CONGENITAL CARDIOLOGY TODAY

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

December 2013; Volume 11; Issue 12
International Edition

IN THIS ISSUE

CONGENITAL CARDIOLOGY TODAY
Editorial and Subscription Offices
16 Cove Rd, Ste. 200
Westerly, RI 02891 USA
www.CongenitalCardiologyToday.com

Congenital Cardiology Today is The official publication of the CHiP Network (www.chipnetwork.org)

Diagnostic Utility of the EKG in Newborns with Hypoplastic Left Heart Syndrome

By Juan N. Aliaga, BS; Tabitha G. Moe, MD; Kelly M. McDonnell, DO; Rhonda A. Bitinis, DO; and Edward K. Rhee, MD

Abstract

Objective

Hypoplastic Left Heart Syndrome is Critical Congenital Heart Disease (CCHD). Early detection is essential to guide further imaging and treatment. The purpose of this study was to identify electrocardiographic markers that may aid with early diagnosis.

Design, Setting, and Patients

Electrocardiograms of thirty-two patients in an urban tertiary care hospital with known Hypoplastic Left Heart Syndrome were age and gender matched in a 2:1 ratio to normal patients. Standard intervals were recorded, including; heart rate, PR interval, QRS duration, corrected QT interval, axis (P, QRS, T wave), and precordial lead voltages.

Outcome Measures and Results

QRS duration, S wave voltage in lead V1, and heart rate were found to be statistically significant in predicting patients with HLHS. QRS duration of greater than 60msec was highly correlated with identification of Hypoplastic Left Heart Syndrome.

Conclusions

QRS duration greater than 60 milliseconds is 91% sensitive and 92% specific to separate HLHS patients from age matched controls. 12-lead EKG is inexpensive, readily available, and should be added to the newborn cardiovascular screening armamentarium.

Keywords: Hypoplastic Left Heart Syndrome, Newborn Screening, EKG

Introduction

Hypoplastic Left Heart Syndrome (HLHS) is one of the Critical Congenital Heart Diseases (CCHD), currently accounting for approximately 20-25% of infant mortality attributed to Congenital Heart Disease.[1] The current incidence rate of HLHS is 0.016 to 0.036% of all live births within the general newborn population.[2] Annually, it is estimated that 2100 infants are effectively diagnosed at initial cardiac screening in the United States.[1]

Typically, HLHS is characterized by underdevelopment of the left heart, including severe hypoplasia of the left ventricle, with associated atresia, stenosis and hypoplasia of the mitral and/or aortic valves, as well as the ascending aorta and aortic arch.[3] The current gold standard in diagnostic testing for HLHS is a screening echocardiogram. HLHS may be identified early during fetal ultrasound; however, in many instances the prenatal and

Melody® Transcatheter Pulmonary Valve Ensemble® Transcatheter Valve Delivery System

Indications: The Melody TPV is indicated for use in a dysfunctional Right Ventricular outflow Tract (RVOT) conduit (≥16mm in diameter when originally implanted) that is either regurgitant (≥ moderate) or stenotic (mean RVOT gradient ≥ 35 mm Hg)

Contraindications: None known.

Warnings/Precautions/Side Effects:

- DO NOT implant in the aortic or mitral position.
- 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.
- 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: 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, and pain at the catheterization site.

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

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Humanitarian Device. Authorized by Federal law (USA) for use in patients with a regurgitant or stenotic Right Ventricular Outflow Tract (RVOT) conduit (≥16mm in diameter when originally implanted). The effectiveness of this system for this use has not been demonstrated.

newborn examinations will fail to properly detect the lesions associated with congenital heart defects, particularly in areas with limited resources. Identifying a significant marker within a routinely available, cost-effective screening test is significant and has the potential to be useful in practice. Electrocardiographic evaluation has served as a quick, relatively inexpensive tool in the diagnosis of cardiac conditions in pediatric and adult settings at all levels of care. A 12-lead electrocardiogram (EKG) has limited specificity in diagnosing congenital heart disease; it can serve as an additional tool for early recognition of congenital heart defects.

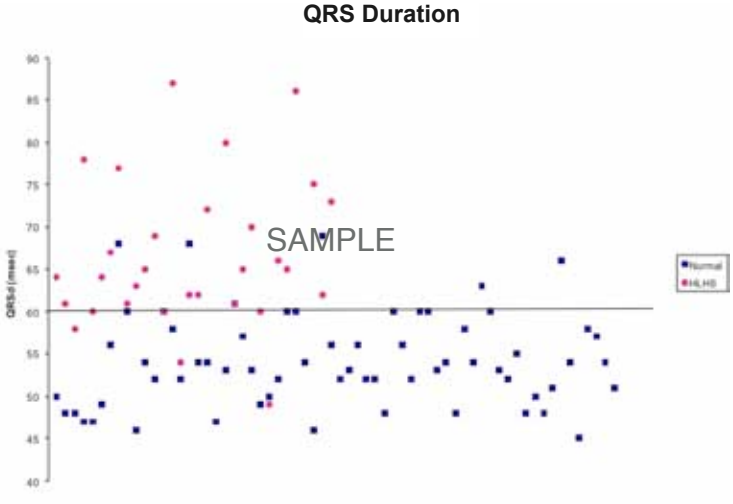
Current newborn cardiac screening recommendations include auscultation, four-limb comparison oxygen saturation,[4] and four-limb comparison sphygmomanometry. These routine screening tests guide practitioners to additional investigations if abnormalities are detected. These routine screening tests for CCHD can be performed by a community provider, are cost-effective, and widely available. None of these will exclude the presence of HLHS.[5]

