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VALUE OF 3D SPECKLE TRACKING ECHOCARDIOGRAPHY IN DETECTING LEFT VENTRICLE REMODELLING AND CARDIAC DYSFUNCTION IN PATIENT WITH AORTIC VALVULAR DISEASES

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Objectives Aortic valvular disease is a very common cause of heart failure and cardiac death. Non-invasive assessment of early stage cardiac dysfunction caused by aortic valvular diseases is of great diagnostic and prognostic importance. In this study, we aim to investigate the value of the state-of-the-art three-dimensional speckle tracking echocardiography (3DSTE) in detecting left ventricle (LV) remodelling and early stage cardiac dysfunction.

Methods Sixty-nine patients with aortic valvular diseases and NYHA heart function class I or II as well as 48 age matched healthy controls were recruited. All patients received conventional echocardiography. Furthermore, real-time three-dimensional echocardiography (RT3DE) images were recorded and 3DSTE were performed using a commercial available ultrasound diagnostic system (Vivid E9, GE Vingmed Ultrasound, Chicago, US). The 3DSTE allows rapid semi-automatic measurement of longitudinal strain (LS), circumferential strain (CS), radial strain (RS), and a novel area strain (AS) which represent the recline of surface area of LV during contraction. Besides, LVEF and LV mass can also be measured during 3D strain analysis.

Results Patients with aortic valvular diseases have significantly lower LVEF (54.5% vs 62.4%, $p<0.001$) and higher LV mass index (117.3 g/m^2 vs 82.2 g/m^2 , $p<0.001$) than control. Other clinical characteristics including age, sex, heart rate are comparable between two groups ($p>0.05$). As for the strain derived parameters, global LS (-15.5% vs -19.3% , $p<0.001$), RS (46.4% vs 54.0% , $p=0.003$) and AS (-28.5% vs -33.3% , $p=0.001$) are significantly lower in aortic valvular disease group. There's no significant difference in CS between two groups (-17.4% vs -18.5% , $p=0.134$).

To investigate if the pressure and volume overload have differential impact on LV deformation, patients with aortic valvular diseases were further divided into aortic stenosis and aortic regurgitation sub-groups ($n=39$ and 30 respectively). One-way ANOVA showed all four strain parameters were different among the three groups (LS, $p<0.001$; CS, $p=0.024$; RS, $p=0.013$; AS, $p=0.004$). LSD multiple comparison showed that although LS is significantly lower in both aortic stenosis and aortic regurgitation group compared with healthy controls, the most dramatic change is seen in stenosis group (Stenosis vs Control: -14.5% vs -19.3% , $p<0.001$; Stenosis vs Regurgitation: -14.5% vs -16.9% , $p=0.010$). This result is consistent with previous reports that LS is the most sensitive parameter for sub-clinical heart dysfunction. As for the CS, there's no significant difference between stenosis and control group (-18.3% vs -18.5% , $p=0.838$). CS impairment were only seen in aortic regurgitation patients (Regurgitation vs Control:

-16.2% vs -18.5% , $p=0.022$). Area strain and RS are decreased in both aortic stenosis and regurgitation patients, but there's no difference between two sub-groups.

Reproducibility of 3D strain parameters were tested in 20 random selected patients. The inter-observer variability for global LS, CS, RS and AS is 6.2%, 7.4%, 7.9% and 4.3% respectively.

Conclusions 3DSTE are useful to detect early stage heart dysfunction caused by aortic valvular diseases. LS is most vulnerable to pressure overload caused by aortic stenosis while CS is more sensitive to volume overload due to aortic regurgitation.