Title: Patient-specific Medical Image Quantification for Prognosticating Timely Treatment Response & Informing Therapeutic Strategy for Improved Cardiovascular Outcomes.

Abstract:
Characterization of regional cardiac function may have application in prognosticating timely treatment response and informing therapeutic strategy in patients with ischemic cardiomyopathy. A key research focus of The MeDCaVE has been on developing automated imaging-based analysis, visualization and decision-support techniques for characterization of cardiac function through a systematic analysis of 4D (3D + time) left and right ventricular motion over the cardiac cycle. In this effort we have defined objective, clinically useful metrics of pathological remodeling and declining cardiac performance, using standard cardiac magnetic resonance imaging (MRI) and Computed Tomography (CT) sequences for several distinctive patient cohorts including asymptomatic patients (Menon, Morris et al. 2014), symptomatic patients with a history of ischemic heart disease or myocardial infarction (Adhyapak, Menon et al. 2014), as well as a series of prospective heart failure patients due for surgical or percutaneous ventricular restoration therapy (Adhyapak, Menon et al. 2013; Menon, Adhyapak et al. 2013; Adhyapak, Menon et al. 2014; Adhyapak, Menon et al. 2014; Menon, Adhyapak et al. 2014; Menon, Ludwig et al. 2014) – a procedure for surgical correction the left ventricular shape in the interest of improving cardiac performance. The MeDCaVE has reported several promising biomarkers in regard to cardiac function in the literature over the past two years, based on cardiac MRI and CT image analysis and most recently using Ultrasound imaging as well in the interest of developing a portable cardiac diagnostics tool. While several of these novel biomarkers are being further investigated in their utility to identify quantitative signs of pathological cardiac function which may boost standard image makers as precursors of declining cardiac performance, The MeDCaVE has also been actively developing interactive surgical planning (Menon, Yoshida et al. 2013; Yoshida, Menon et al. 2013) and post-operative monitoring tools (Hong, Menon et al. 2013) which transcend applicability of these biomarkers in the Radiology or diagnostic imaging space alone and apply them in pre-operatively modeling, simulating and forecasting the functional response (viz. biomechanics and hemodynamics) of a chosen surgical strategy or medical device therapy (Albal and Menon 2013; Albal, Montidoro et al. 2014), prior to surgery – a frontier currently beyond the reach of clinical practice. Such predictive surgical modeling can potentially improve patient-specific outcomes when applied in conjunction with image-guided (minimally invasive) surgical technology (Friehling, Menon et al. 2014) but can also significantly reduce costs for the healthcare system.

Keywords: Cardiomyopathy, Cardiac Magnetic Resonance Imaging, Computed Tomography, Ultrasound, Machine Learning, Disease Stratification, Ventricular Function, Biomechanics, Hemodynamics, Surgical Planning.

References


