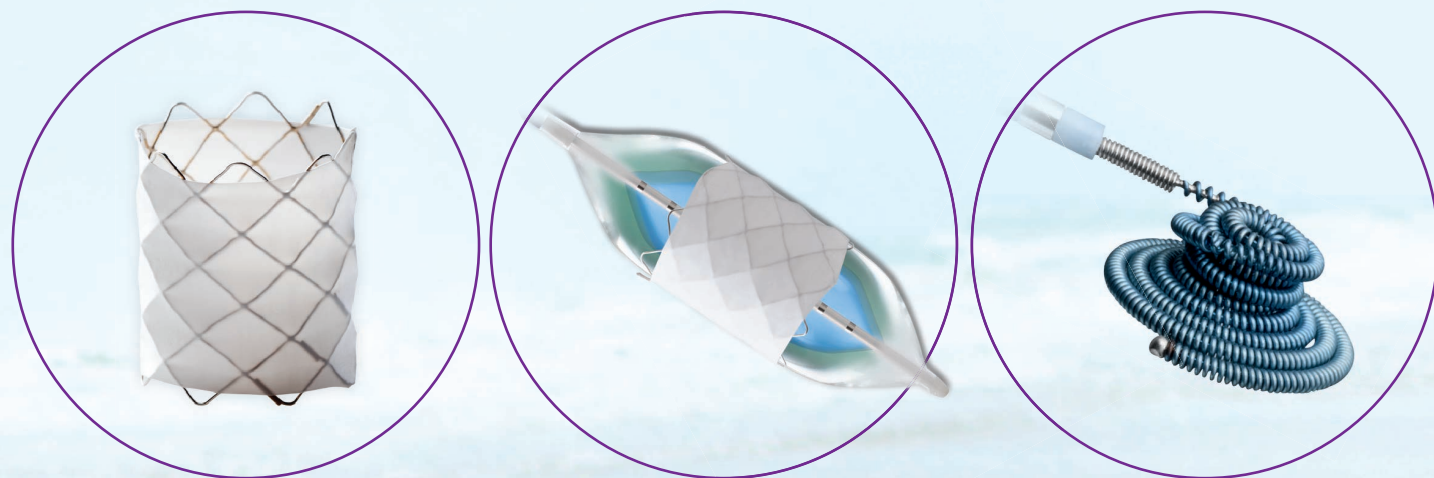
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Refer to the Instructions for Use for complete indications, relevant warnings, precautions, complications, and contraindications.

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Medical News, Products & Information

Compiled and Reviewed by Tony Carlson, Senior Editor

Announcing The New TCTMD!

Newswise — NEW YORK – October 26, 2016 – The Cardiovascular Research Foundation (CRF) is pleased to announce the launch of the new TCTMD (www.tctmd.com), the leading online resource for cutting-edge news and information in interventional cardiology and beyond.

Since 2000, TCTMD.com has provided outstanding, comprehensive news and education in the ever-evolving field of cardiovascular medicine. The fully reconfigured and redesigned website features arresting graphics, an elegant layout, and more intuitive navigation. Among the highlights are a vastly improved search tool, more opportunities for interaction and personalization, and curated content that efficiently tells visitors the most important news or information they need to know without losing sight of other topics that will also pique their interest. The design is also fully responsive and optimized for mobile use, enhancing how it looks and operates on handheld devices and tablets.

"We're very proud of TCTMD's new design," said Joshua Hartman, MBA, Executive Director of the CRF Center for Education, and one of the founders of TCTMD. "For over 15 years, we've strived to produce exceptional cardiovascular content for physicians and healthcare professionals. And now we have a modern and sophisticated new home to showcase it."

"TCTMD is already known for delivering some of the best cardiology news coverage online," said Shelley Wood, CRF's Editorial Director and Managing Editor of TCTMD. "We hope that this redesign helps strengthen TCTMD's role as the premier destination for clinical trial results, hot topics and controversies, slide presentations, clinical guideline summaries, and everything else relevant to the field. We want readers coming to the website for one type of content to engage with other, related content. To be able to offer slides, for example, or video commentary, that accompany a study we've covered as news just enriches the experience for the visitor."

