Case Report

Beating Heart Mitral Valve Replacement Surgery without Aortic Cross-Clamping via Right Thoracotomy in a Patient with Compromised Left Ventricular Functions

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Abstract

Global myocardial ischemia and ischemia-reperfusion injury are potential adverse events related with cardioplegic arrest. Beating heart surgery has avoided such complications and adapted to valve surgery following successful results published on myocardial revascularization. Difficulty in weaning from cardiopulmonary bypass may be lessened by using on-pump beating heart surgery for mitral valve interventions. Here we describe a 64-year-old male patient with severe mitral regurgitation and dilated cardiomyopathy. Beating heart mitral valve replacement surgery was performed without aortic cross-clamping through a right thoracotomy approach. We believe that, particularly in patients with poor left ventricular functions, beating heart mitral valve surgery may be advantageous.

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Introduction

Following the popularization of beating heart techniques for myocardial revascularization, its use for heart valve surgery has proven its safety in the second half of 2000s and successful results have been reported.[1-3] Various protocols have been defined for myocardial protection during arrested heart surgery, but each strategy has its limitations and pitfalls and none has proven ideal.[4, 5] Particularly, in patients with compromised ventricular functions, cardioplegic arrest may make weaning from cardiopulmonary bypass (CPB) very challenging.[3] The on-pump beating heart technique without aortic cross-clamping is an acceptable alternative to mitral valve surgery with low operative morbidity and mortality in cases with compromised ventricular functions.[1]

Here we report a case of severe mitral regurgitation with poor left ventricular functions. Mitral valve replacement surgery was successfully performed via right thoracotomy under CPB without aortic cross-clamping.

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Case Report

A 64-year-old man was admitted to our hospital with the complaints of severe dyspnea, orthopnea, and palpitations. The patient was in the New York Heart Association (NYHA) Class III-IV. He had received an implantable cardioverter-defibrillator two years previously and had been followed up for mitral regurgitation and atrial fibrillation with medical therapy for 4 years. Electrocardiography (ECG) revealed biventricular enlargement and atrial fibrillation. Echocardiography documented third-degree mitral regurgitation and first-to-second-degree tricuspid regurgitation. The left ventricular end-diastolic diameter was 8.0 cm, left ventricular end-systolic diameter was 6.4 cm, left atrial diameter was 54 mm, and the calculated systolic pulmonary artery pressure was 52 mmHg. Left ventricular ejection fraction was 30% with the Simpson method. Coronary angiography was normal. Mitral valve surgery was planned. Written informed consent was obtained from the patient.

Right anterolateral thoracotomy was performed on the fifth intercostal space. Normothermic CPB (36-37 °C) was established following femoral arterial and selective bicaval venous cannulation with a flow rate of 2.2 l/min/m^2. The mean arterial pressure was maintained between 65 and 80 mmHg. The aorta was not cross-clamped, no cardioplegia was used during the procedure, and the heart was allowed to beat. The patient was kept in the Trendelenburg position throughout the procedure while the aortic root was vented in order to prevent any possible air embolism. The adequacy of the myocardial perfusion was confirmed by ECG monitorization.

Standard left atriotomy incision was made. Both leaflets were normal in appearance, and the annulus was severely dilated. The leaflets were left in place, not resected. The mitral valve was replaced with a 33-mm Carpentier-Edwards Perimount pericardial bioprosthesis. De-airing maneuvers were performed prior to the cessation of CPB. The patient was weaned from CPB without any inotropic support. The total CPB time was 110 minutes. The postoperative course was uneventful. The patient was intubated for 12 hours, kept in the intensive care unit for 48 hours, and discharged on the sixth postoperative day. Postoperative echocardiography revealed a normally functioning bioprosthetic mitral valve.

Discussion

Beating heart mitral valve surgery has the particular advantage of minimizing ischemia-reperfusion injury due to aortic cross-clamping and myocardial ischemia.[1, 6] During the global myocardial ischemic period, especially in the previously damaged myocardium with a predisposition, due to increased demand and reduced perfusion, irreversible cellular damage may occur further compromising ventricular functions.[7] Physiologic normothermic blood perfusion of the heart is employed during the procedure, which protects the myocardium.[8] Although the adverse events related to CPB itself cannot be avoided, the avoidance of myocardial damage makes the beating heart technique a logical alternative for patients with poor ventricular functions.

Regarding the blood transfusion requirements, need for inotropic support, and intubation times, controversial results have been documented. Ghosh et al.[9] reported decreased requirements in their series, whereas Karadeniz et al.[10] found no difference on outcomes.

One of the most feared complications of beating heart mitral valve surgery is air embolism. The position of the patient (head down), continuous aortic root venting, strict employment of routine de-airing maneuvers, intraoperative use of transesophageal echocardiography for the detection of bubbles, and most importantly a competent aortic valve decrease the incidence of air embolism.[8, 11] We also did not employ aortic cross-clamping unlike Mojena et al.[7] We believe that aortic cross-clamping causes micro and macro emboli from the aorta as Cicekoglu et al.[8] suggested. Furthermore, it has been documented that beating heart mitral valve surgery has no adverse effects on neurocognitive functions.[8]

Beating heart mitral valve surgery has a major drawback: the presence of aortic insufficiency. In case of aortic insufficiency, the blood may flood to the operation field and render exposure very challenging.[11] As a matter of fact, the concept of the beating heart technique has a limited surgical exposure, so there is a limited potential for complex mitral valve procedures. The presence of aortic competence maintains a bloodless field, but still this approach causes a relatively blood-filled field compared to conventional mitral valve surgery. In addition to this, aortic competence also serves as a secure aortic-clamp and prevents air embolism.[8]

Our patient had dilated cardiomyopathy with a left ventricular end-diastolic diameter of 8.0 cm. The mitral annulus was severely dilated, causing severe mitral regurgitation. There was prominent tethering due to an enlarged ventricular cavity. The use of cardioplegic arrest may further compromise ventricular functions, tipping the balance in favor of beating heart surgery. Our patient's cardiomyopathy prompted us to protect all his chordae; we, therefore, did not perform leaflet resection and sutured the bioprosthesis to the annulus. We opted against ring annuloplasty because tethering would not lead to a satisfactory reduction in the annular size and would give rise to residual insufficiency.

Conclusion

We believe that beating heart mitral valve surgery can

be safely performed with all precautions taken to prevent the most feared complication: the air embolism. Not cross-clamping the aorta may provide further protection since the aorta is not manipulated. It avoids ischemia-reperfusion injury. The procedure should be carefully planned and practiced mentally by the whole team prior to the operation because all the steps are somewhat different to routine cardiovascular surgical practice.

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