

## Clinical Research Focus

Our focus is on making pediatric and congenital heart disease CMR diagnostic imaging faster, crisper and more robust for our patients, from fetus to adult. We want to image faster, image safer and image earlier.

Through development of faster imaging and image reconstruction techniques, we are committed to using MR to guide interventional procedures by using X-ray Fused with Magnetic Resonance (XFM) technology, developing Radiation-free Right Heart Catheterization where catheters are guided through the heart with CMR, and to use MR imaging to identify acute ablation lesions following Electrophysiology ablation procedures.



Back row (L-R): Russell Cross, MD Michael Hansen, PhD Karin Hamann, RN Shena Phillips, ARMRT  
Front row, (L-R): Imani Mojerie, BS Laura Olivieri, MD Yue-Hin Loke, MD Ileen Cronin, NP Adrienne Campbell, PhD Simon Vargas, ARMRT  
Not pictured: Elena Grant, MBChB

## Our Vision of CMR in 20 Years

The year 2037 will hold wonderful things. We hope to perform MRIs without sedation, quickly and efficiently, examining not just a resting condition, but using provocative testing to understand hemodynamics in a variety of physiologic states. We hope to perform radiation-free cardiac catheterizations in children with complex anatomy with a variety of tools to guide catheters in the magnet and perform interventions (biopsies, angioplasties, device closures) in the magnet.

## SCMR Involvement

We are involved in the Pediatric and Congenital subcommittee, the Pediatric research committee, the Interventional Cardiac Magnetic Resonance working group.

## Notable ICMR Publications

### ★ Image Fusion Guided Device Closure of Left Ventricle to Right Atrium Shunt



Grant EK, Faranesh AZ, Cross RR, Olivieri, LJ, Hamann KS, O'Brien KJ, Hansen MS, Donofrio MT, Lederman RJ, Ratnayaka K, Slack MC.

### ★ Improved workflow for quantification of left ventricular volumes and mass using free-breathing motion corrected cine imaging



Russell Cross, corresponding author Laura Olivieri, Kendall O'Brien, Peter Kellman, Hui Xue, and Michael Hansen

### ★ Native T1 values identify myocardial changes and stratify disease severity in patients with Duchenne muscular dystrophy