At the outset of their 2-year effort, the TCTMD redesign team conducted focus groups and surveys to better understand what was most important to users and where the site could improve.

"We coupled that valuable input with feedback from our own internal editorial and digital teams at CRF to refine our goals and objectives," said Stephanie Gutch, Associate Director of TCTMD/Digital who spearheaded the initiative. "We then partnered with a design and development firm who helped strategize and execute this long-awaited update. The site is going to continually evolve and grow with our users. We're looking forward to seeing how

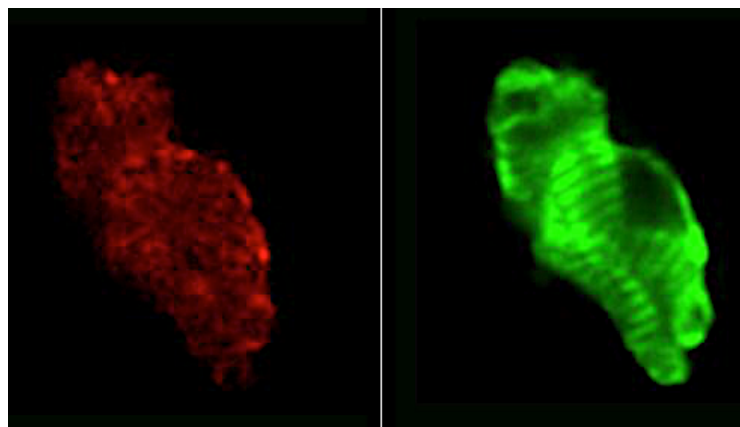
people engage with our content and will make future enhancements based on this."

TCTMD's New Features:

- Immediate access to breaking news as well as the opportunity to dive deeper into complex subjects
- Clinically focused subsections that allow you to immerse yourself in rich condition-specific content
- Enhanced and improved search
- More intuitive navigation between related content: news, slides, video, live cases and more
- Ample opportunities to stumble across unique content you didn't know you were looking for

For more information, visit www.crf.org and www.tctmd.com.

Scientists Create an Atlas of the Developing Mouse Heart



A team of scientists have created a temporal and spatial N Atlas of the developing mouse heart. Credit: Harvard Medical School,

It's not simple, making a heart. In the womb, the organ begins as a tube, sprouts bead-like lumps, folds in on itself and eventually morphs into the more familiar-looking four-chambered structure. But exactly how heart cells follow their genetic programming to create an intricate, life-sustaining pump remains something of a mystery. "We would love to have a blueprint that tells us how the heart gets from start to finish," says cardiology researcher Jonathan Seidman, the Henrietta B. and Frederick H. Bugher Foundation Professor of Genetics at Harvard Medical School.

Seidman and colleagues from HMS and beyond, including senior investigator Christine Seidman, the Thomas W. Smith Professor of Medicine at HMS, have just filled in that sketchy diagram a little more.

The researchers sampled heart cells from seven different stages of embryonic development in mice. Using recent single-cell RNA



PICS-AICS
Pediatric and Adult Interventional Cardiac Symposium

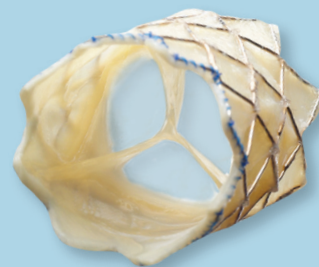
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The Melody TPV System first received CE mark in September, 2006.
The Melody TPV System received Health Canada approval in December 2006
and US approval under an HDE on January 25, 2010 (H080002).
PMA approval received January 27, 2015 (P140017).

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Melody™ Transcatheter Pulmonary Valve Ensemble™ II Transcatheter Valve Delivery System

Important Labeling Information for United States

Indications: The Melody TPV is indicated for use as an adjunct to surgery in the management

of pediatric and adult patients with the following clinical conditions:

- Existence of a full (circumferential) RVOT conduit that was equal to or greater than 16 mm in diameter when originally implanted AND
- Dysfunctional RVOT conduits with a clinical indication for intervention, AND
 - regurgitation: \geq moderate regurgitation, AND/OR
 - stenosis: mean RVOT gradient \geq 35 mm Hg

Contraindications: None known.

