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LEFT VENTRICULAR VORTEX ANALYSIS IN PERIOPERATIVE PATIENTS WITH CONGENITAL HEART DISEASE USING VECTOR FLOW MAPPING

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Objective The aim of this study were to explore the perioperative characteristics of left ventricular vortex during isovolumic contraction time (ICT) in patients with atrial septal defect (ASD) and patent ductus arteriosus (PDA) using vector flow mapping (VFM).

Methods Forty presumably healthy volunteers, 18 patients with ASD and 15 patients with PDA who underwent percutaneous transcatheter closure in West China Hospital were enrolled. All the subjects received right arm cuff blood pressure measurement and echocardiography monitored by ECG at rest. The patients got examination before and on the second day after closure. Left ventricular flow was observed in the apical three-chamber view (AP-3C) for at least 15 consecutive cardiac cycles. Image parameters keep consistent for the same patient before and after closure. VFM analysis of left ventricular vortex during ICT in subjects include maximum flow volume of vortex (Q_{max}), half-value area of vortex (S), diameter of half-value area of vortex (D), vortex intensity (VI). Other observed parameters include heart rate (HR), blood pressure (SBP/DBP), end-diastolic dimension of left ventricle (LVEDD), ejection fraction of left ventricle (LVEF), peak velocity of aortic flow (AV). Paired t-test was used to compare variations between pre- and post-operational status of the patients, while independent t-test for variations between patients and controls matched by age, gender and body surface area. Rank sum test was used to compare parameters of skewed distribution.

Results Q_{max} , S, D, VI in 40 presumably healthy volunteers were 38.088.55 cm²/s, 2.951.07 cm², 1.910.35 cm and 14.596.62/s respectively. Comparisons between ASD patients and controls show that S, D, VI, LVEDD, AV in preoperational ASD patients were significantly different from those of controls ($p=0.000$, 0.000, 0.003, 0.002, 0.032). Q_{max} decreased in ASD patients but p value was in the cuff point ($p=0.050$). Pre- and post-operational comparisons in ASD patients show no significant change in Q_{max} , D, S, VI ($p=0.472$, 0.116, 0.113, 0.396) except in LVEDD ($p=0.000$). Comparisons between PDA patients and controls show that Q_{max} , S, D, LVEDD, AV in preoperational PDA patients were significantly different from those of controls ($p=0.000$, 0.004, 0.002, 0.002, 0.008). Pre- and post-operational comparisons show significant change happened in Q_{max} , DBP, LVEDD, LVEF, AV ($p=0.010$, 0.000, 0.000, 0.001, 0.004) while S, D, VI keep constant ($p=0.498$, 0.577, 0.363).

Conclusions The cardiac structure, haemodynamic status and characteristics of left ventricular vortex during ICT in patients with ASD and PDA have changed. Compared with healthy volunteers, patients with ASD underwent gradually reduced LVEDD and decelerated AV. Vortex formed in ASD patients became smaller and stronger, maximum flow volume

of vortex may be lowered. Echocardiographic evaluation on the second day after closure detected dilated left ventricle, but vortex during ICT did not change much. Compared with healthy volunteers, patients with PDA underwent gradually increased LVEDD and accelerated AV. Besides, vortex during ICT enlarged significantly and maximum flow volume of vortex increased, while vortex intensity keep constant. On the second day after closure, diastolic blood pressure of PDA patients rose significantly and echocardiographic evaluation shows sharply decreased maximum flow volume of vortex, lowered LVEF with LVEDD and AV restored.