Olivieri LJ, Kellman P, McCarter RJ, Cross RR, Hansen MS, Spurney CF

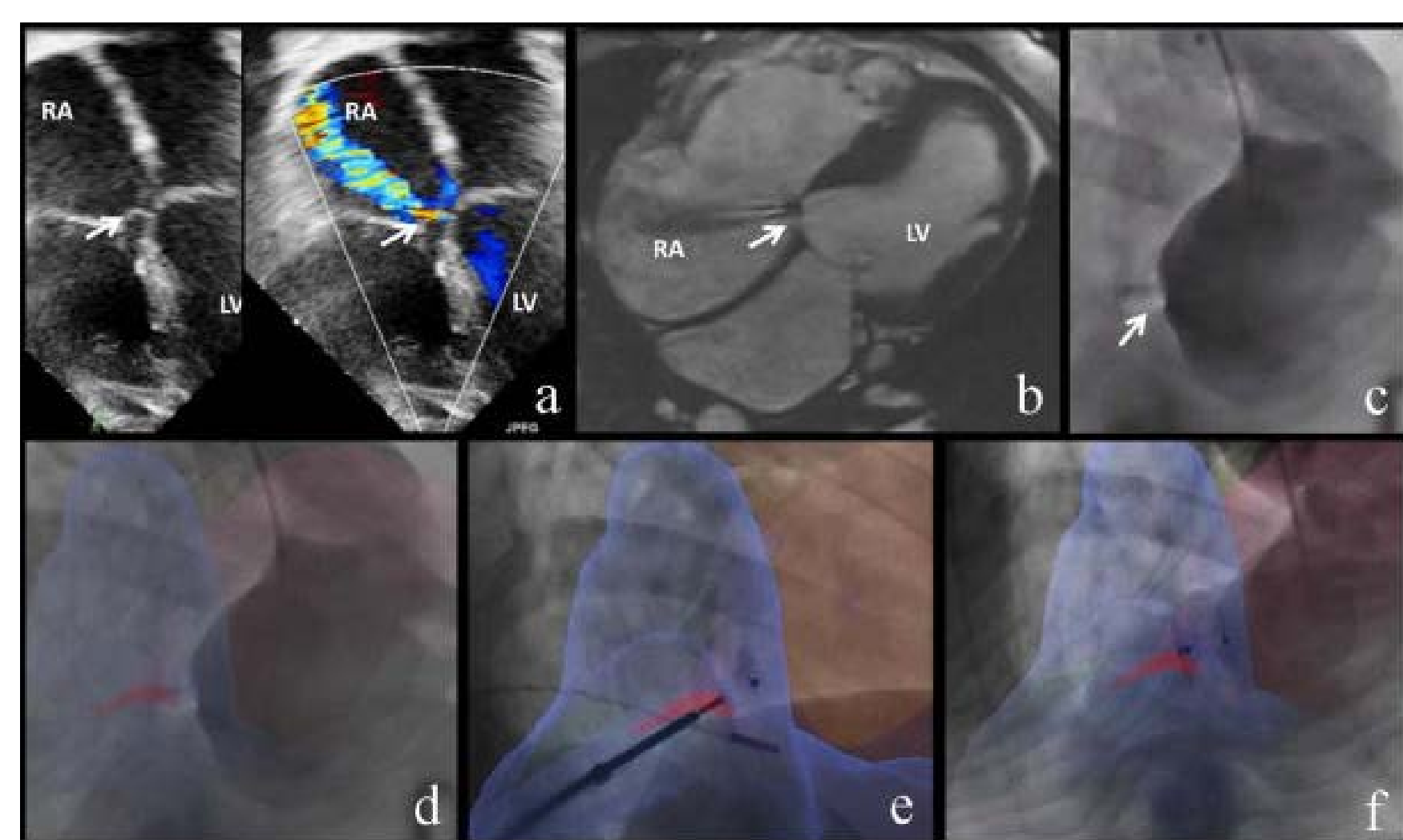
