Aortic valve bypass for high-risk patients with symptomatic aortic stenosis: a case report

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Abstract

There are a significant number of symptomatic aortic stenosis (AS) patients not referred to the traditional methods for some complexity conditions. We described a case of a 61-year-old female with severe symptomatic AS, calcific small aortic annulus (16.6 mm), narrow porcelain ascending aorta (aortic root 14.6 mm, internal diameter 14.0 mm), chronic renal insufficiency and a history of previous sternotomy for mechanical mitral valve replacement (MVR) and coronary artery bypass grafting (CABG) who underwent aortic valve bypass (AVB) with favorable results. AVB has been proposed as a complementary to surgery operation of aortic valve replacement (SAVR) and transcatheter aortic valve implantation (TAVI) in high-risk AS patients.

KEYWORDS

Aortic valve bypass, Apico-aortic conduit, Aortic valve stenosis, Porcelain aorta

1 — INTRODUCTION

AVB is a surgical procedure to widen the area of the left ventricular tract by constructing a valved conduit through the cardiac apex and the descending aorta. It has been considered that AVB is an alternative technique to traditional methods for high-risk AS patients, since there is no need for sternotomy, aortic cross-clamping, cardioplegic cardiac arrest, incision of ascending aorta and debridement[1]. Here, we report the case of a high-risk symptomatic AS female with contraindications to SAVR, TAVI and balloon aortic valvotomy, in whom favorable results were obtained after constructing aortic valve bypass.

2—CASE

A 61-year-old female suffering from aggravating chest distress and shortness of breath for a year was admitted to our Department of Cardiology. The patient with a history of chronic renal insufficiency had undergone mechanical MVR and CABG 7 years before admission. On physical examination, her blood pressure was 90/57 mmHg, heart rate was 84 beats/minute. Lung breaths sounded clear. Cardiac examination revealed a grade 4/6 systolic murmur and a diastolic murmur in the auscultation area of the aortic valve. Transthoracic echocardiography showed calcified aortic valve with small aortic annulus for a diameter of 16.6 mm, as well as severe stenosis and moderate regurgitation, accompanied by hypokinesis of the left ventricular wall, the peak flow velocity of 4.28 m/second, peak across aortic valve gradient of 73.4 mmHg, mean gradient of 44 mmHg, and a calculated aortic valve area of 0.33 cm^2. The left ventricular end-diastolic diameter was 67.1 mm. The left ventricular ejection fraction was 26%. Thoracic computed tomography (CT) showed severe and diffuse calcifications of the coarctated ascending aorta (a porcelain aorta) and aortic arch (Fig.1A), with an aortic root diameter of 14.6 mm and an internal diameter of 14.0 mm. The calculated European system for cardiac operative risk evaluation (EuroSCORE) II mortality was 72.04 %.

Under general anesthesia, the patient was placed in the right decubitus position with hips externally rotated to allow access to the left femoral vessels. Cardiopulmonary bypass was established between the left femoral

artery and vein. A left lateral thoracotomy was performed through the sixth intercostal space to show both the left ventricular apex and the descending thoracic aorta. After systemic heparinization, the descending aorta was clamped, to which a 23-mm mechanical valved conduit was sewn in an end-to-side fashion. Under ventricular fibrillation induced with hypothermia of 25 , the left ventricular apex was opened and the aortic valve was repaired by through the direct apical incision. Then a 26-mm vascular tube graft was anastomosed to the apical incision by 2-0 polypropylene sutures with pledgets. Finally, the two grafts were anastomosed together end-to-end with a continuous 4-0 polypropylene suture.

Postoperatively, the patient was treated with double therapy consisting of warfarin and aspirin. The patient was extubated 21 hours after the operation and was discharged from the hospital on day 18 after surgery in good condition. The pre-discharge echocardiography showed a decreased pressure gradient across the aortic valve (peak 29 mmHg, mean 11 mmHg) and an ejection fraction of 47.82 %, with the left ventricular end-diastolic diameter of 54.6 mm. Contrast-enhanced CT demonstrated a valved apico-aortic conduit with fluent blood flow (Fig.1B).

3—DISCUSSION

For adults suffering from symptomatic AS, SAVR is recommended in those at low risk (EuroSCORE II¡4%), while the TAVI is considered to be a choice for patients who are not suitable for SAVR, especially for those suitable for transfemoral access[2]. Another traditional therapy for symptomatic AS is balloon aortic valvotomy, which usually be chosen for hemodynamically unstable patients in the transitional period to SAVR or TAVI[2].

