Fri. Jul 7, 2017

ROOM 3

AEPC-AHA-JSPCCS Joint Symposium

AEPC-AHA-JSPCCS-TSPC Joint Symposium (I-AJS) New applications of cardiovascular magnetic resonance in pediatric cardiology

Chair:Satoshi Yasukochi(Heart Center, Nagano Children's Hospital, Japan)
Chair:Brandley S. Marino(President of VDY, AHA)
Chair:Gurleen Sharland(President of AEPC)
1:00 PM - 2:30 PM ROOM 3 (Exhibition and Event Hall Room 3)

[I-AJS-01] New applications of cardiovascular magnetic resonance in pediatric cardiology

○Mark A. Fogel （Children's Hospital of Philadelphia, USA）

1:00 PM - 2:30 PM

[I-AJS-02] Hybrid cardiovascular magnetic resonance and fluoroscopic guided cardiac catheterization

○Kuberan Pushparajah （Evelina London Children's Hospital and King's College London, UK）

1:00 PM - 2:30 PM

[I-AJS-03] Advanced applications of CMR for understanding pathophysiology in CHD – The Senning Model

○Emanuela R Valsangiacomo Buechel （Division of Cardiology, Pediatric Heart Center, University Children's Hospital Zurich, Switzerland）

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[I-AJS-04] Hemodynamic evaluation in patients with congenital heart defects using phase-contrast flow measurements and bloodstream equations

○Yuichi Ishikawa （Department of Cardiology, Fukuoka Children's Hospital, Japan）

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[I-AJS-05] 4D flow MRI and Blood Flow Imaging for Adult Congenital Heart Surgery

○Keiichi Itatani[1], Masaaki Yamagishi[2], Takako Miyazaki[2], Nobuyoshi Maeda[2], Satoshi Taniguchi[2], Shuhei Fujita[2], Hisayuki Hongu[2], Satoshi Numata[1], Sachiko Yamazaki[1], Tomoya Inoue[1], Kazuki Morimoto[1], Suguru Ohira[1], Kaichiro Manabe[1], Rina Makino[1], Hiroko Morichi[1], Kosuke Nakaji[3], Kei Yamada[3], Shohei Miyazaki[4], Toyoki Furusawa[4], Teruyasu Nishino[4], Hitoshi Yaku[1] （1.Department of Cardiovascular Surgery, Cardiovascular Imaging Research Labo, Kyoto Prefectural University of Medicine, Japan, 2.Department of Pediatric Cardiovascular Surgery, Kyoto Prefectural University of Medicine, Japan, 3.Department of Radiology, Kyoto Prefectural University of Medicine, Japan, 4.Cardio Flow Design Inc., Japan）

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[I-AJS-01] New applications of cardiovascular magnetic resonance in pediatric cardiology

○Mark A. Fogel (Children's Hospital of Philadelphia, USA)

Cardiovascular magnetic resonance (CMR) has been applied to congenital heart disease for over 30 years and has evolved to become to an integral part of the care of the patient. Recent advances have led to further applications in pediatric cardiology and new ways to diagnose and treat patients. For example, new approaches to surgical planning using computational fluid dynamics in conjunction with CMR allows for visualizing and predicting a whole range of surgical options and outcomes. Along those lines, 4-dimensional flow imaging, where a " slab" of velocities are obtained, has opened up novel ways to visualize and measure flow characteristics of the native and repaired congenital heart disease such as the Fontan pathway or the reconstructed aorta. Displacement encoding (DENSE) is a dedicated method to assess myocardial strain whereas the advent of tissue tracking can be utilized on standard cine sequences to also measure multidimensional strain. Techniques such as T1 mapping have opened up new insights into tissue characterization and the ability to predict outcome. XMR, the combination of CMR and cardiac catheterization, has been utilized to save time in the cath lab as well as radiation exposure. Finally, lymphatic imaging has allowed pediatric cardiologists to gain new insights into complications and treatment of the single ventricle. This lecture will survey a number of various new techniques in CMR which are slowly changing the field of pediatric cardiology.

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[I-AJS-02] Hybrid cardiovascular magnetic resonance and fluoroscopic guided cardiac catheterization

○Kuberan Pushparajah (Evelina London Children's Hospital and King's College London, UK)

Cardiac catheterisation under fluoroscopic guidance is an important modality in the diagnosis and treatment of acquired and congenital heart disease. However, there is a recognised burden of the risk of radiation to patients and staff, and the cancer risk particularly in children with congenital heart disease requiring repeat investigations or interventions. MRI has the advantages of providing 3D anatomical information, cardiac function, flow, soft tissue characterisation and scar detection without the use of radiation.
MRI augmented or MRI guided catheterisation was pioneered in patients at our unit (Guy's Hospital) 15 years ago and is routinely employed for diagnostic catheterisation in congenital heart disease particularly as a validated tool in the assessment of pulmonary vascular resistance. Early studies show promise in the use of MRI guided electrophysiology studies and radiofrequency ablation where MRI tissue characterisation allows assessment of the ablation targets and effects. There are a few small case reports of early experience in MRI guided interventions for structural congenital cardiac lesions in animals and humans. However, there are still limitations to the wider adoption of these techniques, particularly with respect to suitable cardiac catheters and guidewires in the MRI environment. There are improvements in MRI sequences for rapid scanning, device visualisation, interactive visualisation platforms with integrated segmentation tools. Novel guidewires and catheters which allow passive or active tracking are being developed. There is renewed enthusiasm for adoption of these technologies

which may well lead to wider use of MRI catheterisation in clinical practice.

