

Evaluation of myocardial stiffness in healthy adult and hypertrophic cardiomyopathy with HFpEF populations using noninvasive ultrasound shear wave imaging

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Objectives. Myocardial stiffness is an important prognostic and diagnostic parameter in heart failure. Up to now, there is no noninvasive tools for quantitative evaluation of this parameter. We introduce recently a new ultrasound based technique called Shear wave imaging (SWI) to quantitatively assess the intrinsic tissue stiffness. The goal of our study was to investigate the potential of Myocardial SWI, to quantify noninvasively the diastolic myocardial stiffness (MS, kPa) in healthy adult volunteers (HV) and in hypertrophic cardiomyopathy populations with heart failure with preserved ejection function (HCM-HFpEF).

Methods. We included prospectively 80 adults: 60 HV (divided into three groups: 20-40 yo (n=20); 40-60 yo (n=20); 60-80 yo (n=20)) and 20 HCM-HFpEF. An echocardiography, a cardiac magnetic resonance (CMR) and a biological exploration were achieved in all the study population. The MS estimation was performed using an ultrafast ultrasound scanner with cardiac phased array, on the basal antero-septal segment during the end-diastole, in long and short axis views. Fractional anisotropy (FA) of shear wave speed was also estimated.

Results. For 20-40, 40-60, and 60-80 yo group respectively, the mean MS was 2.59 ± 0.58 kPa, 4.70 ± 0.88 kPa, 6.08 ± 1.06 kPa ($p < 0.01$ between each group). MS strongly correlated with age ($r = 0.88$). For the HCM-HFpEF group (mean MS = 12.68 ± 2.91 kPa), the MS was significantly higher than in the healthy volunteer ($p < 10^{-4}$), with a cut-off identified at 8 kPa (AUC = 0.993, Se = 95%, Sp = 100%). The FA was lower in HCM-HFpEF (mean = 0.170 ± 0.082) than in HV (0.289 ± 0.073), $p < 0.01$. Positive correlations were found between the MS and parameters in echocardiography (E/e' , $r = 0.783$; E/Vp , $r = 0.616$; left atrial volume index, $r = 0.623$) and CMR (late gadolinium enhancement, $r = 0.804$).

Conclusion. The MS estimation was found to increase with age in healthy population. A MS cut-off of 8 kPa could differentiate healthy and HCM-HFpEF patients. We hope that this new noninvasive parameter will help to better diagnose the diastolic function and its prognosis in clinical practice. (Non-Invasive Evaluation of Myocardial Stiffness by Elastography: NCT02537041)

