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Mitral Valve Replacement via Anterolateral Right Thoracotomy without Cross-Clamping in a Patient with Fungal Infective Endocarditis and Functioning Internal Mammary Artery after Previous Coronary Artery Bypass Grafting and Mitral Valve Repair

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ABSTRACT

A 55-year-old man developed severe mitral regurgitation with persistent fungal infective endocarditis 8 months after coronary artery bypass grafting with a left internal mammary artery and 2 saphenous veins, as well as mitral valve repair with a prosthetic ring. Echocardiography demonstrated severe mitral regurgitation and a valvular vegetation. Computed tomography coronary arteriography indicated that all grafts were patent and located intimately close to the sternum. Median resternotomy was not attempted due to the risk of injury to the bypass grafts, and therefore, a right anterolateral thoracotomy approach was utilized. Mitral valve replacement was performed with the patient under deep hypothermia and ventricular fibrillation without aortic cross-clamping. The patient`s postoperative course was uneventful. Thus, right anterolateral thoracotomy may be a superior approach to mitral valve surgery in patients who have undergone prior coronary artery bypass grafting.

INTRODUCTION

Mitral valve procedures after previous coronary artery bypass grafting (CABG) with functioning internal mammary artery (IMA) grafts are associated with a high mortality risk. In particular, injury to IMA grafts may be fatal. Several reports have recommended using an anterolateral right thoracotomy approach, combined with ventricular fibrillation and without cross-clamping, to preserve the IMA and to provide adequate myocardial protection without cardioplegia. Here, we present our experience with a mitral valve replacement (MVR) using this technique in a patient who developed infective endocarditis (IE) with systemic fungal infection after CABG and mitral valve repair.

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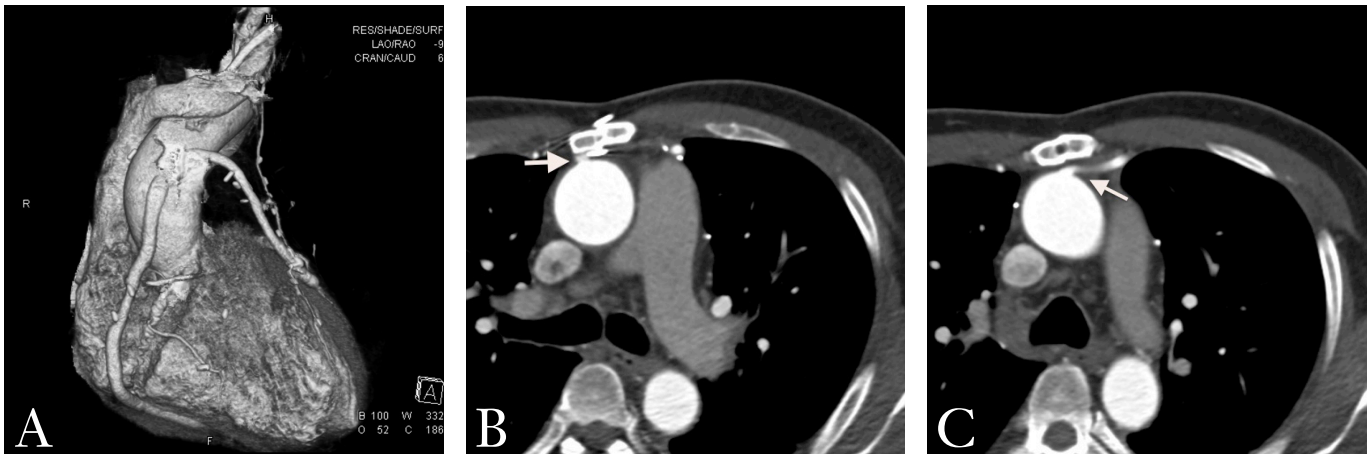
CASE REPORT

