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Three-dimensional Echocardiography for Decision Making in a Complex Ventricular Septal Defect

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Conflict of Interest

The authors have no financial conflicts of interest.

Author Contributions

Conceptualization: Mukherji A, Singhi AK; Data curation: Mukherji A, Mohapatra SK; Methodology: Mukherji A, Mohapatra SK, Singhi AK; Supervision: Singhi AK; Visualization: Mukherji A; Writing - original draft: Mukherji A, Mohapatra SK; Writing - review & editing: Singhi AK.

A 2 and half year old girl was referred to our hospital with an echocardiographic diagnosis of a moderate sized ventricular septal defect (VSD). The child was previously evaluated at a different center and was offered surgical closure of the VSD. However, on-table, the defect was found to be unsuitable for surgical closure. Thus chest closure was done and the child was kept on medical follow-up. She however continued to have symptoms of growth failure suggesting a need for further intervention.

Detailed transthoracic echocardiography done at our center showed a large inlet VSD which was almost entirely covered by the septal leaflet of tricuspid valve (TV) and its chordal attachment to the crest of ventricular septum (**Figure 1A**). On a more posterior plane there was a 5.5 mm effective VSD which was partially restricted by TV chordal tissue aneurysm (**Figure 1B and C**). Subcostal view highlighted the presence of straddling of the TV valve (**Figure 1D**). The VSD appeared hemodynamically significant with a dilated left ventricle (end-diastolic diameter: 33.5 mm; +2.33 Z). For better understanding of the complex VSD as well as for further planning, real time 3-dimensional echocardiography image acquisition was done (**Figure 2, Movie 1**).¹⁾ In the posterior sweep, a major chordee of septal tricuspid leaflet was noted to have a type C straddling, with attachment to the left ventricular wall (**Figure 2B**). The effective VSD was also visualized within the chordal aneurysm (**Figure 2B**). A re-attempt of surgical closure with such an anatomy was thought to be risky. Based on the 3-dimensional images a percutaneous closure was thus planned and it was decided to place the occluder in the aneurysm distal to the straddled chordee. Initial hemodynamic measurements revealed pulmonary artery systolic pressures to be one-third of the systemic and a pulmonary flow:systemic flow ratio of 1.8:1. Angiograms were done which outlined the VSD, but also showed significant tricuspid regurgitation (re-directed VSD jet); (**Figure 3A**). Subsequently, the VSD was closed with a 8 × 6 mm Konar multifunctional occluder (Lifetech, Shenzhen, China).²⁾ Post-release angiogram showed no residual VSD but minimal flow through the device to right atrium; (**Figure 3B**). Post procedural echocardiography revealed stable position of the occluder and mild tricuspid regurgitation (**Figure 3C and D**). The tricuspid regurgitation was secondary to the intra-device residual flow but appeared hemodynamically insignificant. The procedure was uneventful and the child went on to have significant symptomatic benefit on follow-up.