However, a significant number of patients with symptomatic AS are not referred to the three above-mentioned traditional methods for some complexity conditions. Risk factors among them include severely calcified aorta root or ascending aorta (porcelain aorta) and/or aortic valve leaflet, narrow left ventricular outflow tract (¡18 mm)[1], small aortic annulus, ascending aorta banding, severe left ventricular dysfunction, previous CABG[3]. AVB is regarded as a good option for reducing the left ventricular overload by connecting the left ventricular apex and descending aorta in patients with contraindications to SAVR and TAVI.

We presented a case of AVB surgery that was conducted successfully in a high-risk symptomatic AS patient with contraindications to methods. Internal diameters of the aortic annulus, aortic sinus and ascending aorta are narrow with severe calcification to the extent that it is hard to inflate a balloon or release a transcatheter aortic valve. Besides, there was a lack of appropriate valve in the market we can found. Considering of the coarctated and porcelain aorta, replacement of ascending aorta combined SAVR seemed necessary, but the mortality risk calculated by EuroSCORE II for this operative plan was 72.04%. In this case, patient characteristics showed contraindications to SAVR, TAVI and balloon aortic valvotomy. To widen the total area of the left ventricular tract and decrease the cardiac afterload, we finally performed a surgical procedure of aortic valve bypass and aortic valvuloplasty in consideration of the severe stenosis and moderate regurgitation of the aortic valve.

Indication for AVB is severe symptomatic AS in high-risk patients with contraindications to both AVR and TAVI[1]. The implantation of the apico-aortic conduit relieves left ventricular outflow obstruction by shunting blood flow. Compared with TAVI, Patients undergoing AVB procedures have similar in-hospital mortality, lower complication rate, and fewer hospital charges[3]. Even so, AVB is seldom offered as the initially routine treatment as a result of the technical difficulty of apical anastomosis procedure. The new invention of an automated apical connector device would help collapse the technical barriers[4].

A theoretical risk of the AVB procedure is the possibility of flow subtraction with cerebral hypoperfusion ascribed to the competition between the antegrade and retrograde flow from two ventricular outputs. In a recent study, Benevento et al.[5] showed that the blood flow distribution after AVB depends on the effective orifice area of the stenotic aortic valve and apico-aortic valved conduit implanted. Mantini et al.[6] reported that the flow redistribution after AVB does not compromise cerebral blood supply. Another serious complication is aortic thrombosis at the level of flow stagnation caused by the collision of two blood flows, which is more likely to happen when the retrograde flow is dominant and antegrade/retrograde flows are equivalent[7].

The recommendation is that patients who underwent AVB receive long-term strict anticoagulation[7].

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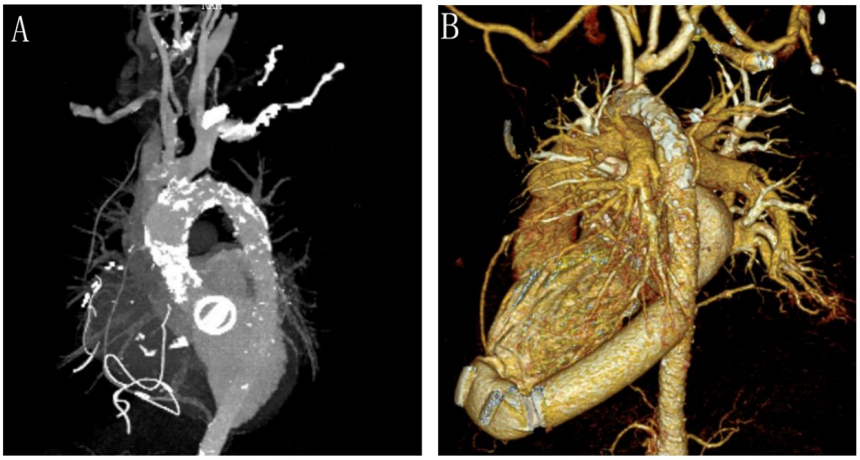

FIGURE 1: A: Preoperative CT showed severe and diffuse calcifications of the coarctated ascending aorta (a porcelain aorta);**B:** Postoperative contrast-enhanced CT showed a mechanical valved conduit connecting the apex of the left ventricle to descending aorta.