Case Report

Pulmonary Venous Baffle Obstruction Following Senning Procedure - Role of Transesophageal Echocardiography

Abstract

We present a case of D-transposition of great arteries with atrial septal defect and patent ductus arteriosus electively posted for Senning's operation at 10 months of age. The patient developed signs of lung congestion immediately after termination of cardiopulmonary bypass. A stenosis in the pulmonary venous baffle was detected in transesophageal echocardiography showing a peak gradient of 10 mmHg and a mean gradient of 5 mmHg. Hence, revision of baffle was planned. The stenotic area was excised and augmented with homologous pericardium. Post-correction, lung compliance improved and the peak and mean gradient decreased to 3 and 1 mm Hg, respectively. The patient was extubated in the intensive care unit after 36 h and shifted to ward after 5 days with stable hemodynamics.

Keywords: *Pulmonary venous baffle stenosis, senning, transposition of great arteries*

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Introduction

Transposition of great arteries (TGA) is the second most common form of cyanotic congenital heart diseases (CHDs) and accounts for 5-7% of all CHDs with a prevalence rate of 0.2 per 1,000 live births.[1] Atrial switch operations like Senning or mustard are commonly performed in developing countries like India in patients with TGA who present late and are associated with good survival outcome.[2] However, these procedures are associated with various complications which can be either acute or chronic in onset. Transesophageal echocardiography (TEE) plays an essential role in diagnosing these complications in the perioperative period. We hereby report a case of pulmonary venous baffle obstruction following Senning procedure which was diagnosed with the help of TEE and helped in the revision of surgery.

Case

A 10 months old male child weighing 6 kg was presented to our hospital with complaints of bluish discoloration of the skin and respiratory distress. On examination, his blood pressure was 65/39 mm Hg, heart rate was 115/min, room air oxygen saturation was 69%, and respiratory rate was 35 breaths/min. On transthoracic echocardiography (TTE) a D-TGA, with 5 mm ostium secundum atrial septal defect, 3 mm patent ductus arteriosus with mild tricuspid regurgitation was diagnosed. There was no stenosis or regurgitation across the aortic and pulmonary valve. After a thorough preoperative evaluation, atrial switch operation, that is, Senning procedure was planned. On the day of the surgery, patient was premedicated with 2 mg oral midazolam under the supervision and shifted to the operating room. After instituting American Society of Anesthesiologists (ASA) standard monitoring, a 24G intravenous cannula was inserted on the dorsum of the left hand. Anesthesia was induced with intravenous fentanyl (5 mcg), ketamine (5 mg), and atracurium (3 mg). The trachea was intubated with 4.5 mm uncuffed tube and fixed at 11 cm after confirmation of bilateral air entry. Anesthesia was maintained with isoflurane, atracurium, fentanyl, and oxygen--air mixture. The right femoral artery was cannulated for invasive arterial pressure monitoring and a central venous catheter was placed into the right internal jugular vein. A pediatric TEE probe was inserted and preoperative TTE findings were confirmed. Sternotomy

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was performed and a standard aortic and bicaval cannulation was done after adequate anticoagulation. The cardiopulmonary bypass (CPB) was initiated and anterograde cardioplegia was administered. After Senning procedure, CPB was terminated with an inotropic support of intravenous milrinone 0.4 mcg/kg/min and noradrenaline 0.05 mcg/kg/min. However, within 5 min after CPB termination, the patient's oxygen saturation came down to 85% despite giving 100% oxygen. The lung compliance was reduced and peak pressure increased to 35 mm Hg. The two-dimensional TEE revealed a narrowing in the pulmonary venous baffle anterior to the entrance of the pulmonary veins. The turbulence was observed in the baffle on color doppler examination [Figure 1 and Video 1]. A continuous wave doppler placed across the turbulence revealed a peak gradient of 10 mm Hg and mean gradient of 5 mm Hg [Figure 2]. The diagnosis of pulmonary venous baffle obstruction was confirmed by measuring pressure difference across the obstruction by direct measurement. Hence, revision of surgery was planned and CPB was reinstituted. The stenotic area was excised and it was augmented with a pericardial patch. The CPB was successfully terminated with an inotropic support of intravenous milrinone 0.4 mcg/kg/min and noradrenaline 0.05 mcg/kg/min. The TEE revealed an improvement in the severity of stenosis with a reduction of the mean gradient to 1 mm Hg [Figures 3, 4 and Video 2]. His lung compliance was improved and shifted to the intensive care unit with stable hemodynamics. The trachea was extubated after 36 h and shifted to ward after 5 days.