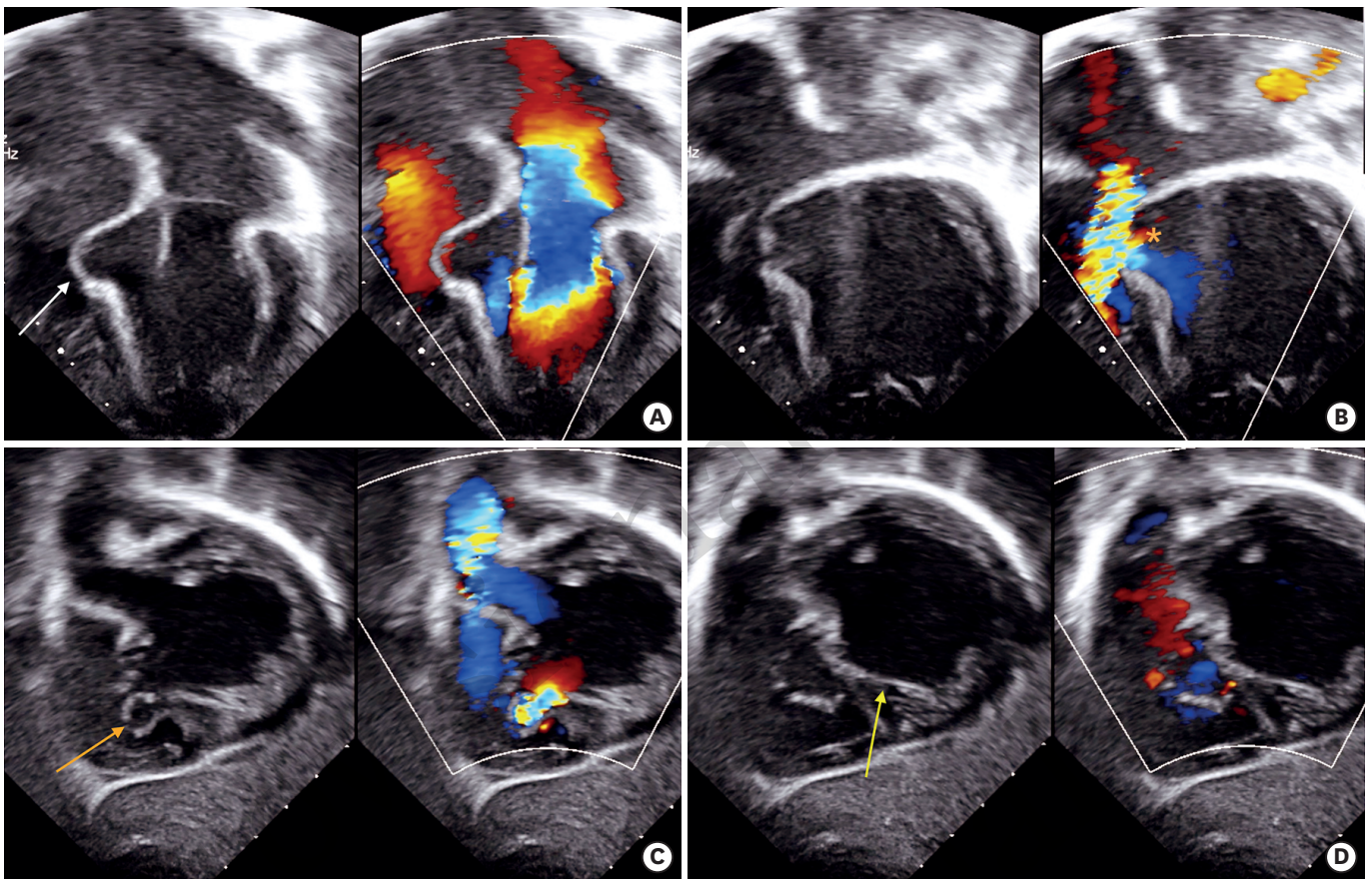


Figure 1. Transthoracic 2-dimensional echocardiography. (A) Large inlet VSD closed by septal leaflet of tricuspid valve with attachment to the crest of ventricular septum (white arrow). (B) Smaller effective VSD in a posterior plane (golden asterisk). (C) Subcostal parasagittal view in systole showing the VSD restricted by the chordal aneurysm (golden arrow). (D) Same view in diastole showing the straddling chordae with its attachment to left ventricle wall (yellow arrow). VSD: ventricular septal defect.

