Aortic Valve Replacement after Previous Coronary Artery Bypass Grafting: A Case Report

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Summary: We experienced a case of aortic valve replacement after previous coronary artery bypass grafting with patent bypass grafts. Based on the retrosternal anatomy assessed by preoperative angiography and thoracic computed tomography, aortic valve replacement was performed through a median resternotomy. After careful dissection of the right side of the heart and the ascending aorta, cardiopulmonary bypass was established with cannulation of the ascending aorta and bicaval venous cannulation. The patent bypass grafts were dissected only as required for clamping and were clamped during cardiac arrest. After aortic valve replacement, the patient was uneventfully weaned from cardiopulmonary bypass and had a good postoperative recovery. It is important that surgeons have a meticulous strategy for reducing the risks associated with operating on patients with patent bypass grafts. We report on the surgical management of patients undergoing aortic valve replacement after previous coronary artery bypass grafting, including careful planning during the first operation.

Key words aortic valve replacement, coronary artery bypass grafting, patent bypass grafts

INTRODUCTION

Recently, acceptable results have been reported for aortic valve replacement (AVR) after previous coronary artery bypass grafting (CABG); however, the procedure remains challenging [1], particularly in patients with patent bypass grafts (PBGs), where there is a 5% incidence of injury to the internal thoracic artery (ITA) [2,3]. The presence of PBGs is associated with specific risks of graft injuries and insufficient myocardial protection; the dissection required to clamp the PBGs increases the potential risk of graft injuries, although clamping the PBGs ensures myocardial protection. Accordingly, an alternative strategy that leaves the ITA graft undissected and unclamped has been applied [2-5]. In addition, the therapeutic planning, including graft design during the previous CABG [6] and preoperative computed tomography (CT) [7-9], has also been reported. For patients undergoing AVR after previous CABG who have PBGs, it is important to have a meticulous surgical strategy to minimize specific risks. We report on the surgical management of patients undergoing AVR after previous CABG.

CASE REPORT

A 71-year-old man was referred to our hospital for a 3-month history of chest pressure on exertion. He had undergone CABG of the left ITA to the left anterior descending artery, the right ITA via the transverse sinus to the posterolateral branch of the left circumflex
artery, and the right gastroepiploic artery to the right posterior descending branch of the right coronary artery for angina pectoris 9 years previously. In addition, mild aortic valve stenosis (AS) with highly echogenic leaflets and a transvalvular peak pressure gradient (PPG) of 26.0 mmHg had also been observed on transthoracic echocardiography. Angiography to investigate his symptoms of chest pressure on exertion showed triple-vessel disease of the native coronary arteries, all of which had PBGs (Fig. 1). Cardiac catheterization showed an increased PPG across the aortic valve of 47.0 mmHg. Consequently, we decided to perform AVR to treat the deterioration of his AS.

Two months after discharge, he was readmitted for AVR, but complained of shortness of breath on exertion. On physical examination, a systolic and diastolic grade 2 murmur was audible at the left sternal border in the third intercostal space. Chest X-ray showed cardiomegaly with a cardiothoracic ratio of 58.0% and mild pulmonary congestion. Transthoracic echocardiography showed severe AS with a PPG of 85.4 mmHg. After treatment for congestive heart failure, preoperative thoracic CT was performed, showing a safe space between the ascending aorta and the sternum and proximity of the right ventricle free wall to the sternum (Fig. 2).

AVR was performed through a median resternotomy, paying close attention to prevent injury to the mediastinal structures. After careful dissection of the adhesions around the right side of the heart and the ascending aorta, cardiopulmonary bypass (CPB) was established with cannulation of the ascending aorta and bicaval venous cannulation. The PBGs were dissected only as required for clamping. After the initiation of total CPB, a right atriotomy was performed and a coronary sinus cardioplegic catheter was introduced for retrograde cardioplegia. The ascending aorta was carefully cross-clamped while avoiding injury to the right ITA. Cardiac arrest was achieved by retrograde cold blood cardioplegia with clamping of the PBGs. After a transverse aortotomy, the aortic valve was exposed. All three cusps of the valve were thickened with fused commissures that limited their excursion. A 21-mm bioprosthesis was implanted in the supra-annular position with pledged mattress sutures. The patient was uneventfully weaned from the CPB. The durations of the operation, CPB, and aortic cross-clamping were 723, 294, and 175 min, respectively.