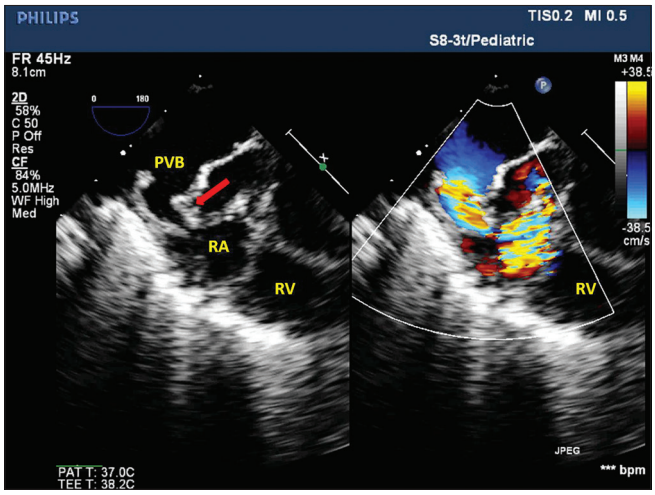

Figure 1: The transesophageal echocardiographic image was taken at the mid-esophageal level, 0°, probe rotated towards right side with color compare following Senning procedure showing a turbulence in the pulmonary venous baffle (PVB) suggestive of stenosis (red arrow). RA: Right atrium; RV: Right ventricle

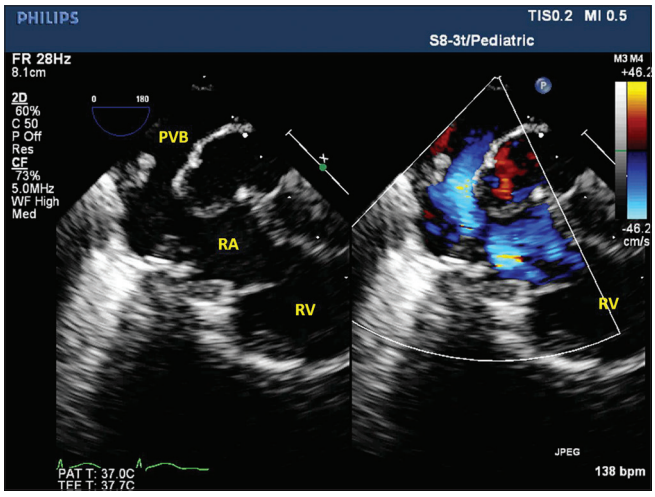

Figure 3: The transesophageal echocardiographic image was taken at the mid-esophageal level, 0°, probe rotated towards right side with color compare after surgical correction of pulmonary venous baffle (PVB) stenosis showing a laminar flow in the PVB. RA: Right atrium; RV: Right ventricle

Discussion

Arterial switch operation (ASO) is the most commonly performed surgery in patients with TGA all around the

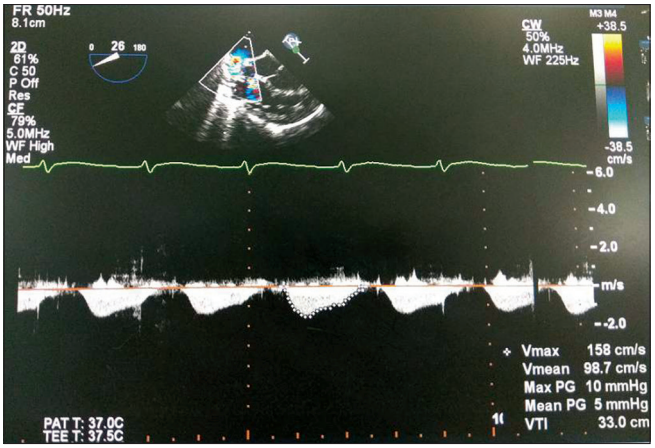

Figure 2: A continuous wave doppler placed across pulmonary venous baffle (PVB) narrowing following Senning procedure showing a peak gradient of 10 mm Hg and mean gradient of 5 mm Hg, suggestive of PVB stenosis

