

## Right-to-Left Shunting through the Unidirectional Valved Patch after Closure of Ventricular Septal Defect

### Abstract

Postoperative transesophageal echocardiography images of a patient undergoing unidirectional valved patch closure of ventricular septal defect in the setting of severe pulmonary hypertension are presented. The images and videos elegantly demonstrate a functioning valve without any obstruction to the left ventricular outflow.

**Keywords:** *Echocardiography, pulmonary hypertension, ventricular septal defect*

A 9-year-old child presented with complaints of breathlessness, poor weight gain, and history of recurrent respiratory tract infections since 1 year of age. On examination, oxygen saturation (SpO<sub>2</sub>) at rest and after the 6-min walk test was 96% and 88%, respectively. Pertinent findings on clinical examination included a palpable and loud second heart sound, a parasternal heave, and a Grade III/VI holosystolic murmur at the cardiac apex. Chest X-ray showed cardiomegaly, biventricular enlargement, a hugely dilated pulmonary artery with peripheral pruning and increased bronchovascular markings. Electrocardiogram (ECG) showed normal sinus rhythm, left axis deviation, and features of biventricular hypertrophy. Echocardiography showed a large inlet ventricular septal defect (VSD) with bidirectional shunting, mild tricuspid regurgitation, and severe pulmonary arterial hypertension. Cardiac catheterization was performed to assess operability. Preoperative pulmonary artery pressure, pulmonary vascular resistance index, and Qp/Qs ratio were 79/41 (mean 65 mm) Hg, 11.6 Woods units, and 1.26:1, respectively, which on oxygenation became 73/47 (mean 61 mm) Hg, 6 Woods units, and 2.3:1, respectively. The aortic saturation on room air was 91.5% that increased to 97% on oxygen. Based on a combination of clinical, X-ray, ECG, and cardiac

catheterization findings, the patient was offered VSD closure with a unidirectional valved patch (UVP). The UVP was designed based on the simple principle that if a “one-way valve” mechanism can be created at the level of septal communication, opening of this valve would allow the blood to flow from right to left during periods of acute right ventricular hypertensive crisis, thereby preventing acute right ventricular failure and maintaining adequate cardiac output. Subsequently, if the right-sided pressures gradually fall in the postoperative period, the gradient across the valve would fall and it would simply close preventing any left-to-right shunt.<sup>[1]</sup> The surgical technique has been described in detail in our prior publications.<sup>[1,2]</sup>

Postoperative transesophageal echocardiography after termination of cardiopulmonary bypass showed right-to-left shunt across valved patch. The valve is opening toward apex of the left ventricle away from aortic valve (AV) [Figures 1, 2 and Videos 1, 2]. The images clearly demonstrate that, as intended, the patch was shunting right-to-left and also indicate the orientation in which the patch should be fashioned to avoid left ventricular (LV) outflow tract obstruction and interference with AV function. The child was extubated on the postoperative day 1 and recovered uneventfully.

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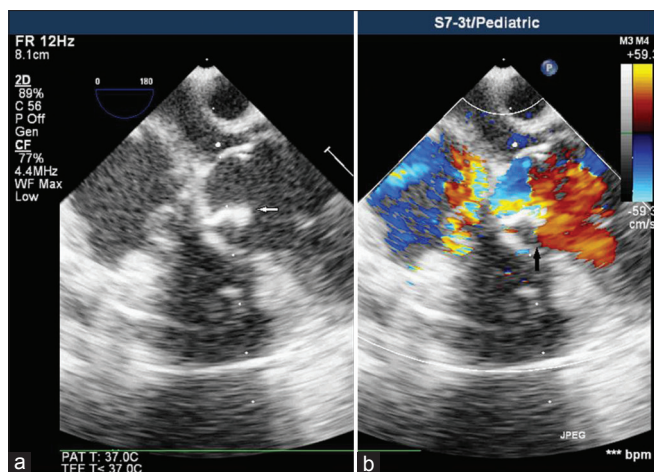
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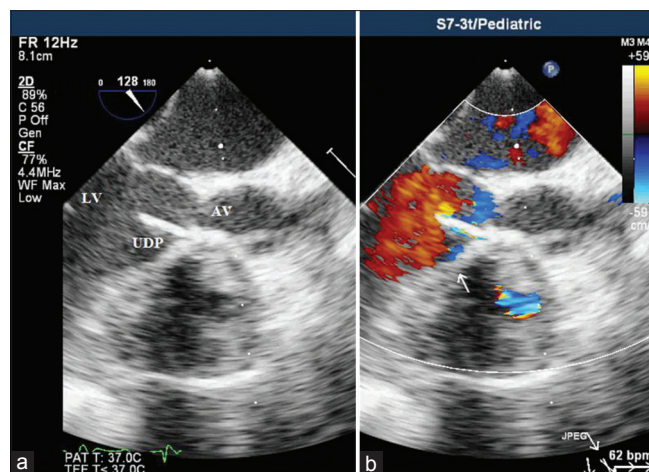
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**Figure 1:** Transesophageal echocardiographic image in midesophageal four-chamber view (a) two-dimensional and (b) color Doppler mode showing unidirectional valve patch opening toward left ventricle (white arrow) and allowing right-to-left shunt (black arrow)



**Figure 2:** Transesophageal echocardiographic image in midesophageal long axis view (a) two-dimensional and (b) color Doppler mode showing unidirectional valve patch opens toward the left ventricular apex away from the aortic valve and allows right-to-left shunting (arrow)

In conclusion, the UVP can be fashioned to produce a right-to-left shunt and avoid acute decompensation if the patient has persistent pulmonary hypertension. It should be placed in such a manner that LV outflow tract obstruction is avoided. Both of these objectives can be assessed well by TEE, and to the best of our knowledge, such TEE images of the UVP have not been published in the English medical literature.

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#### Conflicts of interest

There are no conflicts of interest.

#### References

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