Case Report

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Role of Transesophageal Echocardiography in Differentiating Dynamic versus Fixed Left Ventricular Outflow Tract Obstruction in Complete Transposition of Great Arteries: A Rare Case Report

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ABSTRACT

Obstruction to pulmonary blood flow in complete transposition of the great arteries (TGA) can be dynamic or anatomic. Gradients measured preoperatively across the left ventricle outflow tract (LVOT) by Doppler echocardiography may overestimate the degree of anatomic obstruction as a result of the greatly increased pulmonary blood flow in children with TGA, especially with an associated ventricular septal defect (VSD). It is imperative, therefore, that the pathophysiologic processes involved in left ventricular outflow tract obstruction (LVOTO) be fully evaluated using intraoperative real time transesophageal echocardiography (TEE) in order to make a safe surgical decision. Here, we present a case of TGA VSD with LVOTO which needed muscle bundle resection along with arterial switch operation (ASO) which is guided by intraoperative real time TEE which helping in differentiating anatomic from dynamic LVOTO.

Keyword: Transposition of the Great Arteries, Left Ventricular Outflow Tract Obstruction, Transesophageal Echocardiography

INTRODUCTION

The ASO is the procedure of choice for the management of the TGA. LVOTO in TGA are divided in to either dynamic or anatomic types. Dynamic obstruction is common in TGA with an intact ventricular septum (IVS) due to leftward bulging of the basal muscular ventricular septum toward the lower-pressure LV, which narrows the LVOT during systole but opens widely during diastole [1]. This type of dynamic LVOTO usually resolves after ASO. The frequency of obstruction ranges between 20-33% [1-3]. If LVOTO is anatomic and significant, adequate resection of obstruction

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is necessary with ASO. Intraoperative transesophageal echocardiography (TEE) in TGA prior to the surgical intervention gives more complete, and precise information [4], identify any new findings, and assists in the assessment of hemodynamics and myocardial function prior to operative procedure.

CASE REPORT

A 5-month-old male child presented with cyanosis during crying and agitation since birth. Initial evaluation diagnosed TGA, and the patient was referred to a tertiary centre for further management. The patient was hemodynamically stable with a heart rate of 140/ minute, non-invasive blood pressure was 60/40 mm Hg, preductal, and post-ductal saturation of 70% and 72%, respectively. Cardiologist transthoracic echocardiography (TTE) revealed TGA with 3mm perimembranous VSD with normal biventricular function. Planned for ASO with patch closure of VSD.

Anaesthesia was induced with inhalational sevoflurane and the peripheral line was secured in the left upper limb. Fentanyl 2ug/kg and vecuronium were given to facilitate endotracheal intubation. The central line was placed in the right internal jugular vein and for invasive pressure monitoring the right femoral artery was cannulated. TTE was performed which revealed d-TGA with perimembranous VSD with turbulence across LVOT with a pressure gradient of 45 mmHg (Figure 1). Neonatal TEE probe S8 3t (Philips, Bothell, WA USA) was placed after adequate desufflation of the stomach. TEE in mid esophageal (ME) aortic valve short axis showed a two circle in anterior-posterior relation instead of circle sausage appearance suggestive of TGA (Video 1), 3mm perimembranous VSD (Figure 2), in ME long axis view the pulmonary valve and the aortic valve annular measurement was taken, which was 0.747 cm and 0.845 cm, respectively (video 2 ; Figure 3), LVOTO with thickened muscular bundle causing turbulence (Figure 4) and good biventricular function.