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[I-AJS-03] Advanced applications of CMR for understanding pathophysiology in CHD – The Senning Model

○Emanuela R Valsangiacomo Buechel (Division of Cardiology, Pediatric Heart Center, University Children's Hospital Zurich, Switzerland)

Keywords: Cardiovascular magnetic resonance, systemic right ventricle, TRansposition of the great arteries

The Senning or Mustard procedure for repair of transposition of the great arteries (TGA) results in a right ventricle (RV) sustaining the systemic circulation,as well as in extensive suture lines at the level of the atrial baffles, which may lead to an abnormal atrial function and to arrhythmias. During longterm follow up RV function and occurrence of arrhythmias are the ultimate predictors of outcome.Patients with TGA after atrial repair with the Sessing or Mustard procedure represent a good model for studying complex pathophysiology in CHD, such as the systemic RV and an abnormal preload due to alterated atrial geometry and elasticity. CMR, by combining sequences, is the ideal tool for studying such complex pathophysiology in the same examination and " in vivo".
In this lecture different studies using CMR for assessing Senning patients are presented. Some studies have demonstrated that the function of the atrial baffles, and therefore preload conditions are abnormal. This was already indirectly postulated by comparing stress response in Senning versus in ccTGA patients. The direct CMR measurements of the baffle function confirm this hypothesis. Advanced imaging of the RV function may help to describe the peculiar RV adaptation to the abnormal physiologic condition, and detect early RV dysfunction. CMR feature tracking helps to understand the myocardial mechanics of the systemic RV and of the subpulmonary LV.
These and more data from the literature will be discussed in a global context for understanding the pathophysiology in patients after the Senning repair for TGA.

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[I-AJS-04] Hemodynamic evaluation in patients with congenital heart defects using phase-contrast flow measurements and bloodstream equations

○Yuichi Ishikawa (Department of Cardiology, Fukuoka Children's Hospital, Japan)

Over the last several years, cardiovascular magnetic resonance (CMR) has undergone rapid evolution, and tremendous advances have resulted in progressive expansion of the clinical applications. But practically, CMR in patients (pts) with congenital heart defects (CHD) is generally difficult to scan because of their anatomical complexity. Inappropriate CMR imaging protocols and/or inadequate post-examination reviews results in an incomplete or erroneous interpretation. To avoid such situation, we employed " a bloodstream equation" as a hemodynamics validation tool. In a patient with unrepaired

simple VSD, for example, the blood flow volume in ascending aorta, the sum of those in supra and inferior venae cavae, and the trans-tricuspid flow should become all equal as systemic blood flow (Qs). And the blood flow volumes in main pulmonary trunk, the sum of those in right and left pulmonary arteries, the sum of those in pulmonary veins, and the trans-mitral flow should become all equal as the pulmonary blood flow volume (Qp). After a validation process, an accurate value of Qp/Qs should be identified. If a validated value of the blood flow is not consistent, the existence of unrecognized shunt is suggested. A value of LV and/or RV output calculated from a ventricular volumetry can be also available for a validation process. From December 2008 to June 2017, those CMR examinations have made in 2350 patients with CHD in Fukuoka children' s hospital and CVIC, including 513 pts with single ventricle physiology after total cavopulmonary connection, 213 pts after bidirectional Glenn procedure, 669 pts with repaired TOF physiology, 143 pts with repaired TGA, 127 pts with ASD, 114 pts with repaired AVSD, 37 pts with VSD. All acquired data were validated using bloodstream equations. In the presentation we introduce those inductive CMR findings in single ventricle physiology.

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Background: Recent progress in cardiac MRI and blood flow imaging is outstanding and 4D flow MRI and computational fluid dynamics (CFD) flow simulation have been expected for wide clinical applications. Because long-term outcomes of congenital heart diseases have close relationship with its hemodynamics, cardiac MRI and blood flow imaging have advantages in the evaluation of adult congenital diseases.
Method and Results: 4D flow MRI is applied to the variety of patients with adult congenital heart disease. Flow energy loss (EL) is a parameter of cardiac workload and a predictor of ventricular deterioration. Pulmonary stenosis and regurgitation in patients with Tetralogy of Fallot are evaluated not only with right ventricle (RV) volume and regutgitant fraction, but also with EL estimation. Other anomalies including the situation after one and a half repair or single systemic RV is also evaluated with 4D flow MRI and flow EL. For the determination of the surgical strategies, CFD flow simulation is a powerful tool because it enables virtual surgery on a computer. Complicated Fontan circulation such as hepatic factor maldistribution in azygous connection is one of the good candidates for blood flow diagnosis with 4D flow MRI and surgical planning in CFD flow simulation.
Conclusions: 4D flow MRI is a novel and powerful tool for the evaluation for indication of adult congenital heart surgery, especially for cases with RV dysfunction and for Fontan cases. CFD flow simulation is usefule for the determination of surgical procedures.