The purpose of this case-controlled study is to evaluate the diagnostic utility of the 12-lead EKG in HLHS patients by identifying statistically significant electrocardiographic markers for HLHS. In addition, a quantitative comparison of EKG interpreting accuracy between an experienced specialist versus a novice pediatric resident was evaluated in order to develop further investigation of different factors affecting EKG evaluation in the pediatric care setting.

Table 1. The Mean Values and Standard Deviation for Each Measured Variable Between the Control and HLHS Groups. Heart Rate, PR Interval, QRS Duration, QT Interval, S Wave Voltages in V1,V2, V5, V6

	HLHS Group Mean (SD)	Control Group Mean (SD)
Heart Rate (bpm)	153.7 (17)	133.1 (17.6)
PR Interval (msec)	96.7 (46.6)	100.8 (12.8)
QRS Duration (msec)	68.3 (10.9)	54.2 (5.6)
QT Interval (msec)	258.7 (36.8)	282.6 (32.3)
S Wave in V1 (mV)	1.2 (1.5)	4.8 (4.8)
S Wave in V2 (mV)	6.2 (6.1)	11.8 (6.8)
S Wave in V5 (mV)	8.6 (4.8)	5.2 (3.8)
S Wave in V6 (mV)	6.8 (4.6)	3.3 (2.8)

QRS Duration



Methods

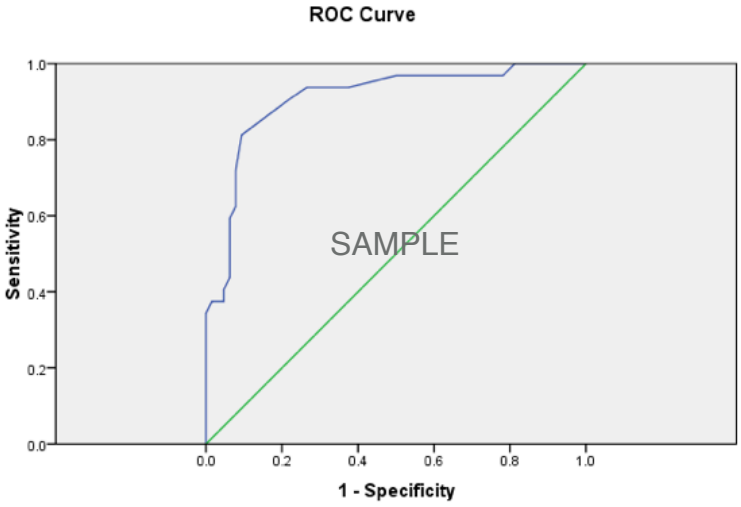
Between February 2005 and October 2008, 32 newborns with HLHS were evaluated at St. Joseph's Medical Center in Phoenix, Arizona. Twelve-lead EKG tracings from known HLHS patients were matched at a ratio of 2:1 to EKGs of normal, age and gender-matched newborns (n=64). Standard intervals from HLHS and normal EKGs were recorded, including: heart rate, PR interval, QRS duration, corrected QT interval, axis (P, QRS, T wave), and precordial lead voltages. Measurements were preformed manually and then evaluated for statistical significance.

The analysis of measured and scored data was done using a two-tailed, two-sample unequal variance Student T-test. Mean, median, maximum and minimum values were calculated for each variable, as well as their respective standard deviations.

A receiver operating characteristic curve (ROC curve) was derived from our data in order to determine the accuracy of EKG-measured variables in helping to diagnose HLHS in the clinical setting.

The reader's overall impression (normal vs. abnormal) was also calculated for HLHS and normal newborns. All diagnostic