A 55-year-old man underwent CABG and mitral valve repair. After 2 months, he developed a high fever and was administered antifungal therapy as Candida guilliermondii was detected in blood cultures. Transthoracic echocardiography (TTE) indicated the presence of vegetation on the posterior mitral valve ring, with moderate mitral valve regurgitation (MR). After 6 weeks of antifungal therapy, he was afebrile, repeat TTE indicated the absence of vegetation, and he was discharged in good condition. After 6 months, he was again referred to our department with recurrent fever. On admission, he presented with spiking fever; however, no pathogens were isolated on blood culture. TTE demonstrated dehiscence of the mitral annulus ring at the posterior annulus with severe paravalvular leak, and presence of a small mobile vegetation (1.0 × 0.6 cm). After an additional 8 weeks of antifungal therapy (fluconazole and caspofungin), the size of the vegetation did not diminish and he continued to exhibit severe MR, as indicated by TEE, and was in congestive heart failure. We decided to perform a redo mitral valve operation. The anterolateral right thoracotomy approach was used because preoperative computed tomography (CT) coronary angiogram showed that all three grafts were patent, including the IMA graft to the left anterior descending artery, and that these grafts were in very close proximity to the sternum (Figure)— particularly the saphenous vein graft (SVG) graft to right coronary artery being intimately close to the undersurface of the sternum in the midline and at high-risk of injury should resternotomy be attempted.

SURGICAL TECHNIQUE

After appropriate anesthesia was administered, a double-lumen endotracheal tube was used to decompress the right lung. The patient was placed in a supine position, with the right side of the chest slightly elevated. External defibrillation pads were attached to the patient before draping. The right femoral artery and vein were surgically exposed and, after systemic heparinization, were cannulated with a 21-Fr arterial cannula and a 21-Fr venous cannula (Medtronic,



Preoperative computed tomography (CT) coronary angiogram showing that all three grafts were patent including the IMA graft to the left anterior descending artery and that these grafts were in very close proximity to the sternum.

Minneapolis, MN, USA) under TEE guidance. A right anterolateral thoracotomy was performed in the fourth intercostal space. Carbon dioxide (CO2) was continuously insufflated at a rate of 2-3 L/min into the chest throughout the procedure to displace intracardiac air. The interatrial groove and right superior pulmonary vein were dissected for venting of the left ventricle prior to systemic cooling on cardiopulmonary bypass (CPB).

During CPB, the patient was cooled to 21°C and placed in the Trendelenburg position. No attempts were made to limit IMA flow. Once the heart was in a state of fibrillation, the left atrium (LA) was opened and vented, and complete systemic cooling was achieved. While cooling and after opening the LA, the mitral valve was inspected. Partial dehiscence of the mitral valve ring was noted at the posterior annulus. A mobile vegetation was attached to the ring at the posterior annulus. The ring was gently explanted, and the vegetation and the infected tissue were completely resected. This resection resulted in a sizable defect of the posterior leaflet including the coaptation zone, and therefore, we decided to abandon primary mitral valve repair. MVR was instead performed using a bi-leaflet mechanical valve. During rewarming, the left atriotomy was closed. The heart regained its rhythm spontaneously, and de-airing procedures via the small vent in the left ventricle and a needle into the aortic root were continued until the CPB was terminated. TEE was used to detect air bubbles before the patient was weaned from CPB. The durations of fibrillation and CPB were 75 minutes, and 200 minutes, respectively.

The patient was extubated on the first postoperative day. His length of stay in the intensive care unit was 3 days. Following 6 weeks of antifungal therapy, the patient recuperated and was discharged well. TTE performed prior to discharge revealed normal function of the prosthetic mitral valve. For the last one year since the operation no further recurrence of IE has been observed with antifungal treatment and the patient has been in NYHA Class I.