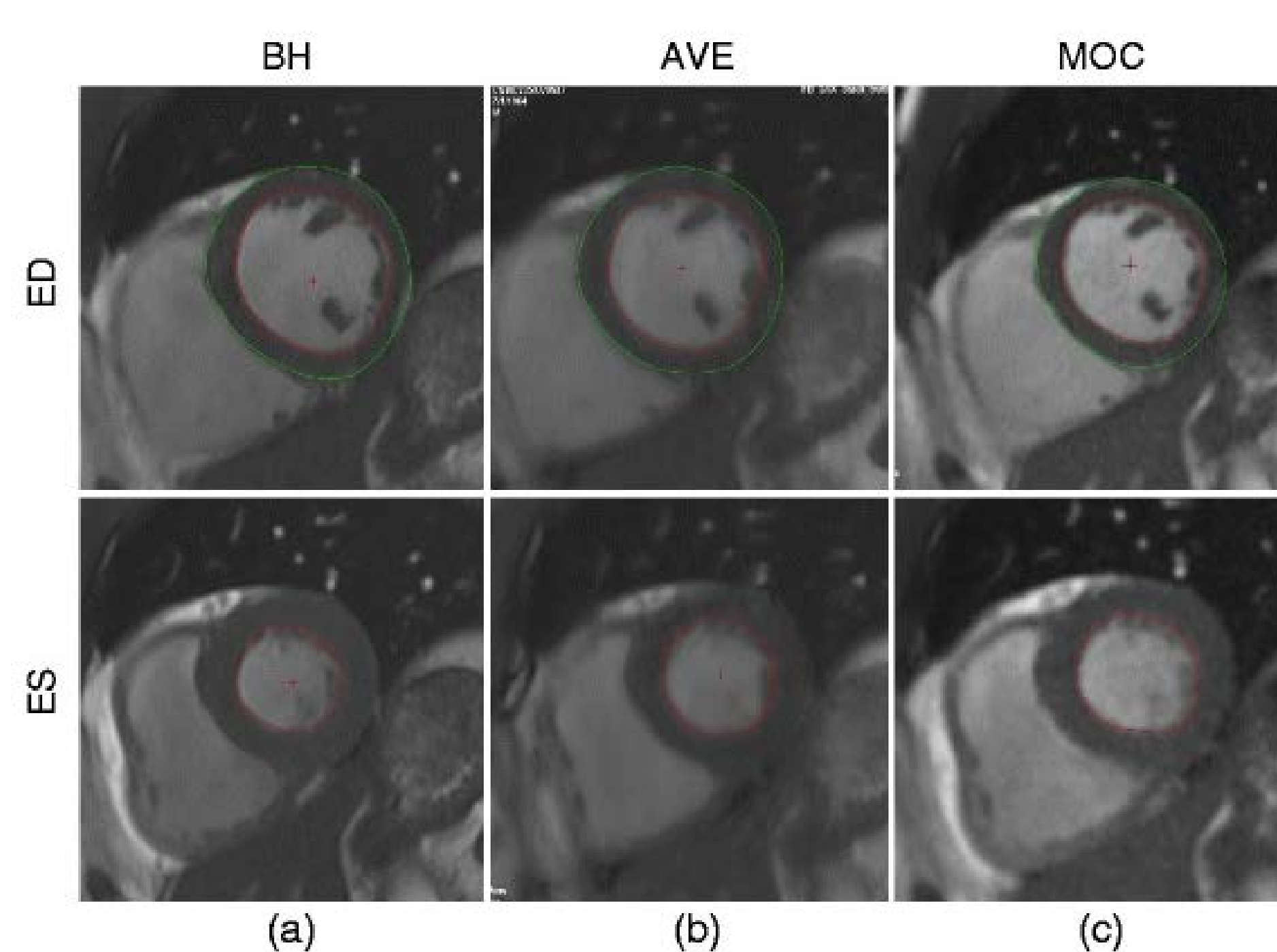
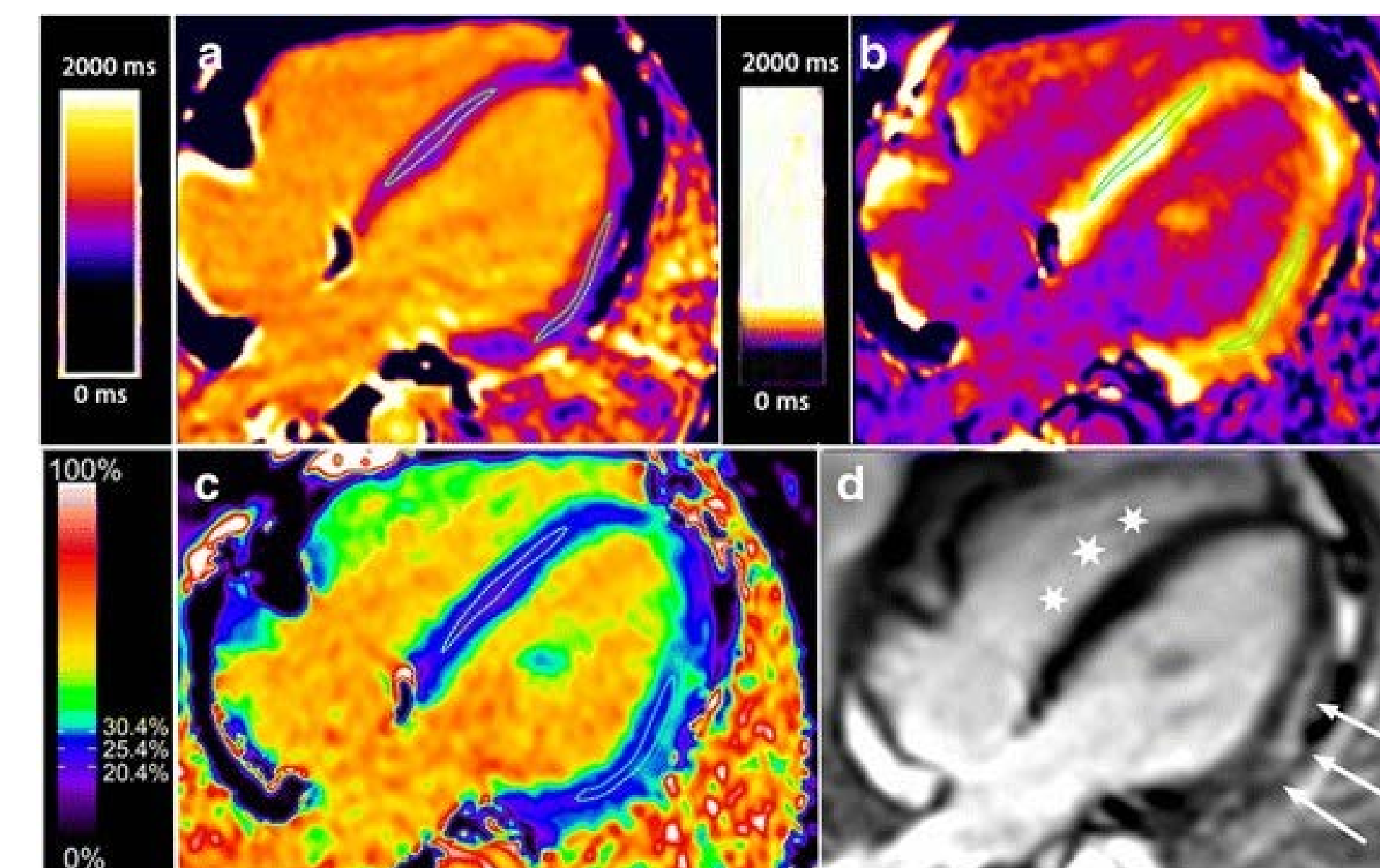