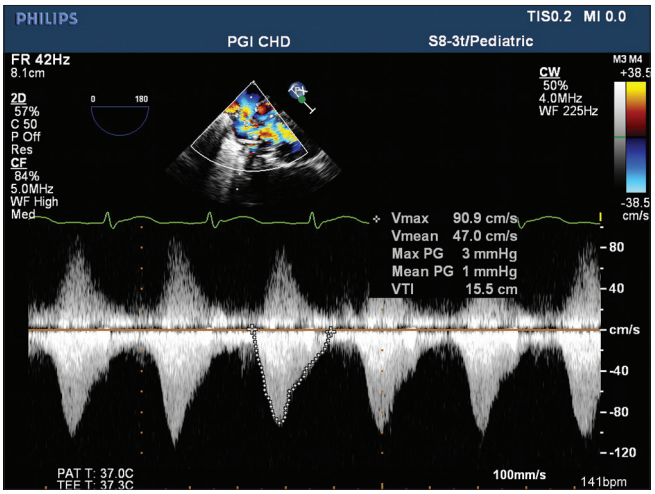

Figure 4: A continuous wave doppler placed in the pulmonary venous baffle (PVB) after surgical correction of PVB stenosis showing a peak gradient of 3 mm Hg and mean gradient of 1 mm Hg

world and was first performed by Jatene *et al*. and Yacoub in 1975.[3] Since its introduction, the techniques of Mustard and Senning have lost some of their importance and serve as a surgical options only for few indications.[4] The longer the period between birth and operation, the less muscle mass is left in the left ventricle losing its ability to function at systemic workloads by virtue of the physiological decrease in pulmonary vascular resistance in the postnatal period.[5,6] ASOs are preferred for those who present late.[4]

The Senning operation was 1st performed by Ake Senning in 1958.[7] It involves an intra-atrial switch of the pulmonary and systemic pathway. Overall survival after Senning's procedure after 15 years is 83%.[8] However, it is associated with various complication which includes sinus node dysfunction, right ventricular dysfunction, atrial arrhythmias, atrioventricular valve regurgitation, obstruction and/or leak in systemic or pulmonary venous baffle.[9] The incidence of pulmonary venous baffle stenosis (PVBS) post-Senning procedure is 1.9--7.6%.[10] Reoperation in the Senning is required in 9--30% of cases in which majority of them are due to the obstruction in the systemic or pulmonary venous baffle. The PVBS can develop due to narrowed baffle, scarred tissue, calcification, or by retraction of the right atrium.[10] It can be managed either by the transcatheter balloon dilatation or by surgical intervention.[4] In our case, PVBS was present at 1 cm anterior to the opening of the lower pulmonary vein and was surgically corrected.

The TEE is routinely performed in the intraoperative period to confirm the preoperative diagnosis and for the evaluation of intra or extracardiac baffles and biventricular function following the Senning procedure.[11] A narrowing in the pulmonary venous baffle can be seen in the two-dimensional TEE, whereas turbulence of blood flow across the stenosis can be appreciated in Color doppler TEE examination. Pulse wave or continuous wave doppler helps in the quantification of severity of stenosis by measuring the pressure gradient across the stenosis. Apart from the baffle, individual pulmonary veins should be assessed for turbulence. A mean pressure gradient of more than 4--5 mmHg in the pulmonary venous pathway or individual pulmonary veins is not acceptable and should be addressed.[12] Accurate detection of an obstruction in the operating room with TEE helps in the unnecessary re-exploration in the postoperative period. In our case, PVBS was developed following the Senning procedure, which was timely detected by the TEE and helped in the revision of the baffle.

Conclusion

Senning operation can be associated with pulmonary venous baffle obstruction. TEE plays an important role in the intraoperative management of such cases by defining the site and severity of obstruction, and also assesses the adequacy of baffle post repair.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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