

Myocardial stiffness assessment using shear wave imaging in healthy children and hypertrophic cardiomyopathy

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Background. The evaluation of diastolic left ventricular function is critical for hypertrophic cardiomyopathy (HCM) evaluation. The pathophysiology of HCM is characterized by an increase of ventricular stiffness in most patients. However, myocardial stiffness cannot be measured non-invasively by the existing techniques.

Purpose. The goal of our study was to investigate the potential of Myocardial Shear Wave Imaging (SWI), to quantify non-invasively the passive diastolic myocardial stiffness in a pediatric population of HCM.

Methods. We included prospectively 20 children between five and eighteen years old, 10 healthy volunteer and 10 patients with HCM. A complete clinical echocardiography was as well achieved in all the study population. SWI was performed using an ultrafast ultrasound system (Aixplorer, Supersonic Imagine, France) and a phased-array probe (2.75 MHz central frequency, 96 elements, SuperSonic Imagine, France) to track and evaluate the shear wave speed (SWS). SWI acquisitions were performed on the basal antero-septal segment during the end of the diastole with ECG triggering, in a short axis (SA) and long axis (LA) views. SWS were compared between the two groups and analyzed with the clinical parameters of echocardiography.

Results. Shear wave imaging was performed successfully in 90 % of healthy volunteer and in 95% of HCM patients. The mean SA-SWS was 1.15 ± 0.23 m/s [min=0.79; max=1.58] in the healthy volunteer and 1.95 ± 0.41 m/s [min=1.22; max=3.21] in the HCM patients ($p=0.01$). The mean LA-SWS was 0.94 ± 0.22 m/s [min=0.67; max=1.51] in the healthy volunteer and 1.81 ± 0.36 m/s [min=1.05; max=2.94] in the HCM ($p=0.01$). The averaged SWS is higher in SA than in LA ($p<0.05$ for both group), due essentially to the local elastic anisotropy of the myocardial muscle. Statistical analysis showed good repeatability of SWS measurements. Positive correlations were found between the evaluation of SWS and clinical parameters in echocardiography such as interventricular septum thickness, left ventricular mass, left atrium volume and doppler parameters (E/A, Ea/E, Ea/Aa).

Conclusion. Non-invasive SWI evaluation of diastolic myocardial stiffness can distinguish healthy children and HCM. SWI could be a new clinical parameter for the diagnosis of HCM.