Poster Prize of the Day of BioMedical Research 2024
Best Project by a medical student

Detecting diastolic dysfunction using cardiovascular magnetic resonance derived E/e'

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Introduction: Diastole is the phase of the cardiac cycle when blood enters the heart's ventricles from the atria. However, in diastolic dysfunction, ventricular relaxation and filling is impaired. For patients undergoing surgery and general anaesthesia, its presence is associated with perioperative haemodynamic instability and poor postoperative outcomes. Diastolic dysfunction is often diagnosed using invasive catheter laboratory measurements or non- invasive echocardiography by calculating the ratio of peak early diastolic transmitral velocity (E) and peak early diastolic velocity of the left ventricular muscle (e'). A higher E/e' ratio is associated with increasing severity of diastolic dysfunction. While cardiovascular magnetic resonance (CMR) imaging is a key modality for the diagnosis and characterization of heart disease; it is traditionally limited in the assessment of diastolic dysfunction. 4D flow, an emerging CMR technique, now allows for blood flow quantification, and mitral annular tissue (MAT) velocity can further be measured with new software techniques. This study investigated if CMR derived E/e' can detect diastolic dysfunction.

Methods: Sixty healthy controls (19-63 years, 51% male) and seventeen patients with echocardiographic diagnosed diastolic dysfunction (grade I-III, 47-82 years, 61% male) were prospectively recruited to undergo a CMR exam. First a 4D flow data set was acquired of the heart and velocity of the blood through the mitral valve was quantified. For assessing tissue movement, a cine image of the 4-chamber view was acquired and MAT velocity was derived by tracking the septal and lateral mitral annulus. Peak septal and lateral MAT velocity at early diastole (e') were averaged and combined with peak transmitral E wave velocity to quantify E/e' ratio.

Results: For blood flow measurements, patients had no significant difference in peak transmitral E wave velocity (72±27 cm/s vs 79±18 cm/s, $p=0.271$) in comparison to healthy controls. For tissue quantifications, MAT velocity derived e' was significantly smaller in patients (8.7±3.5 cm/s vs 16.9±4.3 cm/s, $p<0.001$). Consequently, E/e' ratio was significantly higher in patients 9.6±4.2 vs 4.9±1.2, $p<0.001$). Moreover, this parameter could discriminate the patients from controls (area under the curve: 0.90±0.05, $p<0.001$).

Conclusion: Early results demonstrate that E/e' ratio can be derived from CMR using 4D flow and MAT velocity analysis. Importantly E/e' ratio was able to discriminate the patients with diastolic dysfunction. This new approach to diastolic assessment using CMR will now be further investigated for its use in defining varying grades of diastolic dysfunction and as a potential pre-operative risk stratification marker.