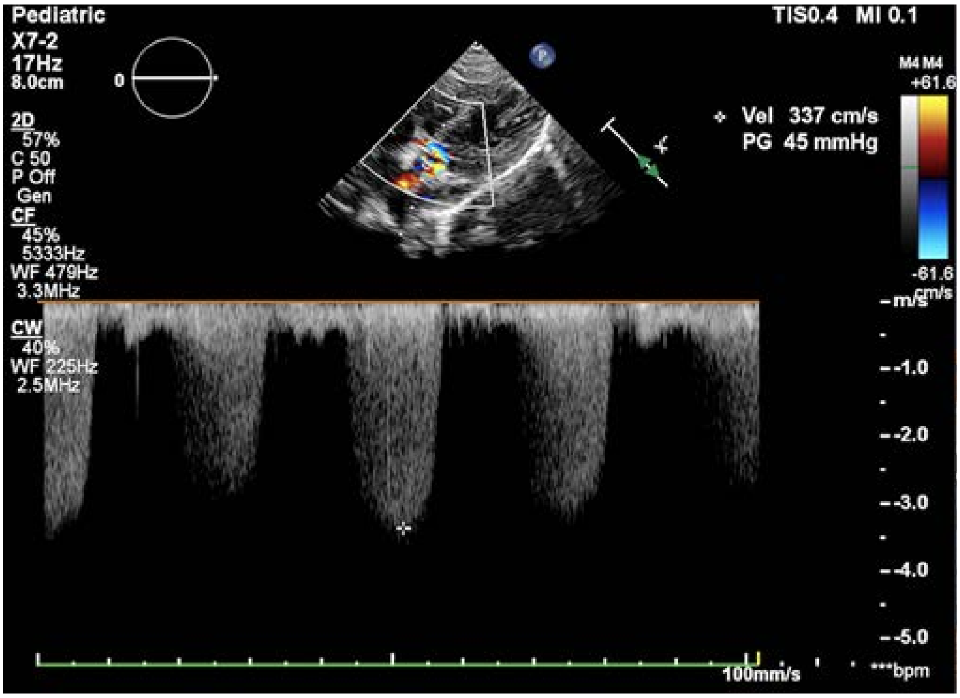

Figure 1. Apical five chamber view showing peak gradient of 45 mm Hg across the left ventricular outflow tract.

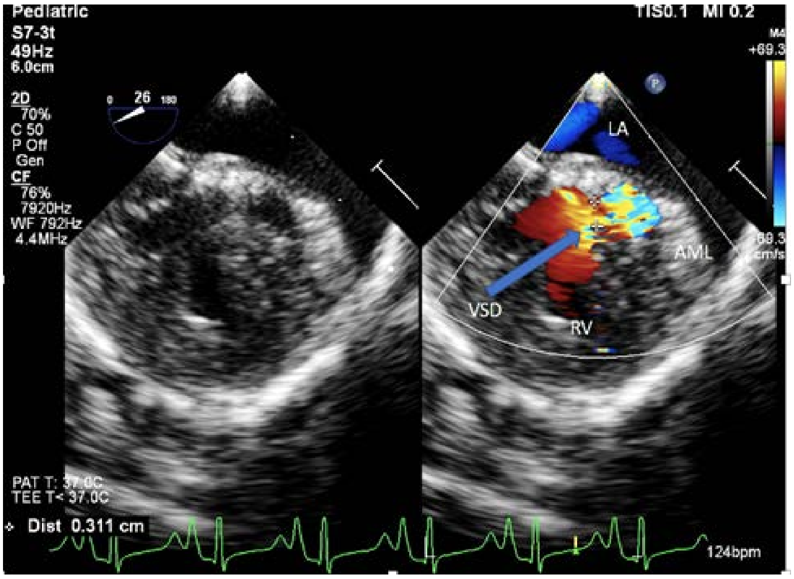

Figure 2. ME four chamber view showing ventricular septal defect (VSD).

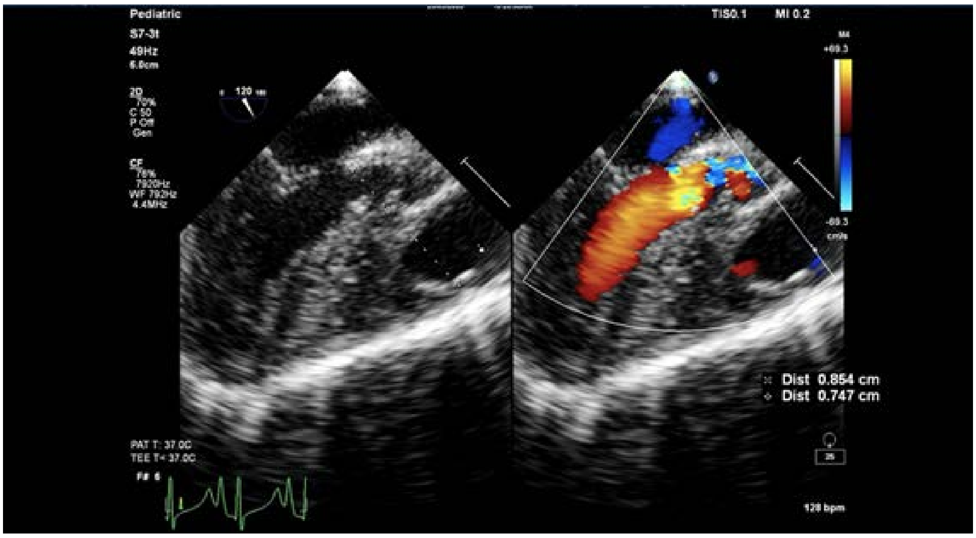

Figure 3. ME long axis view showing two great arteries placed parallel with its annular diameter.