Image Fusion Guided Device Closure of Left Ventricle to Right Atrium Shunt. A. Pre-intervention trans-thoracic echocardiogram, 4-chamber view in color compare mode showing left ventricle to right atrium (LV-RA) shunt (white arrow). B. Pre-intervention steady-state free precession cardiac MRI (Siemens 1.5 Tesla) with noncontrast angiographic sequences, assisted by respiratory compensation and EKG-based cardiac gating. The magnetic resonance image shows right heart enlargement and LV-RA shunt (white arrow). The defect diameter is 3 mm and velocity-encoded MRI Qp:Qs is 1.4:1. C. The baseline conventional left ventriculogram shows the LV-RA shunt (white arrow). D. XFM [x-ray fused with MRI] overlay baseline left ventriculogram (blue = right ventricle, light pink = left ventricle, dark pink = LV-RA shunt) highlights the intracardiac shunt. E. Following XFM guided wire crossing of the LV-RA defect, this panel shows XFM guided defect closure with a muscular VSD occluder. The device is deployed in the defect and still attached to the delivery cable. F. The post-intervention left ventriculogram with XFM overlay shows successful device closure of the LV-RA defect.



Representative mid-ventricular end-diastolic (ED) and end-systolic (ES) images with and without endocardial and epicardial contour tracings for each of three image acquisition types: (a) breath-held SSFP, (b) free-breathing SSFP, and (c) retrospective motion corrected re-binning



Four chamber view of a boy with DMD and lateral wall fibrosis using MOLLI. Panel a is the native T1 map, panel b is the post-contrast T1 map, panel c is the extracellular volume (ECV) map and panel d is the late gadolinium enhancement (LGE) map. Typical regions of interest to derive T1 and ECV values are displayed on the three parametric maps. Arrows indicate the lateral wall bright, subepicardial LGE, while stars indicate the nulled, normal septal myocardium

## Publications and Presentations

### Abstracts

- Grant EA. *Case Presentation - Fusion Guided Device Closure of Gerbode Type Defect*. Society for Cardiovascular Angiography and Interventions Fall Fellows Course 2014; Las Vegas, NV
- Hansen MS, Cross RR, Olivieri, LJ, O'Brien KE, DiPrimo M, Zheng T, Yang X, Finnerty M, Kellman, P. *Dedicated Neonatal Cardiac Coil, Preliminary Results*. International Society for Magnetic Resonance in Medicine Annual Meeting 2015; Toronto, Canada
- Grant EK, Faranesh AZ, Olivieri LJ, Kanter JP, Cross RR, Hansen MH, O'Brien K, Hamann K, Ehtiati T, Lederman RJ, Ratnayaka K. *X-Ray Fused with MRI (XFM) Guidance of Transcatheter Interventions in Congenital Heart Disease: Preliminary Results*. Pediatric Interventional Cardiology Symposium (PICS/AICS) Annual Scientific Sessions 2015; Las Vegas, NV (oral)
  - Best Oral Abstract Finalist (Top 4 of 196 total)
- Grant EK, Berul CI, Cross RR, Moak JP, Hamann KS, O'Brien KJ, Hansen MS, Kellman P, Ratnayaka K, Olivieri LJ. *Ventricular Arrhythmia Ablation Lesions in Children and Adolescents: Acute Magnetic Resonance Imaging with Outcome Correlation*. American Heart Association 2015 Scientific Sessions; Orlando, FL (oral)
- Olivieri LJ, Kellman P, Arai A, Cross RR, Ratnayaka K, Hansen MS, Spurney CF. *Regional extracellular volume fraction can identify myocardial changes in patients with Duchenne muscular dystrophy*. American Heart Association 2015 Scientific Sessions; Orlando, FL (poster)
- Enos J, Hartz J, Quinn R, Gaur L, Cross R, Olivieri LJ. *A Comparison of Right Ventricular Volumes in Children and Adults with Repaired Tetralogy of Fallot - Including and Excluding Right Ventricular Trabeculations*. Society for Cardiovascular Magnetic Resonance Scientific Sessions 2016; Los Angeles, CA (poster)
- Olivieri LJ, Hsu L, Hamann K, John A, Kuehl K, Arai A. *Coronary Flow Reserve in Adults with Systemic Right or Single Ventricles*. Society for Cardiovascular Magnetic Resonance Scientific Sessions 2016; Los Angeles, CA (poster)
- Kellman P, Olivieri L, Grant E, Berul C, O'Brien K, Ratnayaka K, Hansen M. *Dark Blood Late Gadolinium Enhancement Improves Conspicuity of Ablation Lesions*. SCMR meeting, January 2016.
- Swink J, Matisoff A, Ratnayaka K, Deutsch N, Olivieri L, Schwartz J. *Anesthesia for Pediatric Magnetic Resonance Imaging Guided Right Heart Catheterization: A Review of Early Experience*. Pediatric Anesthesia Meeting, Denver, April 2016.
- Campbell-Washburn AE, Lederman RJ, Faranesh AZ, and Hansen MS. *Distortion correction of Golden Angle radial images with GIRF-predicted k-space trajectories using the gradient waveform history*. ISMRM annual meeting 24 (Singapore 2016): 518.
- Siegel B, Olivieri L, Gordish-Dressman H, Spurney C. *MRI feature tracking in Duchenne muscular dystrophy patients more frequently demonstrates decreased myocardial strain associated with late gadolinium enhancement positive segments compared to echocardiographic speckle tracking*. American Heart Association Scientific Sessions 2016, New Orleans, LA

