Long-axis cardiac function

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Abstract

Background

Heart failure patients in general have a reduced quality of life and a poor prognosis. An aspect of cardiac failure that often is overlooked in clinical assessments is the reduced displacement of the atrioventricular (AV) plane in the longitudinal (apical-basal) direction. MRI studies have shown this mode of pumping to be the main contributor to stroke volume (SV). This thesis focuses on the AV-plane displacement (AVPD), the link to cardiac hemodynamics in experimental settings and the ability of longitudinal ventricular shortening to predict mortality and morbidity in heart failure patients.

Methods

Paper I and Paper IV uses porcine and ovine subjects in an experimental setting to accurately measure hemodynamic responses after interventions. Imaging and measurements with cardiac magnetic resonance (CMR) and fluoroscopy are recorded and analyzed. Paper II and Paper III retrospectively includes 287 heart failure patients who underwent prior CMR scans during 2003-2015. The CMR scans are used for measuring volumes, cardiac functions and detecting presence of fibrosis, e.g. due to myocardial infarction. Data on patient’s medical histories and cause of deaths are collected from medical journals and national registries and subsequently analyzed with time-to-event analyses for predictions of morbidity and mortality.

Preliminary results

Paper I demonstrate that a close link between SV and AV-plane displacement is present before and after acute myocardial infarction in two types of myocardial infarctions, namely homogenous ischemia/reperfusion infarcts and microembolism infarcts, acutely and during the first week. Paper II show that AV-plane displacement and global longitudinal strain both are predictors of mortality after adjusting for well-known clinical risk factors. Paper III will investigate the ability of longitudinal ventricular shortening parameters to predict heart failure associated morbidity. Paper IV will aim to directly measure the myocardial forces at play during ventricular shortening in ovine subjects through an implanted device capable of measuring and generating forces. This will yield measurements of force-velocity relationships of the mitral annular plane.

Significance

This thesis sheds light on the significance of the longitudinal ventricular shortening in cardiac physiology and it’s ability as a prognostic marker in heart failure. These findings could be integrated in the clinical assessment of heart failure patients and may be used as input when developing novel cardiac assist devices.

Papers:

Published:


Manuscript:

Planned studies:

3. Longitudinal ventricular shortening as predictors of major adverse cardiac events.
4. Force-velocity relationship of the mitral annular plane