The patient was treated for a superficial postoperative sternal wound infection and discharged on the 46th postoperative day. Five years after surgery, the patient is doing well.
The presence of PBGs in patients undergoing AVR after previous CABG is associated with risks of graft injuries and insufficient myocardial protection. Consequently, surgeons make particular efforts to reduce these specific risks.

To our knowledge, the most common surgical procedure in this situation involves median resternotomy and clamping of the PBGs. The advantage of clamping the PBGs is that regional myocardial rewarming and cardioplegia “wash-out” near the PBGs during cardioplegic arrest are avoided, which ensures myocardial protection. However, the dissection required to clamp the PBGs increases the potential risk of graft injuries. Some authors [2-5] have reported on the efficacy of an alternative strategy that leaves the ITA graft undissected and unclamped. Fujita et al. [5] recently confirmed that their surgical strategy of leaving the patent ITA grafts undissected was of benefit with regard to the postoperative peak creatine kinase-MB level, ST changes seen on the electrocardiogram, and new asynery seen on the echocardiogram. A surgical strategy to eliminate dissection for PBG clamping would be widely accepted and could induce favorable outcomes in future.

Nevertheless, in patients with a patent right ITA crossing the midline, as in our case, surgeons dissect the bypass graft from the aorta to enable aortotomy for AVR. Therefore, it is indispensable for a favorable outcome that surgeons are aware of not only the route of the PBGs, but also the relationship between the PBGs and mediastinal structures. Preoperative CT has been reported to be of benefit in patients undergoing cardiac reoperations [7,8]. In recent years, multidetector CT (MDCT) has emerged as a highly reliable modality for the comprehensive assessment of mediastinal and bypass graft anatomy, and it is routinely performed during preoperative planning [8]. For patients undergoing cardiac reoperations, we have also routinely performed preoperative thoracic CT, but not always MDCT because earlier-generation MDCT was often discouraged owing to induction of bradycardia with β-blockers. Fortunately, a safe space was observed between the ascending aorta and the sternum on preoperative thoracic CT in the present case. Moreover, the information obtained from preoperative angiography (Fig. 1b) and the previous operation report indicated that the right ITA had been passed behind the ascending aorta. Consequently, we were able to perform an aortotomy for AVR without injuring the patent right ITA; however, preoperative MDCT would have helped in planning the surgical approach.

With the improved long-term survival of CABG, we occasionally encounter patients who require AVR after previous CABG. Most of these patients were diagnosed with mild or moderate AS at the time of the previous CABG. The management of patients with mild or moderate AS at the time of CABG remains complex: patients with untreated AS may require AVR at a
later time, and those who underwent AVR will be exposed to risks associated with prosthetic valves, such as endocarditis and bioprosthetic valve degeneration [1,10]. For these patients, surgeons should therefore plan their surgical procedure to enable future aortotomy for AVR at the time of CABG. Sugita et al. [6] reported a case in which the proximal anastomoses were attached in a more distal position of the ascending aorta than usual. In our case, we planned the CABG procedure using only \textit{in situ} arterial grafts with the position of the right ITA behind the ascending aorta and could more easily perform the AVR after previous CABG. Meticulous surgical planning can play an important role in the ease of any future AVR operation.

**CONCLUSION**

In patients undergoing AVR after previous CABG who have PBGs, MDCT helps to define the anatomy of the PBGs and their relationships with other mediastinal structures, and this is useful in planning the AVR procedure to achieve a favorable outcome. If surgeons carefully plan the CABG procedure, keeping in mind the possibility of a future aortotomy for AVR, the AVR procedure can be performed more easily.

**DISCLOSURE STATEMENT**

The authors declare no conflicts of interest associated with this study.

**REFERENCES**