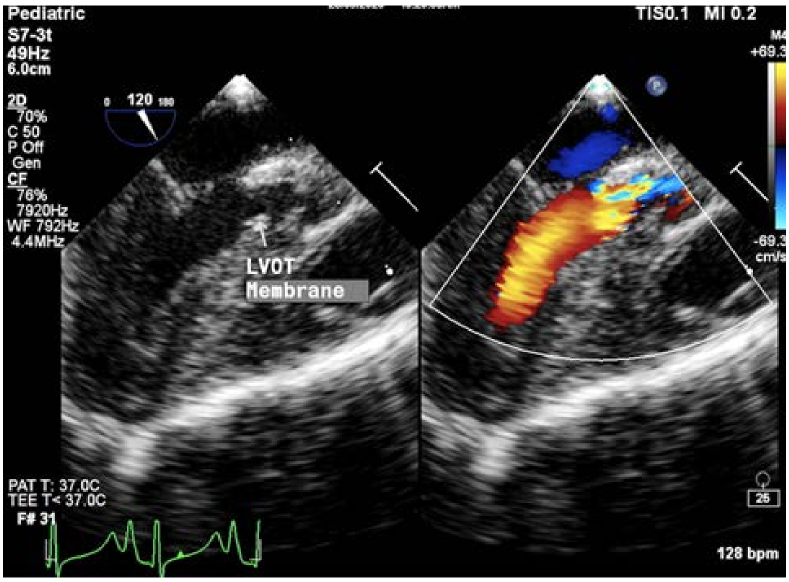

Figure 4. ME long axis view showing muscle bundle in left ventricle outflow tract (LVOT).

After achieving an activated clotting time of more than 480 seconds, bicaval and aortic cannulation was performed. Cardiopulmonary bypass (CPB) was initiated. A primary ASO was performed with pericardial patch closure of VSD with LVOT muscle bundle resection. The CPB time was 140 minutes and the aortic cross-clamp time was 122 minutes. The patient came off CPB with minimal inotropic support, milrinone 0.3ug/kg, and nor adrenaline 0.05ug/kg. After attaining adequate hemostasis, the sternum was closed on the table and shifted to the cardiac surgical intensive care unit (ICU). The postoperative ICU course was uneventful and the patient was extubated on postoperative day 2. Shifted to the ward on postoperative day 5.

DISCUSSION

Dynamic forms of LVOTO are common in those with TGA IVS while anatomic form of LVOTO is common in TGA VSD. Intraoperative TEE in TGA prior to the surgical intervention gives more complete, and precise information [4], identify any new findings, assist in the assessment of hemodynamics and the assessment of the surgical result. Right ventricular outflow obstruction (RVOT) is the most frequent postoperative complication [5], occurring with sufficient severity to require reintervention in up to 10% of cases [6], Usually the obstruction is at the supravalvular level and less commonly, in the right ventricular infundibulum.

Anatomical classifications for outflow tracts obstruction are divided into three types. Type 1 includes anomalies of the tricuspid valve (septal leaflet prolapse due to VSD). Type 2 involves the mitral valve that includes all the anomalies such as malposition and anomalous insertion of cords. Type 3 involves alterations of the outflow tract and the pulmonary valve. In our case, the echo study revealed a Type 3 defect which was reported in a previous study [7].

Wu et al. [8] in their study proposed echocardiographic criteria to differentiate the dynamic and anatomical nature of LVOTO in TGA patients. Isolated sub-pulmonary stenosis, pulmonary to aortic valvular annulus ratio > 0.98, or a pressure gradient through the LVOT < 22 mmHg falls in dynamic nature of LVOTO in TGA. In contrast, differentiating patients with fixed non-resectable LVOTO from those with resectable LVOTO was best achieved using the compound criteria, that is, patients who had a pulmonary to aortic annulus ratio <0.85 and an LVOTO pressure gradient >35 mmHg had fixed non-resectable LVOTO.

For these patients, surgeries other than ASO should be performed. Index case, the child LVOTO pressure gradient was 35 mmHg and pulmonary to aortic annulus ratio was 0.87 which falls into anatomic resectable LVOTO

LVOTO is boon for a neonate undergoing ASO because it trains the left ventricle for future systemic pressure thus improving the survival of such children at the cost of systemic hypoxemia. In an untrained left ventricle, with less left ventricular mass to maintain the systemic cardiac output, prolonged ICU stay with heavy inotropic support, left ventricular assist device (LVAD) support, or extracorporeal membrane oxygenation (ECMO) is needed to improve the functionality of the left ventricle [9].

In this case, TEE guided us to differentiate the type of LVOTO and the exact location of obstruction. Dynamic LVOTO resolves after ASO while anatomic types of obstruction always require surgical intervention. It is very important to know which type of obstruction is present because RVOT is the most common cause of early reintervention after ASO.

CONCLUSION

Preoperative echocardiography can overestimate the gradient across the LVOT due to increased pulmonary blood flow especially in TGA VSD. Intraoperative TEE provides detailed anatomic imaging of both discrete and complex forms of LVOTO, and Doppler techniques provide additional information regarding the site, mechanism, and severity of the obstruction.

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