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In-vivo assessment of systolic and diastolic myocardial stiffness in a pig using 3D magnetic resonance elastography

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Myocardial stiffness is a novel biomarker with both diagnostic and prognostic potential in a range of cardiac diseases such as ischemia or myocardial infarction known to have increased stiffness. Application of Magnetic Resonance Elastography (MRE) to the heart enables measurement of myocardial stiffness in vivo. This study was performed to assess the feasibility of measuring in vivo myocardial stiffness during systole and diastole in a pig using 3D MRE. A custom passive driver was placed on the chest and imaging was performed in prone position on a 1.5 Tesla whole body MR imager (Signa Excite; GE) with a 4-channel coil in oblique plane using ECG-gated spin-echo echo planar imaging sequence at 140 Hz vibration frequency with 5 breath holds of approximately 25 seconds. Systolic and diastolic short-axis acquisition was performed prescribing corresponding time delays observed from a FIESTA cine scan. Acquisition parameters: 1 shot, NEX=1; TR/TE=4600/52ms; FOV=28.8 cm; 96x96 image matrix; 11 continuous 3 mm thick slices with 0 mm spacing, isotropic acquisition; 2 motion-encoding gradient (MEG) pairs; x, y, and z motion-encoding directions; ASSET=2, and 4 phase offsets. MRE stiffness was obtained using 3D direct inversion algorithm and an ROI covering the left ventricle was used to report stiffness. The mean stiffness of the myocardium in systole was 6.3 kPa and 4.5 kPa in diastole. The results indicate that 3D MRE can differentiate systolic and diastolic myocardial stiffness. Follow up studies with a larger sample size are underway to further validate these findings.

Biography

Shivaram Poigai Arunachalam is a Research Engineer in the Department of Radiology, in Mayo Clinic, Rochester, MN USA. He works on developing technical tools for cardiac magnetic resonance eleastorgraphy imaging for non-invasive assesment of myocardial stiffness in vivo which can be useful in the prognosis and diagnosis of vareity of cardiac diseases. He is also a final year PhD candidate in the Department of Biomedical Engineering at the University of Minnesota, Minneapolis, MN working on developing novel cardiac mapping systems for Atrial Fibrillation (AF).

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