Warnings/Precautions/Side Effects:

- DO NOT implant in the aortic or mitral position. Preclinical bench testing of the Melody valve suggests that valve function and durability will be extremely limited when used in these locations.
- DO NOT use if patient's anatomy precludes introduction of the valve, if the venous anatomy cannot accommodate a 22 Fr size introducer, or if there is significant obstruction of the central veins.
- DO NOT use if there are clinical or biological signs of infection including active endocarditis. Standard medical and surgical care should be strongly considered in these circumstances.
- Assessment of the coronary artery anatomy for the risk of coronary artery compression should be performed in all patients prior to deployment of the TPV.
- To minimize the risk of conduit rupture, do not use a balloon with a diameter greater than 110% of the nominal diameter (original implant size) of the conduit for pre-dilation of the intended site of deployment, or for deployment of the TPV.
- The potential for stent fracture should be considered in all patients who undergo TPV placement. Radiographic assessment of the stent with chest radiography or fluoroscopy should be included in the routine postoperative evaluation of patients who receive a TPV.
- If a stent fracture is detected, continued monitoring of the stent should be performed in conjunction with clinically appropriate hemodynamic assessment. In patients with stent fracture and significant associated RVOT obstruction or regurgitation, reintervention should be considered in accordance with usual clinical practice.

Potential procedural complications that may result from implantation of the Melody device include the following: rupture of the RVOT conduit, compression of a coronary artery, perforation of a major blood vessel, embolization or migration of the device, perforation of a heart chamber, arrhythmias, allergic reaction to contrast media, cerebrovascular events (TIA, CVA), infection/sepsis, fever, hematoma, radiation-induced erythema, blistering, or peeling of skin, pain, swelling, or bruising at the catheterization site.

Potential device-related adverse events that may occur following device implantation include the following: stent fracture, *stent fracture resulting in recurrent obstruction, endocarditis, embolization or migration of the device, valvular dysfunction (stenosis or regurgitation), paravalvular leak, valvular thrombosis, pulmonary thromboembolism, hemolysis.

*The term "stent fracture" refers to the fracturing of the Melody TPV. However, in subjects with multiple stents in the RVOT it is difficult to definitively attribute stent fractures to the Melody frame versus another stent.

For additional information, please refer to the Instructions For Use provided with the product.

CAUTION: Federal law (USA) restricts this device to sale by or on the order of a physician.

Important Labeling Information for Geographies Outside of the United States

Indications: The Melody Transcatheter Pulmonary Valve is indicated for use in patients with the following clinical conditions:

- Patients with regurgitant prosthetic Right Ventricular Outflow Tract (RVOT) conduits with a clinical indication for invasive or surgical intervention, OR
- Patients with stenotic prosthetic RVOT conduits where the risk of worsening regurgitation is a relative contraindication to balloon dilation or stenting.
- Existence of a full (circumferential) RVOT conduit that was equal to or greater than 16 mm in diameter when originally implanted.

The intended lifetime for the Melody device is 2 years.

Contraindications:

- Venous anatomy unable to accommodate a 22 Fr size introducer sheath; implantation in left heart.
- Unfavorable right ventricular outflow tract for good stent anchorage.
- Severe right ventricular outflow obstruction, which cannot be dilated by balloon.
- Obstruction of the central veins.
- Clinical or biological signs of infection.
- Active endocarditis.
- Known allergy to aspirin or heparin.
- Pregnancy.

Potential Complications/Adverse Events: Potential procedural complications that may result from implantation of the Melody device include the following: rupture of the RVOT conduit, compression of a coronary artery, perforation of a major blood vessel, embolization or migration of the device, perforation of a heart chamber, arrhythmias, allergic reaction to contrast media, cerebrovascular events (TIA, CVA), infection/sepsis, fever, hematoma, radiation-induced erythema, pain at the catheterization site.