### Manuscripts in Press

- Grant E, Berul C, Cross R, Moak J, Hamann K, Cronin I, O'Brien K, Ratnayaka K, Hansen M, Kellman P, Olivieri L. *Pediatric Ventricular Arrhythmia: Cardiac MRI Assessment of Acute Radiofrequency Ablation Lesions with Clinical Correlation*. Journal of Clinical Electrophysiology [In Press]

### Oral Presentations

- Ratnayaka K. *MR-guided Pediatric Interventions*. Society for Cardiovascular Magnetic Resonance / European Cardiovascular Magnetic Resonance Joint Scientific Sessions 2015; Nice, France
- Ratnayaka K. *Coarctation of the Aorta*. Adult Congenital Heart Disease in the 21st Century 2015; Bethesda, MD
- Ratnayaka K. *Rotational Angiography and Fusion/Registration Technologies: How Do We Assess the Benefits and Cost/Risks?* Society for Cardiovascular Angiography and Interventions Scientific Sessions 2015; San Diego, CA
- Ratnayaka K. *MRI Guided Transcatheter Therapy*. Pediatric Interventional Cardiology Symposium (PICS/AICS) Annual Scientific Sessions 2015; Las Vegas, NV
- Hansen MS, Olivieri LJ, O'Brien K, Cross RR, Inati SJ, Kellman P. *Method for calculating confidence intervals for phase contrast flow measurements*. J Cardiovasc Magn Reson. 2014 Jun 24;16:46
- Olivieri LJ, Cross RR, O'Brien KJ, Ratnayaka K, Hansen MS. *Optimized protocols for cardiac magnetic resonance imaging in patients with thoracic metallic implants*. Pediatr Radiol. 2015 Sep;45(10):1455-64
- Olivieri LJ, Cross RR, O'Brien KE, Xue H, Kellman PK, Hansen MS. *Free-breathing late gadolinium enhancement imaging in children*. Pediatr Radiol. 2016 Jun;46(7):983-90
- Grant EK, Faranesh AZ, Cross RR, Olivieri, LJ, Hamann KS, O'Brien KJ, Hansen MS, Donofrio MT, Lederman RJ, Ratnayaka K, Slack MC. *Image Fusion Guided Device Closure of Left Ventricle to Right Atrium Shunt*. Circulation. 2015 Oct 6;132(14):1366-7.
- Cross RR, Olivieri LJ, O'Brien KJ, Kellman P, Xue H, Hansen MS. *Improved workflow for quantification of left ventricular volumes using free-breathing motion corrected cine imaging*. J Cardiovasc Magn Reson. 2016 Feb 25;18:10
- Ratnayaka K, Rogers T, Schenke WH, Mazal J, Chen MY, Sonmez M, Hansen MS, Kocaturk O, Faranesh AZ, Lederman RJ. *MRI Guided Transcatheter Cavopulmonary Shunt*. Journal of American College Cardiology Intervention. 2016 May 9;9(9):959-70.
- Talemal L, Olivieri L, Krishnan A. *Ductal constriction during dexamethasone treatment in an anti-SSA-antibody-exposed fetus with signs of myocardial inflammation*. Cardiol Young. 2016 Jun;26(5):1021-4
- Olivieri LJ, Kellman P, McCarter RJ, Cross RR, Hansen MS, Spurney CF. *Native T1 values identify myocardial changes and stratify disease severity in patients with Duchenne muscular dystrophy*. J Cardiovasc Magn Reson. 2016 Oct 28;18(1):72.
- Kellman P, Xue H, Olivieri LJ, Cross RR, Grant EK, Fontana M, Ugander M, Moon JC, Hansen MS. *Dark blood late enhancement imaging*. J Cardiovasc Magn Reson. 2016 Nov 7;18(1):77.