DISCUSSION

Although the techniques currently used in heart surgery are very advanced, reoperation is still associated with an increased risk of mortality. As stated previously, in a patient with a functional IMA graft after previous CABG, injury to the IMA graft during a reoperation may be fatal [Yoda 2005; Gillonov 1999; Byrne 2001]. Many publications [Yoda 2005; Byrne 2001; Holman 2000; Byrne 1999; Braxton 1996; Stemle 1996; Tribble 1987] have advocated the use of an anterolateral right thoracotomy approach for mitral valve surgery to avoid graft injury during sternal reentry. These studies have demonstrated good results in terms of perioperative morbidity and mortality. In 4 studies [Byrne 2001; Holman 2000; Braxton 1996; Tribble 1987], the outcomes of the control group of patients who were operated using a standard technique were compared with those of patients who underwent the anterolateral right thoracotomy approach for mitral valve surgery. The data demonstrated that the use of an anterolateral right thoracotomy approach, in combination with induced fibrillation, decreased coronary artery graft injury [Byrne 2001], transfusion requirements [Byrne 2001; Braxton 1996; Tribble 1987], postoperative inotropic requirements [Braxton 1996], incidence of early reoperations [Tribble 1987], and hospital mortality [Holman 2000]. However, reports of this technique being used in a patient with IE and a functioning IMA after a previous CABG are scarce.

In the present case, we chose this approach because the CT scan showed that the grafts were in close proximity to the sternum, and that the risk of injury to the grafts or heart was very high, especially the SVG graft to right coronary artery that appeared intimately adherent to the sternum in the midline. Moreover, it is known that proximal aortic arteriosclerosis is the source of macro- and micro-emboli at the time of placement and release of the aortic cross-clamp. Many studies [Sylivris 1998; Barbut 1996; Dexter 1994] have demonstrated that unilateral middle cerebral artery emboli closely correlate with the vascular manipulations that occur within the first 4

minutes of aortic cross-clamping manipulation. Performing MVR without cross-clamping the aorta may thus reduce the risk of micro- and macro-emboli.

Because the ascending aorta was not clamped, air embolism remained a concern with this procedure. To reduce this risk, the patient was placed in the Trendelenburg position, and the surgical field was continuously flushed with carbon dioxide. It was important to begin CO2 insufflation as soon as the thorax was entered before any cardiac chambers are entered and continued until closure of the cardiac chambers. In addition, the left heart was kept empty and vented, and the left atrium was opened only after the onset of ventricular fibrillation. Moreover, torsion of the anterior mitral annulus was avoided to prevent aortic regurgitation. The vent in the left ventricle was removed only after disappearance of the echocardiographic signals representing air bubbles.

There are, however, several contraindications to this approach. The presence of grade 2+ or more aortic regurgitation is contraindicated because it increases the risk of air embolism, limits the visibility of the surgical field, and causes coronary malperfusion. Chest deformities, especially pectus excavatum, can increase the difficulty of left atrial exposure due to pressure exerted by the depressed sternum on the cardiac chambers. Other contraindications include severe peripheral vascular or aorto-iliac disease, which can give rise to vascular complications associated with remote-access perfusion for cardiopulmonary bypass.

On the other hand, minimally invasive surgery via a small right thoracotomy could be considered as an alternative option. The minimally invasive technique usually requires aortic cross-clamping and the delivery of cardioplegia, and concern remains with regard to assured aortic cross-clamping and cardioplegia delivery with a small access. Umakanthan et al has advocated this technique to avoid the risk of poor myocardial protection due to incomplete aortic cross-clamping and cardioplegia [Umakanthan 2008]. The use of an endoballoon system (Heart-Port) is attractive in a redo situation as aortic occlusion and cardioplegia delivery can be achieved without the need to dissect out the ascending aorta for external clamping.

Some authors have reported the use of on-pump beating heart mitral valve surgery without cross-clamping the aorta [Byrne 2001; Kitamura 2011; Thompson 2003; Katircioglu 2008]. However, this is a challenging procedure especially if mitral valve repair is contemplated, as in the present case. In general, a priority is placed on repairing mitral valves, even in reoperations, reserving replacement for cases when a repair is too complex and proves inadequate. Therefore, on-pump beating heart mitral valve surgery may not be indicated for MR due to IE as it is likely to require complex repair.

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