Potential device-related adverse events that may occur following device implantation include the following: stent fracture resulting in recurrent obstruction, endocarditis, embolization or migration of the device, valvular dysfunction (stenosis or regurgitation), paravalvular leak, valvular thrombosis, pulmonary thromboembolism, hemolysis.

For additional information, please refer to the Instructions For Use provided with the product.

The Melody Transcatheter Pulmonary Valve and Ensemble II Transcatheter Delivery System has received CE Mark approval and is available for distribution in Europe.

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Please go to www.chipnetwork.org and let us know more about you. It only takes two minutes. Then we'll be able to send you messages targeted to your interests.

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Sincerely,

Gary Webb, MD
CHiP Network
215-313-8058
garywebb6@gmail.com



The CHIP Network, the Congenital Heart Professionals Network, is designed to provide a single global list of all CHD-interested professionals.

CONGENITAL CARDIOLOGY TODAY

CALL FOR CASES AND OTHER ORIGINAL ARTICLES

Do you have interesting research results, observations, human interest stories, reports of meetings, etc. to share? Submit your manuscript to: RichardK@CCT.bz

sequencing techniques, they sorted the cells into three known categories--myocardial, or heart-muscle, cells; endothelial cells that make blood vessels; and fibroblasts that hold everything together--and watched how their genetic activity changed over time.

"It's the first opportunity we've had to look at a map of the heart with 100-cell resolution," said Jon Seidman.

The results, reported Nov. 10th in *Developmental Cell*, help clarify which cell types are present in various parts of the heart at each time period and uncover a previously unknown cell type. The researchers also describe errors in specific cell types in mice with a genetic mutation that causes congenital heart defects in humans.

"The study provides both a temporal and spatial atlas that plots the development of the different cell populations in each of the four chambers," Jon Seidman said. "The converse is also true: By looking at a cell's RNA expression, we can gather clues to its origins."

Mouse hearts, of course, are not human hearts. For instance, adult mouse hearts are 3,000 times smaller than ours and beat 10 times faster. However, many features are "remarkably conserved" between the two species, the authors say, including the organs' four-chambered structure, the electrical signals that direct muscle contraction and relaxation and the molecules that are involved in muscle function. This builds the team's confidence that their findings will ultimately inform knowledge of the human cardiovascular system.

As the researchers catalogued both new and known genetic markers to identify cells from specific locations and developmental stages, they noticed that one group of cells unexpectedly displayed a blend of genes typically found in either myocardial cells or fibroblasts. The team is now investigating the role of these unusual cells in heart maturation.

The ability to track individual cells and cell types in the developing heart should also help researchers study how gene mutations change the way each cell population matures, the authors said.

"The hope is that now we're beginning to understand at a single-cell level how perturbations in genes and cells lead to changes in cardiac structure and clarify what the important steps are for how the heart is built," said Seidman.

Although chances are slim that the researchers' observations will lead to new therapeutic approaches anytime soon, Seidman said they do plan to investigate how particular defects that lead to congenital heart disease "actually cause the changes that pediatric cardiologists have been seeing for years."

This work was supported by grants from the National Institutes of Health (grants HL125807, R01MH101528-01 and T32GM007753), the National Heart, Lung, and Blood Institute's Bench to Bassinet Program (U01HL098179/UM1HL098179, 2UM1HL098147, 2UM1HL098166), the John S. LaDue Memorial Fellowship at HMS, the Foundation for Anaesthesia Education and Research and the Howard Hughes Medical Institute.

Getting Doctors and Nurses to Work Together at Patient Bedsides

Newswise — The structures of health care systems helps determine how doctors and nurses collaborate during hospital rounds, according to Penn State College of Medicine researchers. A greater understanding of such team-based treatment in hospitals could help improve patient care.

Collaboration among different types of health care professionals, like doctors and nurses, is good for patients because it provides greater communication, coordination of care and patient-centered decision making.