QRS Duration



S Wave in V1

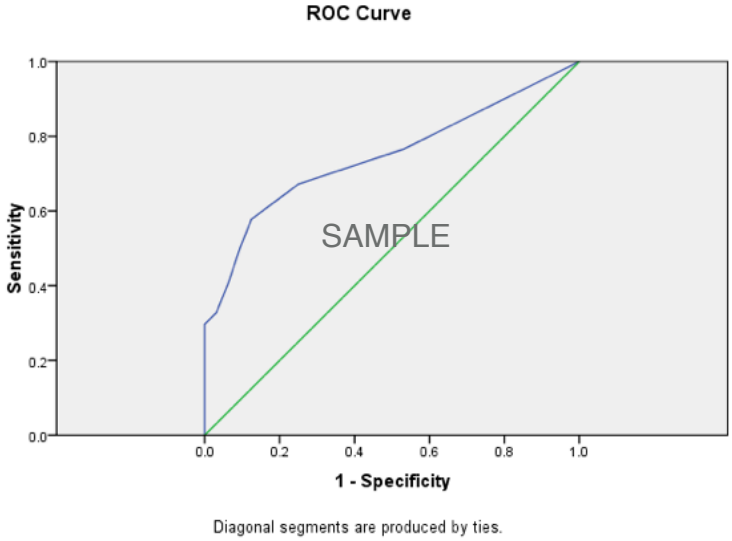


Table 2. Criterion Values and Coordinates of the ROC Curve QRS Duration								
Criterion	Sensitivity	95% CI	Specificity	95% CI	+LR	-LR	+PV	-PV
>=45	100.00	89.0 - 100.0	0.00	0.0 - 5.7	1.00		33.3	
>48	100.00	89.0 - 100.0	18.75	10.1 - 30.5	1.23	0.00	38.1	100.0
>49	96.87	83.7 - 99.5	21.87	12.5 - 34.0	1.24	0.14	38.3	93.3
>53	96.87	83.7 - 99.5	50.00	37.2 - 62.8	1.94	0.062	49.2	97.0
>54	93.75	79.2 - 99.1	62.50	49.5 - 74.3	2.50	0.10	55.6	95.2
>60 *	81.25	63.6 - 92.7	90.62	80.7 - 96.5	8.67	0.21	81.2	90.6
>65	43.75	26.4 - 62.3	93.75	84.7 - 98.2	7.00	0.60	77.8	76.9
>69	34.38	18.6 - 53.2	100.00	94.3 - 100.0		0.66	100.0	75.3
>95	0.00	0.0 - 11.0	100.00	94.3 - 100.0		1.00		66.7

Table 3. Criterion Values with Corresponding Sensitivity and Specificity Values for S Wave Voltage in Lead V1								
Criterion	Sensitivity	95% CI	Specificity	95% CI	+LR	-LR	+PV	-PV
< 0	0.00	0.0 - 11.0	100.00	94.3 - 100.0		1.00		66.7
<=0	46.88	29.1 - 65.2	76.56	64.3 - 86.2	2.00	0.69	50.0	74.2
<=1	75.00	56.6 - 88.5	67.19	54.3 - 78.4	2.29	0.37	53.3	84.3
<=2 *	87.50	71.0 - 96.4	57.81	44.8 - 70.1	2.07	0.22	50.9	90.2
<=3	90.62	75.0 - 97.9	50.00	37.2 - 62.8	1.81	0.19	47.5	91.4
<=4	93.75	79.2 - 99.1	40.63	28.5 - 53.6	1.58	0.15	44.1	92.9
<=5	96.87	83.7 - 99.5	32.81	21.6 - 45.7	1.44	0.095	41.9	95.5
<=6	100.00	89.0 - 100.0	29.69	18.9 - 42.4	1.42	0.00	41.6	100.0
<=19	100.00	89.0 - 100.0	0.00	0.0 - 5.7	1.00		33.3	

evaluations were performed by experienced (pediatric cardiologist) and novice (second year pediatric resident) EKG readers for comparison purposes.

Results

QRS duration, S wave voltage in lead V1, and heart rate were found to be statistically significant in predicting patients with HLHS. QRS duration was the most statistically significant variable with a significantly longer duration in HLHS patients than the control group (68.3 +/-10.9 vs. 54.2 +/-5.6 msec) p = <0.001, followed by S wave voltage in V1 (1.2 +/-1.5 vs. 4.8 +/-4.8 mV) p = <0.001, and faster heart rate (153.7 +/- 17 vs. 133.1 +/- 17.6 bpm) p = <0.001 (Table 1). Plotting of the raw data showed a clear and well-defined separation in the values of QRS duration between the control group and the HLHS group (Figure 1). Constructed ROC curves (Figures 2 and 3) show the theoretical optimal cutoff values derived for each of the significant variables with value of 60 msec for QRS duration (sensitivity 81.3%, specificity 90.6%, negative predictive value 90.6%) and an optimal cutoff voltage value of 2 mV (sensitivity 57.8%, specificity 87.5%, negative predictive value 90.2%) for S wave amplitude in lead V1 (Tables 2 and 3). The area under the ROC curve evaluating the usefulness of QRS duration in predicting HLHS patients was 0.909 (95% CI 0.843 – 0.974). The area under the ROC curve evaluating the usefulness of S wave amplitude in V1 in predicting HLHS patients was 0.746 (95% CI 0.650 – 0.843). Calculated values for sensitivity and specificity are 91% and 92% respectively when using QRSd values to separate HLHS patients from normal.

The evaluation of diagnostic ability between an experienced specialist versus a novice resident was found to be significant with the experienced specialist having more specificity and the pediatric resident more sensitivity in regard to their interpretation of the 12-lead EKGs in the study. The experienced EKG reader identified 72% of EKGs from HLHS patients; however 13% of normal patients had abnormal EKG readings. Novice EKG reader identified 75% of EKGs from HLHS patients; however the novice reader identified 20% of EKGs from normal patients as abnormal.

