Preservation of systemic tricuspid valve function by pulmonary conduit banding in a patient with corrected transposition of the great arteries

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Abstract

Systemic tricuspid valve regurgitation increases mortality and morbidity in patients with a corrected transposition of the great arteries. A 17-year-old male with a physiologically corrected transposition after the closure of a ventricular septal defect and conduit placement between a morphological left ventricle and pulmonary artery presented with exertional dyspnoea. The transthoracic echocardiography showed a severe conduit stenosis, and cardiac catheterization revealed a pressure gradient of 114 mmHg. The patient underwent conduit re-replacement using a pulmonary heterograft. Intraoperative transoesophageal echocardiography revealed an acute severe tricuspid regurgitation after a conduit re-replacement. Pulmonary conduit banding was performed under transoesophageal echocardiography guidance, during which the left ventricular to right ventricular pressure ratio increased from 0.33 to 0.60 and the degree of tricuspid regurgitation decreased mildly. The patient was discharged uneventfully at postoperative day 16. Conduit banding might be a useful technique to preserve the systemic tricuspid valve function during conduit re-replacement in patients with a corrected transposition.

Keywords: Congenitally corrected transposition of the great arteries • Conduit • Tricuspid valve regurgitation

INTRODUCTION

Systemic atroventricular (tricuspid) valve regurgitation (TR) is a major factor associated with increased mortality and morbidity in patients with a corrected transposition of the great arteries (cTGA). However, the causes of TR in the cTGA are not well understood and may be multifactorial [1, 2]. The high incidence of Ebstein-like malformation, an annular dilatation secondary to right ventricular failure, which has a different morphological musculature and shape from that of the left ventricle (LV) and an inherent weakness of the tricuspid valve under systemic pressure, would probably reflect the morphological backgrounds [1]. Nevertheless, more than 70% of the patients with cTGA are free from significant TR. Recent studies have demonstrated that the LV to right ventricle (RV) pressure ratio also may affect the degree of TR [2, 3]. Here, we report the perioperative management of acute severe systemic tricuspid valve regurgitation in a patient with the cTGA during morphological left (pulmonary) ventricle to pulmonary artery conduit re-replacement.

CASE

A 17-year-old male presented to the hospital with exertional dyspnoea. The patient underwent a modified Blalock-Taussig shunt operation at 7 months after birth due to atrioventricular (AV) discordance, double-outlet right ventricle (DORV), ventricular septal defect (VSD) and pulmonary stenosis. Conventional repair with VSD closure and placement of the conduit between the morphological LV and pulmonary artery was performed at 5 years of age resulting in a physiologically cTGA. On admission, the transthoracic echocardiography showed a severe stenosis of the pulmonary artery conduit due to degeneration and calcification. Ventricular and systemic tricuspid valve functions were good, with only a trivial TR. Cardiac catheterization revealed a stenosis on the conduit and showed 114 mmHg pressure gradient across it. Percutaneous intervention was not feasible due to the acute angle between the LV and the conduit. Therefore, surgical intervention was planned for conduit reimplantation. The operation was performed under cardiopulmonary bypass and moderate hypothermia without aortic cross-clamping. A pulmonary heterograft of 23 mm (Labcor stentless pulmonic heterograft; Labcor Laboratories, Brazil) was used. After cardiopulmonary bypass, the morphological left (pulmonary) ventricular (LV) pressure was measured at 30 mmHg, while the aortic pressure was 90 mmHg (LV/RV = 0.33). However, an intraoperative transoesophageal echocardiographic (TEE) examination revealed a severe TR and a septal bulging towards the LV (Fig. 1A). The pulmonary conduit was encircled with nylon tape and snared 2 cm distal to the pulmonary valve. Left ventricular...
pressure was measured continuously. Under TEE guidance, the pulmonary conduit was snared. When left ventricular pressure increased to 55 mmHg (LV/RV = 0.6), TR decreased to a mild degree (Fig. 1B). Conduit banding was performed with the nylon tape. Three ligaclips were put on the nylon tape 0.5 mm apart from each other to enable performing sequential balloon dilatation after surgery if conduit stenosis increases (Fig. 2). The patient was discharged uneventfully at postoperative day 16 in good clinical condition. At discharge, the transthoracic echocardiography showed good ventricular functions and mild TR, and left ventricular pressure was 56 mmHg. At a 6-month follow-up, the patient was asymptomatic and the transthoracic echocardiography showed the same findings as at discharge.

DISCUSSION

Survival after surgical repair in a cTGA with a RV as the systemic ventricle has been evaluated in different studies. The prognosis mainly depends on tricuspid valve regurgitation and right ventricular dysfunction [1, 4]. The double-switch procedure can be performed with good early and intermediate results [5] to avoid these potential complications. However, the superiority of the double-switch operation compared with the conventional repair could not be demonstrated in patients who had no tricuspid regurgitation before the operation. That is why we decided to perform a simple conduit re-replacement due to the acceptable tricuspid valve function instead of the technically complex double-switch operation.

Recent studies have demonstrated that the positions of the ventricular septum and septal attachments of the tricuspid valve depend on the pressure gradient between the RV and LV in patients with a physiologically cTGA. When the LV is exposed to only pulmonary pressure, the ventricular septum protrudes into the LV and the septal attachments are pulled away from their annulus, causing coaptation zone abnormalities and progressive TR [2, 3].

The study by Koh et al. [3] on 15 patients with discordant atrioventricular connection and pulmonary outflow tract obstruction who underwent conventional repair using the LV to the pulmonary artery conduit indicated that the left ventricular pressure of <60% of the systemic right ventricular pressure at the systolic phase could be among the deleterious factors in terms of TR and dilatation of the right ventricular cavity. They suggested that the surgeon can choose a smaller conduit than usually used so as to provide some pressure gradient between the LV and the pulmonary artery. Kollars et al. [2] demonstrated an improvement of TR from severe to moderate in 11 of 14 patients who had pulmonary banding for retraining of the morphological LV in preparation for eventual double-switch procedures. In the same study, they found that the worsening of TR in 16 patients who underwent procedures would decrease the LV pressure either in conventional repair involving VSD closure with the LV to the pulmonary artery conduit placement or the replacement of a stenotic LV to the pulmonary artery conduit.

In our case, we experienced an acute severe TR during conduit re-replacement, confirming the previous studies indicating that the septal shift caused by changes in the LV and RV pressure is an important mechanism affecting the degree of TR. We used the largest conduit available (23 mm) to avoid further conduit re-replacements instead of smaller ones. Decrease of the LV pressure and the development of TR could be managed by conduit banding under TEE guidance. This might be a better option than using small-sized conduits that might be problematic in the near future. Our conduit banding technique using ligaclips might also be suitable for future balloon dilatation, if there is a progression of conduit stenosis and associated increase in pressure gradient.

In conclusion, the LV/RV pressure ratio has a vital role in maintaining systemic tricuspid valve competence in patients with a cTGA. An acute decrease in the LV/RV ratio after a conduit re-replacement may cause an acute severe TR by changing the interventricular septum and septal papillary muscle morphology.
Conduit banding under TEE guidance may be a useful technique to preserve the systemic tricuspid valve function.

Conflict of interest: none declared.

REFERENCES