One way to promote this type of team-based care is by having a mix of providers visit hospital patients together, called rounding. Although significant research has been conducted on bedside rounds, little has been done on interprofessional collaboration during these patient visits, said Dr. Jed D. Gonzalo, Assistant Professor of Medicine and Public Health Sciences.

The limited existing research on the topic finds that the amount of interprofessional bedside care that goes on in hospital settings – such as internal medicine, pediatrics or intensive care – can vary widely, ranging from 1% to 80%. To date, no study has looked at how frequent this practice is across a variety of units in a single hospital. Also, little data exists on what promotes bedside interprofessional rounds in hospital units.

Based on the benefits of collaborative care, Penn State Health Milton S. Hershey Medical Center conducted a hospital-wide initiative starting in 2012 to increase bedside interprofessional rounds. The goal was for at least 80% of patients at the hospital to receive collaborative care at their bedside.

To determine how common bedside interprofessional rounds became following this effort, researchers from the College of Medicine analyzed data from nurses working in 18 of the hospital's units.

Of 29,173 patients treated in those units during the study period, 21,493 – 74% – received bedside interprofessional rounds.

The researchers also examined the factors associated with the shift toward collaborative care. They considered unit characteristics such as number of beds and square feet per bed; staffing characteristics, such as nurse-to-patient ratios; patient-level characteristics, such as length of stay; and nurses' perceptions of team collegiality and the use of scripts to guide bedside rounding.

Gonzalo and his team found several factors associated with greater incidence of bedside interprofessional rounds. Patients who were in the intensive care or intermediate care unit or who were hospitalized for five or more days were more likely to be seen by a nurse and a doctor together. These units generally have more nurses for every patient, Gonzalo said, increasing the likelihood of a nurse being available for bedside rounds when an attending physician sees patients. A longer hospital stay may also provide more opportunities for doctors and nurses to sync up when visiting patients, he added. It is also possible that patients with shorter stays may present cases that do not require as much collaborative care.



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The use of rounding scripts and nurses' perception of staff support for this type of team-based care was also linked to higher use.

Gonzalo, who is also associate dean for health systems education at the College of Medicine, said the study suggests that institutional and relationship factors drive collaborations between doctors and nurses. These "structural factors increase the odds of this process actually occurring," Gonzalo said. "When it comes to interprofessional collaborative care, structure drives behavior."

Rather than simply telling doctors to integrate nurses into their bedside rounds more frequently, hospital administrators must understand the underlying challenges and work to overcome them.

"My hope would be that we increasingly think about the structure of our systems rather than 100% of the time saying it's just about the people," Gonzalo said. "People are the operators, but they're operating in a system and how we design things matters. Better structural and process designs that are more conducive to collaboration and bringing providers together and patients together matter."

The study, recently published in the journal *BMC Health Services Research*, was itself an example of interprofessional collaboration, Gonzalo added, involving the internal medicine, nursing, quality and public health sciences departments.

Other researchers on this project were Judy Himes, Chief Nursing Officer; Dr. Brian McGillen, Hospitalist Director, Division of General Internal Medicine; Vicki Shifflet, General Medicine Acute Care Unit; and Erik Lehman, Public Health Sciences.

The Penn State College of Medicine Department of Medicine funded this study.

PICS-AICS 2017 Update

With a few weeks until the 20th PICS-AICS meeting in Florida - January 16th to the 19th, the people at PICS are busy ensuring this meeting will be the best yet! This year they are fully committed to ensuring the meeting maintains its clinical focus with the addition of taped cases to sessions on both congenital and structural heart disease, as well as live case demonstrations from 9 centers around the globe. There will be many sessions and breakouts for all to select to attend:

- One Day Leadership Seminar — Leadership and Management in the Cath Lab
- Oral and Poster Abstract Presentations
- Daily Taped Case Lunch Sessions
- Update on Structural Interventions
- Simplifying the Complex: My Step-by-Step Approach
- Update on Structural Interventions
- Stenting in the 21st Century
- Evening Symposium: The RVOT— Volumes, Clinical Trials, and the Future
- PICES Young Interventionist Group
- Live Case Presentations from Chile
- Argentina, Saudi Arabia, New York, Houston, Dallas, Pittsburgh, Columbus, and Los Angeles
- My Nightmare Case in the Cath Lab
- FDA Town Hall and Device