Discussion

There are some EKG findings that are typically seen with HLHS, such as right ventricular hypertrophy (RVH) and paucity of left ventricular forces;[6] however these findings can be typical in newborns. QRS duration has now been identified as a significant marker in differentiating HLHS from normal; as a result, the evaluation of QRSd values in a 12-lead EKG can complement the rest of the clinical findings during assessment. It is reasonable to utilize these measured variables as an effective way to screen or evaluate suspected HLHS patients in instances where the availability of echocardiography is limited or delayed.

Considering that the mortality rate of HLHS is the highest among all congenital heart defects and that in many instances, up to 14% of cases, can go undiagnosed before death,[7]

"The evaluation of diagnostic ability between an experienced specialist versus a novice resident was found to be significant with the experienced specialist having more specificity and the pediatric resident more sensitivity in regard to their interpretation of the 12-lead EKGs in the study."

identifying a low-cost, efficient, screening test is of great importance. Electrocardiographic characteristics can contribute to the diagnosis of HLHS and guide further diagnostic work-up to determine degree of hypoplasia and associated mitral and aortic valve atresia, which will guide therapeutic interventions.[8]

Another aspect of the diagnostic process that was investigated in this project was the comparison of diagnostic ability between experienced and novice readers. The findings conclude that the experienced reader can evaluate EKGs with more specificity and the novice reader with more sensitivity. This suggests that novice readers may be able to evaluate EKGs efficiently enough to at least prompt further investigation and evaluation by sub-specialized, expert staff. In the future, it would be of interest to evaluate how the reading efficiency of novice EKG evaluators rate on a large, generalized scale (general pediatricians, family practitioners, emergency department physicians, etc.).

Overall, the 12-lead EKG has a high sensitivity and specificity for assisting in the diagnosis of HLHS. Its use could be implemented as a low-cost, easily accessible screening tool in areas or instances where echocardiography is not readily available and where a moderately trained healthcare professional can evaluate QRSd and determine whether an EKG as a normal or abnormal tracing with an assessed high risk for HLHS.

Conclusion

Early identification of patients with CCHD is essential to improving outcomes and directing care. Clinical features, combined with electrocardiographic findings can guide further work-up. A 12-lead EKG is the standard of care in evaluating patients with suspected cardiovascular disease and is easily obtained. The utilization of QRSd to standard EKG evaluation can add to early identification and is a readily accessible test.

No Conflicts of Interest

Disclosures: none

Contributions

- Edward K Rhee- Study Design, methods
- Juan Aliaga - Statistics
- T. Moe – Manuscript drafting, editing, and submission
- K. McDonnell – Manuscript drafting
- R. Bitinis – Residency coordination and interpretation of EKG's, data collection

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My Pre-Med-Life Crisis: China California Heart Watch Internship, July 2013

By Briana Shipley, BA History, University of Colorado

This summer, *China California Heart Watch* (*China Cal* - www.chinacal.org) invited me to work with their organization holding medical clinics in the Yunnan Province, China. As a Post-Baccalaureate Pre-Med student, this experience was nothing short of culturally awakening, intellectually challenging, and emotionally engaging. I believe that the most valuable aspect of this excursion was learning how to cope with the humanistic and emotional side of medicine: the dichotomy between "human care" and "clinical care." This is an issue I did not expect to face until well into medical school, a seemingly simple matter compared to the rigorous academics. Surprisingly, I discovered just how difficult this could be on Day 1, the first day of our 3 week internship. For the first time, this is the day I wondered if medicine is truly the right fit for me.

Clinic Day 1

After 2 full days of lecture about basic heart anatomy, the circulatory system, auscultation and congenital heart disease, we finally held our first clinic. The patients who came to the *China Cal* headquarters were not local villagers, but rather poor farmers who had traveled a long way to see Dr. Robert Detrano, MD, PhD, Founder of *China Cal*, and who had seen him several times before. These patients were not elderly adults with high blood pressure or obesity; instead, they were children with congenital heart disorders. As a Pre-Med student whose dream is to work in pediatrics, I was thrilled; what could be better than spending time with kids all day, helping them heal and giving them hope and a smile? What I seemed to have strangely forgotten is that doctors are not omniscient, and there isn't always a solution to every patient's ailments.

Day 1 brought in several adorable children, some of whom were candidates for surgery and who would most likely grow up as healthy as their parents dreamed. But one small child, a one-year-old infant with a 40-year-old mother, would not. This baby had the works: VSD, ASD, aortic stenosis, interruption of the aortic arch, among others. Upon examination, she was lethargic and her skin was pale and purple from lack of oxygen supply, but her little smile never faded. After taking the infant's vitals and reviewing her ultrasound and EKG, we had to tell the mother that her only baby is not only inoperable, but likely would not live more than a few months. The look on the mother's face is an image I will never forget. She was defeated and scared,

but strong as she fought for her baby, confident that something could be done to help her. Suddenly, I felt helpless, and it brought a tear to my eye when I knew I should not show it. How, as an aspiring pediatric physician, can I care about children as much as I do while dealing with such heart wrenching moments? How can I handle the rigors of a life in medicine, not academically, but emotionally? Sure, when there are cures and solutions, being a doctor must feel like a wonderful gift. But I lacked confidence that I could deal with moments like this, especially in the field of cardiology, where life-threatening conditions are all too common.

