Brief communication - Cardiopulmonary bypass

Continuous coronary perfusion in redo aortic valve replacement following prior coronary surgery; an old trick for new dogs?

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Abstract

The optimal myocardial protection method for aortic valve replacement in the setting of prior coronary artery bypass surgery remains a subject of debate. Protection is particularly challenging when a patent pedicled internal thoracic artery graft supplies a proximally obstructed left anterior descending artery. Herein, we describe a modification of an old technique; continuous coronary perfusion, which can be used in selected, anatomically suitable cases.

Keywords: Myocardial protection; Coronary perfusion; Redo valve surgery

1. Introduction

Myocardial protection for aortic valve replacement (AVR) following prior coronary artery bypass grafting (CABG) is challenging. Concerns include protection in the context of left ventricular hypertrophy and patent bypass grafts, in particular, the patent pedicled left internal thoracic artery (LITA) graft supplying an occluded left anterior descending artery. Whether a LITA graft should be occluded during cardioplegic arrest in such circumstances is debated. Here, we describe the use of an old non-cardioplegic method of myocardial protection; continuous coronary perfusion.

2. Case history

A 67-year-old man who underwent CABG, 12 years previously, for triple-vessel coronary artery disease was referred for AVR. The previous CABG comprised a pedicled LITA graft to the left anterior descending artery and reversed autologous saphenous vein grafts (SVG) to the first obtuse marginal (OM1) and distal right coronary artery (RCA). He presented with NYHA grade III dyspnoea with signs of aortic stenosis, a Doppler measured gradient of 98 mmHg and echocardiographic findings of severe calcific stenosis and moderate aortic regurgitation. Coronary angiography demonstrated severe native triple-vessel disease with an occluded proximal RCA and proximal LAD but a patent circumflex system feeding a number of small distal branches. The previously placed SVG to OM1 was occluded and OM1 appeared non-graftable at angiography. The LITA graft was widely patent but the RCA graft showed severe proximal disease but a smooth non-diseased distal segment. At operation, femoro-femoral bypass was instituted and at re-sternotomy, extensive and dense adhesions were encountered precluding complete safe mobilization of the left ventricle and LITA graft. The right side of the heart could be satisfactorily freed from adhesions allowing venting via the left superior pulmonary vein. The RCA graft was visible throughout its length.

The patient was cooled to 34°C, the heart fibrillated and the distal ascending aorta cross-clamped. An aortotomy was performed and the left coronary ostium cannulated with a soft balloon catheter (Maquet, Hirrlingen, Germany) connected via a Y-connector to a cardioplegia circuit delivering unmodified blood perfusate at 34°C. The cannula was secured by suture to the ascending aortic wall distal to the ostium. The non-diseased section of the distal RCA vein graft was then transected and similarly cannulated. This circuitry allowed continuous coronary perfusion via the left main, the RCA graft (at 300 ml-min⁻¹ total flow; perfusion pressure 55 mmHg) and the LITA graft (via corporeal perfusion). The heart was then defibrillated and a normal electrocardiogram (ECG) signal with isoelectric ST segments confirmed throughout the clamp period. The aortic valve was then replaced using a bioprosthetic valve and the aortotomy closed. The left main cannula was removed on completion of the aortotomy, the proximal aorta deaired and the cross-clamp released restoring left coronary flow. A repeat reverse SVG was then undertaken to the distal RCA and anastomosed proximally to the ascending aorta using a side-biting clamp. The patient’s cardiovascular recovery was wholly uneventful without the need for any inotropic support but hospital discharge was delayed by a period of confusion that recovered fully and a delayed healing of the femoral access site.