- Development — The Doug Villnave Session
- State of the Art—ASD Closure
- Complex Structural Interventions
- Left Atrial Appendage and Mitral Valve Interventions
- My Nightmare Case in the Cath Lab
- Measuring and Reducing Risk in Collaboration with CCISC
- Advancing in Imaging Modalities
- Interventions Outside the Heart
- Pushing the Boundaries
- Nursing and Associated Professionals Session
- Spanish Breakout Session - All presentations in Spanish
- Battle of the Continents

For more information, visit: www.picsymposium.com.

New Sensor System Predicts Heart Failure Events

Newswise — A suite of sensors can predict heart failure events by detecting when a patient's condition is worsening, according to Dr. John Boehmer, Professor of Medicine, Penn State College of Medicine, who presented the findings at the *American Heart Association Annual Meeting* in New Orleans.

Heart failure is responsible for more than 1 million hospitalizations each year and more than \$20 billion in costs. The new technique could help prevent costly hospitalizations and poor health outcomes including death.

Current efforts to manage heart failure by monitoring weight and symptoms have not significantly reduced hospitalizations. More than one in five patients are readmitted within 30 days after being hospitalized for heart failure.

An international team of researchers set out to investigate if implantable devices already used in heart failure patients could be retrofitted with sensors to track their condition. Their results will also be published in *JACC Heart Failure*.

Nine hundred heart failure patients were followed for up to one year. At the beginning of the study, the researchers uploaded software to each patient's implanted defibrillator, a battery-powered device that delivers an electric shock if the patient's heart stops beating.

The software allowed the defibrillators to also act as sensors, monitoring the patients' heart rate, activity, breathing, heart sounds and electrical activity in the chest.

Over the study period, the suite of sensors detected 70% of heart failure events in patients. This detection was often more than a month before the events occurred. Sensitivity at this level far exceeded the researchers' goal of greater than 40% detection.

While there were false positives, the number was within an acceptable range.

"If you're going to monitor a hundred patients, it becomes a fairly manageable number of alerts that you have to deal with," said Boehmer, a cardiologist at Penn State Health Milton S. Hershey Medical Center.



Barth Syndrome (ICD-10: E78.71)

Symptoms:

Cardiomyopathy, Neutropenia, Muscle Weakness, Exercise Intolerance, Growth Delay, Cardiolipin Abnormalities

www.barthsyndrome.org

Boston Scientific developed the system and funded the study. They named the system HeartLogic.

"This is a new and clinically valuable measure of worsening heart failure, and it combines a number of measures of the physiology and heart failure much like a doctor will look at a patient," Boehmer said. "Doctors look at all their signs and symptoms, get some tests and put it all together and make a decision about how well or ill the patient is. HeartLogic does it similarly. It integrates a number of measurements of what's going on with the patient, including breathing, activity and heart sounds, and puts that all together to give us an index that we believe is both sensitive and specific for heart failure."

Boehmer said the technology can help monitor the patient's condition so heart failure events can be prevented before they happen.

"It's like having high blood sugar if you're managing diabetes," Boehmer explained. "The doctor doesn't need to know about every high blood sugar and every high blood sugar doesn't result in a hospitalization. But you want to treat it before it gets very high and the patient becomes so symptomatic they become ill and end up in the hospital. This is the same concept."

A pilot study and intervention trials to test the system's safety, physician acceptance and use and patient outcomes are planned to investigate benefits to patients.