The rest of the day had me stewing in my emotions as the impending mortality of that beautiful little girl sunk in, forcing me to question my life-long dream of working in the healthcare field at all. I wondered how physicians like those on our internship trip, Dr. Detrano and Dr. Renli Qiao, MD, PhD, were able to handle their roles as bearers of bad news, when caring for others is clearly their most important job in life. But I will never forget what Dr. Detrano and Amy Poole, our head nurse, said to me in response to my worries, something I now believe will carry me through medical school and my career, "For every ten patients you cannot help, there is always one that makes it all worth it. Your best is all you can do. And that is what keeps you going in medicine."

While on one of our many *China Cal* bus trips through the Chinese countryside, I read an inspiring article in *Scientific American* that addressed my worries in a different light. The article discussed surgeons, and how they must emotionally disengage from the lives of their patients in order to make confident decisions and upon success, or failure, transform themselves into some of the most empathetic and sincere caregivers imaginable. I worked on training my brain in this way during village clinics in the weeks that followed Day 1, greeting patients with the utmost warmth, but switching on my concentration and focus when examining them. This idea, along with the motivational words by Amy and Dr. Detrano, has given me a glimpse into what being a compassionate and life-changing physician really means. I walked away from *China Cal* with a more confident and tangible approach to medicine, and an excitement I have never had before.

"But I will never forget what Dr. Detrano and Amy Poole, our head nurse, said to me in response to my worries, something I now believe will carry me through medical school and my career, 'For every ten patients you cannot help, there is always one that makes it all worth it. Your best is all you can do. And that is what keeps you going in medicine.'"

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Image of the Month #8 - December 2013 - Presented by The Archiving Working Group

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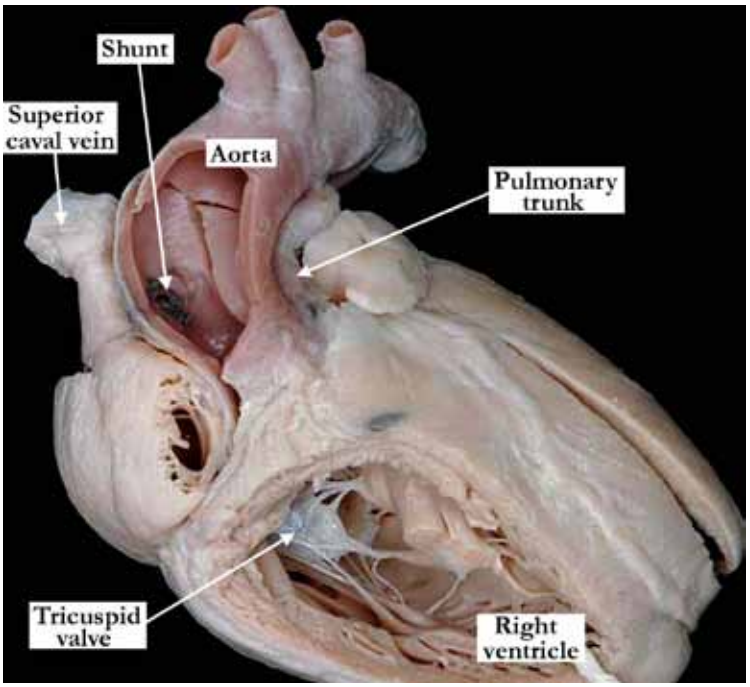
IPCCC: 01.01.26, 12.31.05

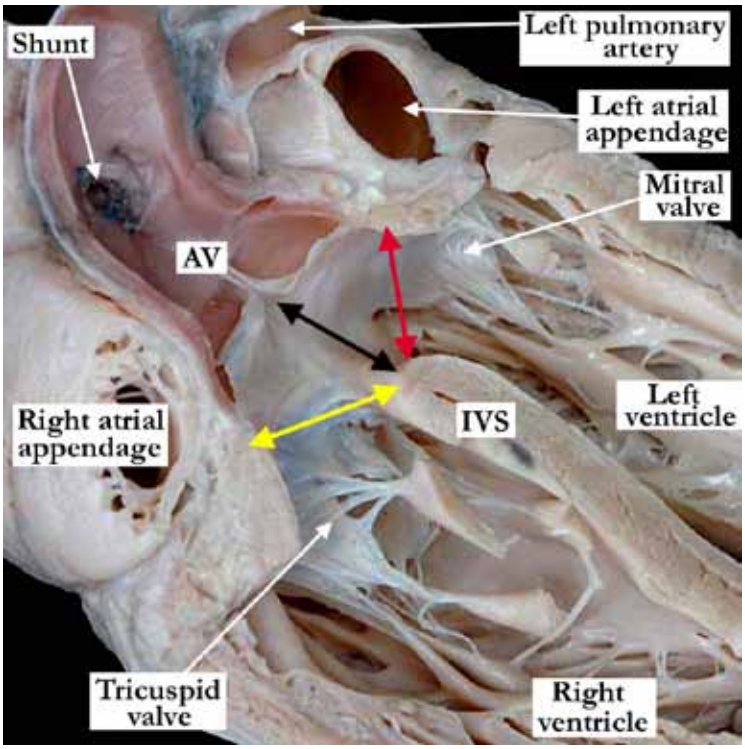
AEPC Derived Term:
Tetralogy of Fallot with pulmonary atresia (01.01.26)
Waterston (ascending aorta-right pulmonary artery) anastomosis (12.31.05)