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3. Discussion

Thirty years ago, continuous beating heart coronary perfusion was a well-recognised and safe method of myocardial protection for AVR [1]. In AVR surgery, its use was associated with an operative mortality of 3% [1] and it was also used in the first published aortic root replacement [2]. Great care was necessary to ensure that continuous perfusion was maintained and to avoid coronary ostial injury. Following the advent of cardioplegia techniques, its use fell into abeyance but this case report demonstrates that the technique should not be consigned to history. In repeat AVR surgery, following prior CABG, it may avoid the necessity to occlude or clamp patent grafts and allows continuous perfusion of the pedicled LITA via the corporeal circuit. Continuous electrocardiogram monitoring is required to ensure that ST segments remain isoelectric and that venous perfusion of the pedicled LITA via the corporeal circuit.

Alternative approaches were also possible including a combination of antegrade and retrograde cardioplegia [3] but protection of the LAD territory with or without LITA occlusion would have remained a concern. Antegrade cardioplegia delivery would also have required instrumentation of the left main and the diseased RCA graft because the aortic regurgitation would compromise root cardioplegia delivery. Retrograde cardioplegia alone may be suboptimal in the hypertrophied ventricle. The new generation of cardiac surgeons may be completely unfamiliar with the technique of continuous coronary perfusion. This case demonstrates that it may still be useful in anatomically suitable cases requiring AVR following previous surgery.

References


eComment: Systemic hyperkalemia in redo aortic valve replacement following previous coronary surgery; another trick?

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We have read with interest the report by Ganesh and Bonser regarding the use of continuous coronary perfusion as myocardial protection strategy during beating heart redo aortic valve replacement (AVR) following previous coronary artery bypass surgery (CABG) [1].

Continuous beating heart coronary perfusion was a well-established method of myocardial protection during primary AVR in the 1970s. Although some results were impressive with reported overall mortality of 3%, unpredictable one-fourth of patients developed perioperative ventricular fibrillation (VF), which increased mortality nearly five-fold compared to the group without VF [2]. The incidence of VF during redo AVR with patent grafts using beating heart coronary perfusion is unknown. This method of myocardial protection in this group of patients has the advantage of a ‘no-touch’ technique to the left internal thoracic artery (LITA) graft as it is well known that once the LITA is injured, mortality approaches 40% [3]. This technique also avoids the risk of washout of cardioplegia by patent LITA and the sequelae of deep hypothermia and circulatory arrest. Disadvantages of this method include cardiac movements, especially if concomitant CABG is required.

To avoid possible problems and keep the advantages of beating heart coronary perfusion, we have recently used a different strategy for myocardial protection in redo AVR with patent grafts – systemic hyperkalemia. This approach was described by Ramanathan et al. [4] and our modification has been used recently in three patients. The age of the patients was 74, 71 and 74 years and redo AVR was performed 19, 15 and 6 years after previous CABG. Left ventricle function was good in two and poor in one. The indication for surgery was severe aortic stenosis. After resternotomy and cannulation of the aorta and right atrium by a bi-stage cannula, cardiopulmonary bypass was established and moderate hypothermia (28 °C) used. The aorta was clamped and 1 l of cold blood antegrade cardioplegia delivered through the ascending aorta. Boluses of 40 mmol of KCl were administered systematically to maintain systemic hyperkalemia above 7 mmol/l and cold saline applied topically to the heart. Continuous perfusion of systemic hyperkalemic blood through the patent LITA and intermittent antegrade cardioplegia through the coronary ostia every 20–25 min assured complete cardiac arrest and AVR was performed. During rewarming, zero-balance ultrafiltration on cardiopulmonary bypass was performed to normalize serum potassium. Cross-clamp times were 50, 72 and 43 min, bypass times 91, 147 and 82 min. Two patients received dopamine at 5 μg/kg/min. Stay in intensive care unit was 2, 1 and 1 day and total hospital stay 9, 12 and 7 days. No patient developed postoperative hyperkalemia requiring treatment.

In conclusion, the addition of systemic hyperkalemia to intermittent cold blood cardioplegia is another safe and useful trick in redo AVR with patent grafts.

References