Other researchers on this project were Ramesh Hariharan, University of Texas Physicians, EP Heart, Houston, TX; Fausto G. Devecchi, Cardiac Arrhythmia Service, Lutheran Health Network, Fort Wayne, IN; Andrew L. Smith, Emory University, Atlanta, GA; Giulio Molon, Cardiology Dept, Sacro Cuore Hospital, Negrar, Italy; Alessandro Capucci, Università Politecnica delle Marche, Ancona, Italy; Qi An, Viktoria Averina, Craig M. Stolen, Pramodsingh H. Thakur, Julie A. Thompson, Ramesh Wariar and Yi Zhang, all at Boston Scientific, St. Paul, MN; and Jagmeet P. Singh, Massachusetts General Hospital Heart Center, Boston, MA.

Hospital Rooms and Patients Equally Likely to Transmit Pathogens - Study Shows How Nurses Got Hard-to-Treat, Disease-Causing Germs on Their Clothes

Newswise — Hospital rooms, not just the patients in them, can spread germs through contact with health care personnel, a Duke Health study reports.

"This study is a good wake-up call that health care personnel need to concentrate on the idea that the health care environment can be contaminated," said Deverick Anderson, MD, the study's lead author and associate professor of medicine at Duke University School of Medicine. "Any type of patient care, or even just entry into a room where care is provided, truly should be considered a chance for interacting with organisms that can cause disease."

Anderson presented the study's findings on Oct. 27 at *IDWeek*, the annual meeting of the Infectious Diseases Society of America (IDSA), the Society for Healthcare Epidemiology of America (SHEA), the HIV Medicine Association (HIVMA), and the Pediatric Infectious Diseases Society (PIDS).

The Duke-led research team set out to understand how pathogens travel between the "transmission triangle" in a health care setting: patients, the environment where care is administered, and the health care provider.

During the study, the researchers took cultures from the sleeves, pockets, and midriffs of the surgical scrubs of 40 intensive care unit nurses at Duke University Hospital. Each set of scrubs was new and the samples were collected at the start (before any patient interaction) and end of each shift. Cultures were also collected from the bodies of all patients the nurse cared for during each shift and the patients' room contents (bed, bedrail, and supply cart).

In total, 167 patients received care over 120, 12-hour shifts. The study collected 2,185 cultures from the nurses' clothing, 455 from patients, and 2,919 from patients' rooms.

Molecular analysis identified organisms on the nurses' clothing that were not present at the beginning of a shift, but were present at the end. The researchers then looked for those same organisms in the samples collected from patients and their rooms.

Specifically, they searched for five pathogens known to cause difficult-to-treat infections, including MRSA, a staphylococcus strain that is resistant to antibiotics. If such pathogens are present on nurses' scrubs, they could be transferred between patients or lead to infection of the nurses themselves.

During the shifts considered, the researchers confirmed 12 instances when at least one of the five pathogens was transmitted from the patient or the room to the scrubs. Six incidents each involved transmission from patient to nurse and room to nurse. An additional ten transmissions were from the patient to the room.

The researchers did not document any nurse-to-patient or nurse-to-room transmission.

The analysis found that pockets and sleeves of the scrubs were most likely to be contaminated, as were the bed rails in the rooms.

"I think sometimes there's the misconception that if, for instance, a nurse is just talking to patients and not actually touching them, that it might be okay to skip protocols that help reduce pathogen transmission, like washing hands or wearing gloves," Anderson said. "The study's results demonstrate the need for caution whenever health care providers enter a patient room, regardless of the task they're completing."

Anderson said the results were also significant because previous studies on pathogen transmission focused mainly on the patient-to-nurse interaction, while this study demonstrated that the room itself should be approached with equal consideration and caution.

"Oftentimes, especially when dealing with very sick patients, health care personnel may feel a conflict between providing care and following protocol that helps prevent pathogen transmission," Anderson added. "Our study shows following prevention strategies has to be a top priority, and that health care providers should be looking for ways to improve the likelihood that they are."

In addition to Anderson, study authors include: Bobby Warren, Rachel Addison, Batu Sharma Kuinkel, Yuliya Likhnygina, Laura Rojas Coy,



Archiving Working Group
International Society for Nomenclature of
Paediatric and Congenital Heart Disease
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Susan D. Rudin, Robert A. Bonomo, David J. Weber, William A. Rutala, Vance G. Fowler, Jr. and the CDC Prevention Epicenters Program.