EACTS-STS Derived Term:
Tetralogy of Fallot, Pulmonary atresia
Palliation, Shunt - systemic-to-pulmonary, Waterston type (ascending aorta to pulmonary artery) (12.31.05)

ICD10 Derived Term:
Tetralogy of Fallot (Q21.3)



Description: This heart with Tetralogy of Fallot has been tilted toward the right to demonstrate the tiny atretic pulmonary trunk. The aorta is large and lies anterior and to the right of its normal position. There is an intact, stenotic Waterston shunt on the right lateral aspect of the ascending aorta. The superior caval vein drains to the right atrium in the usual fashion and the tricuspid valve guards the inlet of the right ventricle. There is right ventricular hypertrophy.
Contributor: Diane E. Spicer, BS



Description: This simulated 5-chamber echocardiographic view demonstrates the overriding aorta and the hole between the ventricles. The aortic valve (AV) lies above the muscular ventricular septum (IVS), committed approximately 50% to the right ventricle and 50% to the left ventricle (black double-headed arrow). There are concordant atrioventricular connections. Note that the tricuspid is in fibrous continuity with the aortic valve along the rightward margin of the cone of space subtended from the leaflets of the overriding aortic valve. It is this locus that represents the plane of deficient ventricular septation, and which, to the best of our knowledge, most would define as the "ventricular septal defect" (yellow double-headed arrow). The presence of aortic-tricuspid valvar continuity means that the defect is perimembranous. It is the black double-headed arrow, however, that represents the geometric plane separating the cavities of the right and left ventricles. The red double-headed arrow then indicates the left ventricular entrance to the cone of space beneath the overriding aortic valve. This plane is formed posteriorly by fibrous continuity between the leaflets of the aortic and mitral (MV) valves. In circumstances when the aortic valve is exclusively supported by the right ventricle, it is this plane that is the interventricular communication, and which is considered by many then to represent the "ventricular septal defect". As shown in this image, however, it is a fundamentally different plane from the one considered to represent the ventricular septal defect in the setting of Tetralogy of Fallot
Contributor: Diane E. Spicer, BS

AWG Web Portal link for this series of images:
http://www.accd-awg.umn.edu/Pulmonary_Atresia/PA_Atresia_TOF/PA_Atresia_TOF_01_01_26.html

This is a special column that is published bimonthly in *Congenital Cardiology Today* with contributors and images from the Archiving Working Group (AWG) of *the International Society for Nomenclature of Paediatric and Congenital Heart Disease.*

Please visit us at the AWG Web Portal at http://ipccc-awg.net and help in the efforts of the *Archiving Working Group* and the *International Society for Nomenclature of Paediatric and Congenital Heart Disease*.

The authors would like to acknowledge the *Children's Heart Foundation* (www.childrensheartfoundation.org) for financial support of the AWG Web Portal.

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Third Fetal Echocardiography Symposium at UCLA

By Mark S. Sklansky, MD

The Third Annual Fetal Echocardiography Symposium at UCLA, located in the Tamkin Auditorium on the beautiful UCLA campus in the heart of Westwood, was another tremendous success, this year with an expanded sold-out audience of 225. The only such course offered on the West Coast of the United States, this one-day symposium has become an invaluable, highly popular annual update for health professionals interested in improving their ability to evaluate the fetal heart. The symposium has retained its focus as an intensive, one-day overview, focused on tips and pearls of scanning prepared by an internationally acclaimed faculty of maternal-fetal medicine specialists, pediatric cardiologists, and obstetric sonographers with decades of experience. As in previous years, attendees were provided both an intensive review and update on the basics of fetal cardiac imaging, including tips and pearls of scanning, as well as insights into detailed fetal echocardiographic interpretation and prognosis.

