How-to-do-it

Aortic valve replacement with continuously perfused beating heart in patients with patent bypass conduits

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Abstract

We present a technique for replacement of the aortic valve in selected patients undergoing redo surgery in the presence of patent coronary artery bypass grafts and occluded native coronary arteries that affords optimal myocardial protection, limited dissection of the heart and minimal risk of injury to existing grafts, in particular, the internal mammary artery.

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1. Introduction

Increasing age of the population and the longevity of bypass grafts currently employed means that a steady stream of patients are presenting for aortic valve replacement that have previously undergone coronary artery bypass surgery. These patients pose significant technical challenges for the surgeon in terms of providing effective myocardial protection without damage to functioning grafts. The internal mammary artery (IMA) is at particular risk in this setting. Inadvertent damage to this vessel is associated with significant morbidity and mortality [2]. Furthermore, such injuries deny surviving patients the long term benefits of an internal thoracic artery graft to the left anterior descending (LAD) artery [1].

The most common approach is complete dissection of the heart, temporary bulldog occlusion of the functioning IMA graft and cardioplegic arrest. The standard technique has the advantage that it is more broadly applicable to cases requiring revision of bypass grafts at the same time as valve replacement. However, the major disadvantages outlined above remain.

One way to avoid injury to the IMA is to perform only limited dissection of the heart, leaving the IMA patent throughout the procedure. This strategy has been employed in conjunction with moderate-to-deep hypothermia (\(\sim 20^\circ C\)) and cardioplegic arrest by antegrade and retrograde routes [3]. However, the technique represents a compromise in terms of myocardial protection because cardioplegia is continuously washed out of the coronary circulation by flow through the patent IMA. Furthermore, most of these hearts are hypertrophied making adequate myocardial protection more challenging. Low cardiac output (14%), myocardial infarction (6.8%) and cardiac related mortality (6%) were reported in this study.

An alternative is to operate on the ‘beating heart’ i.e. to perfuse the grafts throughout the procedure, allowing dissection to be confined to the region of the ascending aorta and right atrium.

2. Technique

The heart is exposed by redo sternotomy. Limited dissection is performed to identify the position of proximal vein graft anastomoses, for cannulation of the aorta and right atrium, venting of the left ventricle...
through the right superior pulmonary vein and application of the cross clamp. Cardiopulmonary bypass is then established, the temperature allowed to drift to 35 °C and the vent inserted. Once the heart is empty, the cross clamp is applied below the vein grafts (Fig. 1). As always, the quality of the aorta should be assessed prior to application of the cross clamp. Excessive calcification in the wall of the aorta in this region may expose the patient to an unreasonable risk of embolism upon removal of the cross clamp and may represent a contraindication to this technique. A transverse aortotomy is made and the native valve is excised and replaced in the normal fashion with the heart continuing to beat in sinus rhythm throughout. There is little or no backflow through the coronary ostia owing to advanced disease in the native vessels proximally. The aorta is closed, de-airing manoeuvres are performed through the aortic root and left ventricular vent with manipulation of the operating table. The cross clamp is released and rewarming commenced. The heart is then weaned from cardiopulmonary bypass, the patient decannulated and chest closed in the normal manner.

3. Patients and results

We have now performed this technique on two patients with patent IMA and patent vein grafts. The first patient was a 73-year-old man presenting with aortic stenosis 8 years following coronary artery bypass surgery. Angiography revealed occlusion of both native coronary arteries, a patent IMA to the LAD artery and patent saphenous vein grafts (SVG) to the first diagonal, obtuse marginal and posterior descending arteries. The second patient was a 70-year-old man presenting with aortic stenosis 5 years following CABG with a functioning LIMA graft to the LAD and SVG grafts to an intermediate, distal circumflex and posterior descending arteries. In this latter patient, the intermediate graft was disconnected from the aorta and anastomosed end-to-side to the proximal end of the circumflex graft on cardiopulmonary bypass so that it would be above the cross clamp; however, the principal remains the same. Both patients left theatre without inotropic support, were discharged from the ICU within 24 h and were discharged from hospital without neurological or other complication on the sixth and eighth postoperative days, respectively.

4. Discussion

Savitt and associates were the first to describe this general approach. They used direct cannulation of the coronary ostia and continuous perfusion of the heart with oxygenated blood at 200–300 ml/min while the aortic valve was replaced [4]. However, patients with functioning three vessel bypass grafts, with or without a functioning IMA graft, present a unique anatomy that allows the heart to be perfused while the aorta is cross clamped provided that the latter is positioned below the level of proximal graft anastomoses. This approach resembles the beating heart approach to redo mitral valve surgery through a right thoracotomy. It provides optimal myocardial protection throughout the duration of the procedure and keeps the operative field clear of the coronary cannulae described by Savitt et al. that are easily dislodged from the coronary ostia during excision of the native valve, decalcification of the root and insertion of the prosthesis.

We have found this technique to be safe and effective in the two patients described herein and recommend consideration of this approach for patients undergoing aortic valve surgery with patent grafts who have previously undergone complete revascularization of the heart. We would emphasise, however, that this technique depends very closely on the quality of the aorta at the site of proposed cross clamping and the disposition of previous vein grafts on the ascending aorta in...
the individual patient. It follows that only a limited number of patients stand to benefit from this technique.

References


