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3D transthoracic echocardiography to assess ventricular septal defect anatomy and severity

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Background: Ventricular septal defect (VSD) is assessed classically by bi-dimensional transthoracic echocardiography (2D-TTE) which seems to underestimate defect size. Our aim was to compare VSD size and morphology obtained by 2D-TTE with those obtained by three-dimensional transthoracic echocardiography (3D-TTE), and to correlate morphological parameters with shunt severity.
Methods: 48 patients with muscular (22.9%) and membranous (77.1%) VSDs were included (median age 21.4 months). Patients were classified according to shunt severity. Type 1 minor shunt, 2a moderate shunt, and 2b severe shunt. Minimal (min-2D) and maximal (max-2D) diameters were assessed using 2D-TTE. Minimal (min-3D), maximal (max-3D) diameters, systolic (sVSDA) and diastolic (dVSDA) areas of the VSD, and aortic valvular area (AVA) were obtained from 3D full volume dataset.
Results: Max-3D was higher than Max-2D diameter ($p<0.0001$). The difference was less between min-3D and min-2D diameters although it remained significant ($p=0.001$). VSDs were asymmetric with a mean asymmetry ratio 2.3±1.4 by 3D-TTE. Asymmetry ratio was higher in muscular than in membranous VSDs. Mean VSD surface area variation was 32 %. It was significantly higher in muscular than in membranous VSDs ($p=0.0001$). VSD severity was better correlated with minimal rather than maximal diameter. Better correlation was found using the defect area (sVSDA/BSA ratio, sVSDA/AVA ratio; $r=0.60$, $p=0.0008$; $r=0.63$, $p=0.0002$). Shunt severity was inversely correlated with the asymmetry ratio. The best parameter to predict shunt severity was sVSDA/AVA ratio.
Conclusion: 3D TTE allows a precise morphological and quantitative assessment of VSD. sVSDA/AVA ratio is an accurate diagnostic tool to predict shunt severity.