The symposium began by sequentially addressing the four-chamber view, outflow tracts, and the three-vessel tracheal view. Each session reviewed technical aspects of scanning (how to obtain optimal views), important anatomic/functional aspects (interpretation, how to confirm normalcy), and pertinent diagnostic/prognostic components of the most common forms of Congenital Heart Disease. Additional talks focused on secondary cardiac findings, including echogenic foci, tricuspid regurgitation, premature atrial contractions, ventricular hypertrophy, and right heart disproportion, as well as aneuploidy and Twin-Twin Transfusion Syndrome. Highlights of the symposium included clinically useful pitfalls and pearls of cardiac imaging from the perspective of sonographers, maternal-fetal medicine subspecialists, and pediatric cardiologists. The symposium concluded with a lively panel discussion, during which the faculty fielded a variety of final questions from the audience.

Left-to-right: Drs. Douglas Montgomery and Bobby Daftari.

Left-to-right: Drs. Karim Diab, Mark Sklansky and Bilal Harake.

Given the recent revisions to North American guidelines for the second trimester anatomy screen, this year's course provided expanded lectures on the outflow tracts, including expanded attention to the three-vessel trachea view. The intensive series of didactic presentations was complemented with live scanning sessions which served to demonstrate the concepts discussed throughout the day. Finally this year's symposium also provided each attendee with a complimentary copy of Dr. Greggory DeVore's educational DVD, "*Fetal Echocardiography Gold Edition Plus*."

The symposium's organizers, Drs. Mark Sklansky and Gregory DeVore, welcome suggestions for next year's symposium, already scheduled for October 18, 2014. Prospective attendees are encouraged to save the date and register early, as this year's symposium sold out over a month in advance. Dr. Sklansky can be reached directly at his email in the author box below.

Attendees gathering in the lobby

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Medical News, Products & Information

New Technique May Help Regenerate Heart Cells to Treat Heart Disease

Researchers have developed a new technique that might one day be used to convert cells from heart disease patients into heart muscle cells that could act as a personalized treatment for their condition. The research was published online on August 22nd in the *Journal of the International Society of Stem Cell Research, Stem Cell Reports*, published by Cell Press.

The investigators previously reported the ability to convert scar-forming cells in the heart (called fibroblasts) into new, beating muscle in mice that had experienced heart attacks, thereby regenerating a heart from within. They accomplished this by injecting a combination of three genes into the animals' fibroblast cells. "This gene therapy approach resulted in new cardiac muscle cells that beat in synchrony with neighboring muscle cells and ultimately improved the pumping function of the heart," explains senior author Dr. Deepak Srivastava of the Gladstone Institutes and its affiliate, the University of California, San Francisco.

In this latest research, Dr. Srivastava and his colleagues coaxed fibroblasts from human fetal heart cells, embryonic stem cells, and newborn skin grown in the lab to become heart muscle cells using a slightly different combination of genes, representing an important step toward the use of this technology for regenerative medicine. Two other groups recently reported similar results using human fibroblasts.

The team envisions that introducing these genes into damaged hearts by gene therapy might convert fibroblasts into new muscle, thereby improving the function of the heart. "Over 50% of the cells in the human heart are fibroblasts, providing a vast pool of cells that could be harnessed to create new muscle," says Dr. Srivastava. However, additional research is needed to improve the process of reprogramming adult human cells in this way. Ultimately, replacing the genes with drug-like molecules that produce a similar effect would make the therapy safer and easier to deliver.

Your Finger's Pulse Holds the Key to Your Heart's Health New Technique from UI Study

Newswise - A University of Iowa physiologist has a new technique to measure the stiffness of the aorta, a common risk factor for heart disease. And it can be as simple as measuring the pulse in your finger.

The new procedure developed by Gary Pierce, Assistant Professor in the Department of Health and Human Physiology, works by placing an instrument called a transducer on the finger or over the brachial artery, located inside the arm just beneath the elbow. The readout, combined with a person's age and body mass index, lets physicians know whether the aorta has stiffened.

Currently, physicians see whether a patient has a hardened aorta by recording a pulse from the carotid artery, located in the neck, and the femoral artery, which is located in the groin. Taking a pulse from the finger or on the arm is easier to record and nearly as accurate, Pierce says. It also works better with obese patients, whose femoral pulse can be difficult to obtain reliably, he adds.

"The technique is more effective in that it is easy to obtain just one pulse waveform in the finger or the brachial artery, and it's less intrusive than obtaining a femoral waveform in patients," says Pierce, first author on the paper, published in the American Journal of Physiology Heart and Circulatory Physiology. "It also can be easily obtained in the clinic during routine exams similar to blood pressure tests."

Heart disease is the leading cause of death for both men and women in the United States, killing about 600,000 people every year, according to the federal Centers for Disease Control and Prevention (CDC). One key to a healthy heart is a healthy aorta. A person's heart has to work harder when the aorta, the large artery that leaves the heart and delivers blood to the body's tissues, stiffens due to aging and an inactive lifestyle. The harder a person's heart needs to work, the higher risk he or she has for developing high blood pressure, stroke and a heart attack.

Since people can live for years without any knowledge of existing cardiovascular problems, this new measurement tool is especially important. It can provide useful diagnostic information for middle-aged and older patients, who are most susceptible to having hardened arteries that can lead to heart disease.