The authors report no conflicts of interest. The study was funded by the Centers for Disease Control and Prevention (U54CK000164).

Newborn Screening Practices, Issue Of Genetic Ownership Examined

Newswise — Before Samantha Zent's parents brought home their newborn daughter from the hospital 22 years ago, Zent left behind a blood sample.

"I was born in Nappanee, Ind., and my blood sample is currently in the Indiana State Department of Health possibly being used for research because state policy says it will be held there until I turn 23," Zent said.

The Indiana State University senior biology major is one of the thousands of babies born each day who leave the hospital having been tested for a variety of inheritable and fatal health conditions through a practice known as newborn screening.

While newborn screening is one of the national public health services that has transformed preventive healthcare, there are certain ethical and legal concerns about what happens to the babies' genetic information beyond the tests.

As a part of the Summer Undergraduate Research Experience program, Zent explored each state's policy and procedure as it pertains to newborn screening practices.

"I found that up until 2014 when President Obama passed the Newborn Screening Saves Lives Reauthorization Act, there was no federal mandate that required hospitals and research entities get parental consent to use the child's sample in research," Zent said.

In recent years, there have been newborn screening lawsuits filed against many states, including one against the Indiana State Department of Health, for the improper storage and use of blood samples obtained from newborn screening.

"I think this really became a national conversation after the book 'The Immortal Life of Henrietta Lacks' by Rebecca Skloot came out," said Nathan Myers, a faculty sponsor for the SURE program.

In 1951, Henrietta Lacks, a poor African-American woman, was diagnosed with cervical cancer at Johns Hopkins Hospital. Her cells were taken without her knowledge and used to advance scientific research. Now known as HeLa cells, they helped to develop medical innovations such as the polio vaccine and countless others.

"There is a certain amount of controversy surrounding this issue of who actually owns your genetic information and to what extent does the individual actually have ownership," Myers said. "Samantha looked at her research from high-risk to low-risk states in terms of a parent's perspective. Is there a lot of information provided on newborn screening and a low level of storage time for the samples? The states that store samples forever and do not provide any information about newborn screening or research are the ones that might have a higher probability of using that genetic information in a negative way."

Zent concluded there is a general lack of knowledge about newborn screening and research for parents and healthcare providers. In her research, which is ongoing, she suggests that genetic counselors may be able to bridge the gap between researchers, physicians and families.

"The personal side of me wishes genetic counselors could meet with all of those women to help them understand what their babies are even being tested for, because I don't think there is very much education," said Megan Tucker, director of the master's of genetic counseling program. "At the same time, when there are less than 50 of us in the entire state, I don't think there is the physical manpower to truly touch the thousands of women that have babies every year."

Genetic counseling began as a profession in the 1970s to interpret and explain genetic information and disorders in order to educate individuals, especially parents and families.

"It is very much a growing field that leads into all kinds of different specialties, not just prenatal but into adult disorders and neurology and cardiology," Tucker said. "So it's growing in a lot of directions, which that in itself makes it hard for us to keep up with all of those things with the few of us that exist."

Indiana State's master's of genetic counseling is the 33rd accredited program in the U.S. and Canada and aims to help fill the profession's needs while providing students with an interdisciplinary education.

"In theory, a graduate student from our program, or any genetic counseling program, should be able to walk out and know all of the areas that genetic counselors work in, such as prenatal, oncology clinics, pediatrics and others," Tucker said.

The two-year program, which accepted its first class in August, offers a unique opportunity for students to gain experiential learning in the new Genetic Counseling Clinic in Wabash Valley.

"Indiana State and Union Hospital have partnered to open the first genetic counseling

clinic in which we are now serving patients with diagnoses of cancer or psychiatric disorders, such as schizophrenia or bipolar disorder," Tucker said. "Through the Center for Genomic Advocacy, the genetic counseling program and the clinic, we begin to truly reach out to individuals outside of the university to the Terre Haute community."

CONGENITAL CARDIOLOGY TODAY

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www.CongenitalCardiologyToday.com

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