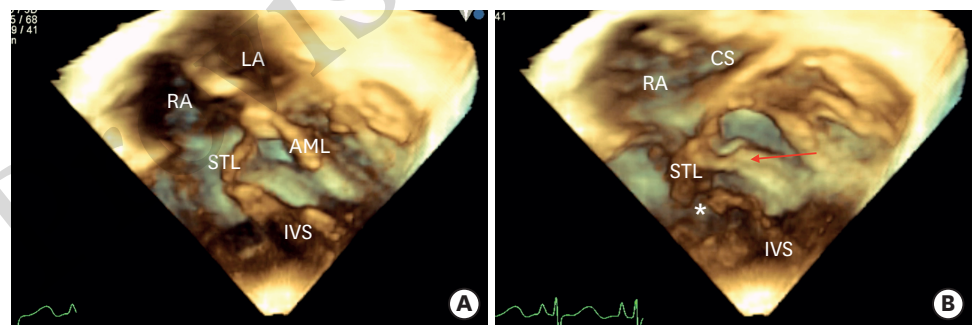


Figure 2. Transthoracic 3-dimensional echocardiography. (A) Deficient inlet muscular septum covered by septal leaflet of tricuspid valve with attachment to the crest of the septum. (B) A posterior sweep at the level of coronary sinus reveals prominent secondary chordae with type C straddling (red arrow); ventricular septal defect seen partially restricted by tricuspid chordal aneurysm with posteriorly directed opening (white asterisk). RA: right atrium, LA: left atrium, AML: anterior mitral leaflet, IVS: inter ventricular septum, STL: septal tricuspid leaflet, CS: coronary sinus.

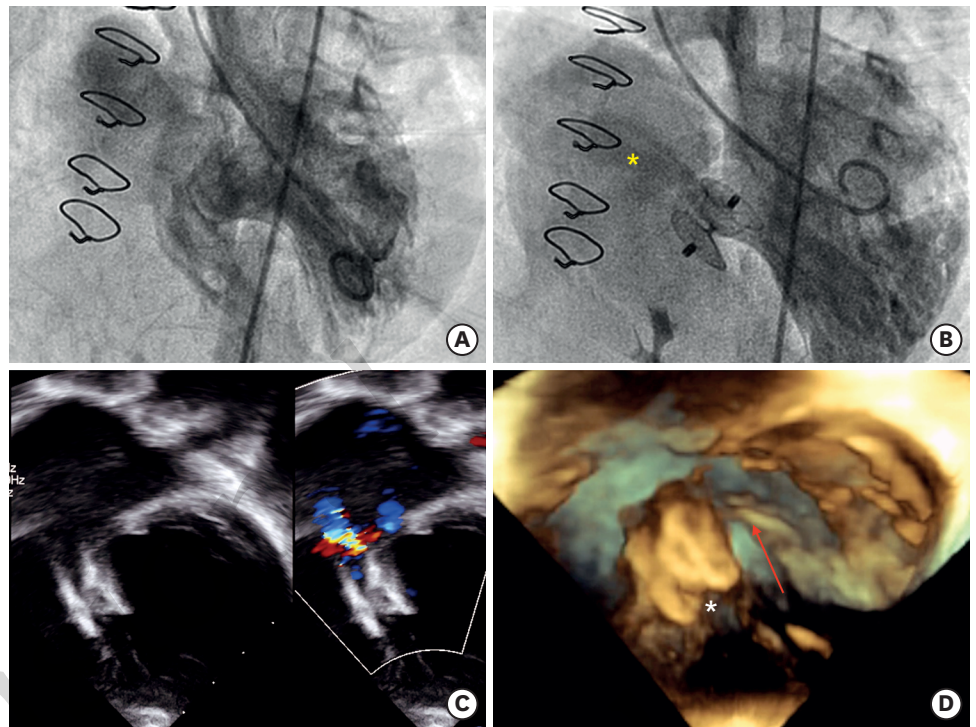


Figure 3. Procedural and post-procedural images. (A) LV angiogram showing a moderate sized VSD with significant tricuspid regurgitation; Sternal wire rings from previous surgical attempt visible. (B) VSD effectively closed by device with some persistent LV to RA shunt through the device (yellow asterisk). (C) Transthoracic 2-dimensional echocardiography showing device in situ with mild tricuspid regurgitation. (D) Three-dimensional echocardiography image reveals the device (white asterisk) to be perfectly positioned below the straddling chordae (red arrow).

LV: left ventricle, VSD: ventricular septal defect, RA: right atrium.

SUPPLEMENTARY MATERIAL

Movie 1

Real time 3-dimensional echocardiography showing type C straddling of tricuspid valve chordae and the complex ventricular septal defect with its effective opening.

[Click here to view](#)

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