Regular assessments of the aorta may help reduce those risks. Pierce's instrument measures notes the speed, called, “aortic pulse wave velocity,” at which the pulse moves between two points. The UI team validated the new instrument's performance against the carotid-femoral-artery pulse wave velocity tests, considered the gold standard for determining aortic stiffness.

"Finding simple noninvasive methods to measure aortic pulse wave velocity in the clinic may help physicians to better inform middle-aged and older adults about their level of cardiovascular risk," Pierce says, noting that past studies have shown that regular exercise protects the aorta from hardening in those age groups.

The paper's corresponding author is Harald Stauss, Associate Professor in Health and Human Physiology. Other authors from the UI include: Darren Casey, Jess Fiedorowicz, and DeMaris Wilson. Douglas Seals from the University of Colorado-Boulder, and Timothy Curry and Jill Barnes from the Mayo Clinic in Rochester, Minn. also contributed to the paper.

The National Institutes of Health (grant award numbers T32 383 AG000279, HL105467, AG013038, F32 AG038067, K23 384, DK082424, UL1RR024979 and UL1RR025780), the American Heart Association and the UI funded the study.

Children’s National / Cerner Collaborate in First Pediatric Health Information Technology Institute

Washington, DC and Kansas City, MO – Children’s National Health System and information technology leader Cerner Corporation has announced the formation of The Bear Institute, a joint effort that will be the first exclusively pediatric health informatics institute in the nation.

The Bear Institute is a seven-year program that will advance evidence-based pediatric care delivery, research, and education through innovation in electronic health information technology (IT). We believe this is the only such institute devoted solely to IT innovation in pediatric care. The Institute will accelerate the development of fully-integrated electronic health records, accessible to care providers, patients and families, health care facilities, educators, and researchers within, and affiliated with, Children's National. The Institute also will facilitate the rapid development of sophisticated health IT capabilities including: linking genomic profiles to decision support for personalized health care; matching patient information with a database of open clinical trials for research opportunities; and more nimble patient and family engagement with their health through secure web-enabled portals and mobile devices.

"If we are to achieve healthier societies, we will need innovation in two critical areas: Information Technology and the health and well-being of children. As information technology becomes more central to delivering world-class care, we see an opportunity to lead IT practice for children's health," said Kurt Newman, President & CEO, Children's National. "We share this vision with Cerner, and that shared vision was the determining factor in the selection of Children's National to be the partner for the Bear Institute. Together, we will serve as innovators for children and families."

With the formation of The Bear Institute, Cerner and Children's National will invest in innovative programming and product development. Successful developments will translate into intellectual property development and research.

"Cerner is thrilled to collaborate with Children's National in creating the first pediatric health informatics institute. Their 140-year history of excellence in serving the health needs of children, commitment to research, and proven record of incorporating health information technology in care all make this a very compelling collaboration," said Neal Patterson, Co-Founder, Chairman and CEO of Cerner, recently ranked 7th among Forbes' Most Innovative Companies in America. "Children in the region, across the country, and around the world will benefit from the work of The Bear Institute."

Children's National brings to the Institute its existing and ongoing significant investment in digitizing health care delivery, as well as its national leadership among pediatric health care organizations in using the electronic health record system to benchmark and track quality and safety initiatives. Additionally, Children's National has led the development of the Children's IQ Network®, a pediatric health information exchange for children, which provides the foundational information technology capability to realize an integrated health care delivery system reaching across the mid-Atlantic region.

"Imagine having all of the essential health information, robust workflow-integrated support for decisions, as well as patient-specific genomic information available at clinicians' fingertips thereby allowing them to make well-informed prevention, diagnostic, and treatment decisions," said Brian Jacobs, MD, VP, Chief Medical Information Officer, Chief Information Officer/Chief Medical Information Officer and Executive Director, Center for Pediatric Informatics and The Children's IQ Network. "We are very close to making this an everyday reality. This collaboration will accelerate that momentum."

The Bear Institute will amplify Cerner's role with Children's National, with the assumption of operational and administrative responsibilities for Children's National information technology via its Cerner Millennium® solutions and services, including remote hosting, monitoring and system performance capabilities, including data protection. Additionally, the current Children's National IT team will become Bear Institute/Cerner associates, offering career development, training, and advancement within one of the nation's health IT leaders.

Digisonics Introduces Appropriate Use Criteria Calculations for Its Cardiovascular Information System

Digisonics, a *Best in KLAS* provider of cardiovascular information systems (CVIS), has introduced functionality for Appropriate Use Criteria (AUC) calculations. Appropriate Use Criteria are evidence-based guidelines to assist referring physicians and other providers in making the appropriate imaging or treatment decision for a specific clinical condition/indication. Digisonics recognizes that reimbursement audits will be tied to appropriate use scores in the future, so there is considerable benefit for facilities that utilize the Digisonics CVIS to monitor appropriate use scores and produce the required structured reports.

Digisonics' cardiovascular information system solutions with appropriate use criteria calculations help facilities prepare for the future of healthcare and ensure the quality of patient care by providing clinicians with evidence-based guidelines to make the best clinical decisions.

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