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Composite Graft Replacement in Acute Aortic Dissection: Technique for Anastomosing the Right Coronary Artery without an Aortic Button

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ABSTRACT

Acute aortic dissection that involves the ostium of the right coronary artery is a rare occurrence, but treatment by composite graft replacement of the aortic root is a technically difficult procedure, usually involving implantation of an aortic button. We describe 2 patients with ostium of the right coronary artery severely damaged by acute aortic dissection. In both cases we used a technique that mobilized the right coronary artery sufficiently so that it could be implanted without including an aortic button.

INTRODUCTION

Comparison has shown that composite valve graft replacement of the aortic root with full-thickness Carrel button coronary ostium reimplantation is superior to the classic wrap inclusion method described by Bentall and De Bono [1968]. Also, during follow-up, pseudoaneurysm formation at the site of anastomosis of the coronary artery ostium is less likely with the Carrel button method than with the classic technique [Kouchoukos 1991]. If an aortic dissection involves the ostium of the right coronary artery, the divided layers of the aorta are approximated with mattress sutures passed through 2 strips of polytetrafluoroethylene (PTFE) felt, 1 placed inside the lumen and 1 placed outside the divided layers of the aorta wall. The button of aortic tissue surrounding the coronary ostium is anastomosed to an interposition graft (saphenous vein, Dacron, or PTFE) or is sutured directly to the composite graft without torsion or tension. If the ostium of the right coronary artery is completely destroyed by an aortic dissection, a bypass graft of saphenous vein is used, and the ostium is oversewn.

This report discusses 2 cases in which the ostium of the right coronary artery was severely damaged by an acute aortic dissection. In both patients, we used a technique that mobilized the right coronary artery sufficiently such that it could be implanted without including an aortic button.

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TECHNIQUE

Two patients who presented with acute type A aortic dissection underwent emergency surgery. In each case, the femoral artery was cannulated. A median longitudinal sternotomy was performed and the pericardium was incised. Cannulae were inserted in the superior and inferior vena cava, a third cannula was placed in the coronary sinus for administration of retrograde cardioplegia, and cardiopulmonary bypass was initiated. After the patient was cooled to 14°C and jugular oxygen saturation was confirmed above 95%, total circulatory arrest was induced. Retrograde cerebral perfusion was maintained via the line in the superior vena cava. The myocardium was protected by retrograde blood cardioplegia.

The ascending aorta was transected. In both cases, the dissection extended from the sinotubular junction of the ascending aorta to the aortic arch, and the ostium of the right coronary artery was involved. Each patient had a single intimal tear located 1 to 2 cm distal to the ostium of the right coronary artery. In one case, the tear extended all the way to the ostium. In both cases, the distal aorta was transected immediately below the innominate artery and reinforced with Teflon felt strips. Then a prosthetic graft (Hemashield woven double velour vascular graft; Medox Medicals, Oakland, NJ, USA) was anastomosed to the distal portion of the aorta. A perfusion cannula was placed in the graft, and antegrade perfusion was initiated. The patient with the tear that extended to the ostium of the right coronary artery had a bicuspid aortic valve. The other patient had annuloaortic ectasia and the ostium was almost completely obstructed (90%).

In each case, the left coronary artery was excised from the aortic wall, including a button of aortic tissue around the ostium, according to the open technique described by Kouchoukos and coworkers [1986]. However, the ostium of the right coronary artery was severed at its junction with the aorta, with no aortic wall tissue included. This vessel was then mobilized approximately 2 cm along its length to eliminate tension. Then the ostium of the right coronary artery was incised medially for a length of 5 to 7 mm, and patency was confirmed by inserting a 2.5-mm diameter probe (Figure 1). The composite graft was sutured in place at the aortic valve annulus using multiple interrupted everted mattress sutures of braided polyester pledgeted with Teflon.

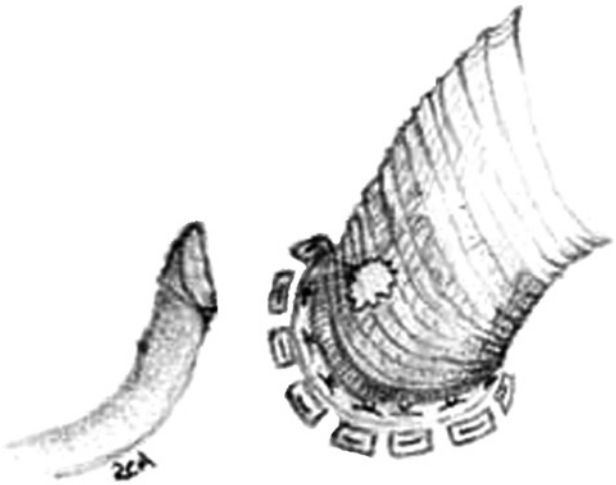

Figure 1. The right coronary artery is severed from the aorta with no margin of aortic wall tissue, and approximately 2 cm of the vessel is mobilized. The medial side of the vessel is then incised 5 to 7 mm.

The appropriate location of the buttonhole for the left coronary artery anastomosis was determined, and a slit was made in the composite graft at this site using a hand-held ophthalmologic cautery probe. The left coronary button was then anastomosed to this part of the graft with continuous 4-0 polypropylene sutures incorporating a thin strip of Teflon felt. The ostium of the right coronary artery was anastomosed to the graft with continuous 5-0 polypropylene sutures but no Teflon felt (Figures 2 and 3).

Both of the patients had uneventful recoveries and were doing well at 16 and 28 months of follow-up, respectively. Periodic echocardiograms have shown that the prostheses were functioning well, and no pseudoaneurysms have formed in either case.

DISCUSSION

The classic Bentall technique carries a high risk of pseudoaneurysm formation (7%-25%) at coronary artery anastomosis sites [Mayer 1978, Kouchoukos 1986, 1991]. In the Carrel button technique, a coronary artery is reattached to the aortic graft directly (end-to-side anastomosis) with negligible tension on the suture line. Research indicates that very few patients require reoperation for coronary anastomosis complications when the open button technique is used [Kouchoukos 1991, Niederhäuser 1998]. However, the true frequency of pseudoaneurysm formation after composite graft replacement using the Carrel button technique is not known, because angiography is not performed on all patients postoperatively.

Advances in imaging techniques have led to the detection of more aneurysms at coronary artery ostium attachment sites after aortic root surgery in patients with Marfan syndrome. Of 40 Marfan patients who were reassessed by Meijboom et al with magnetic resonance angiography at a mean of 5.1 years after elective aortic surgery, 7 had ostial aneurysms in both reimplanted coronary arteries,

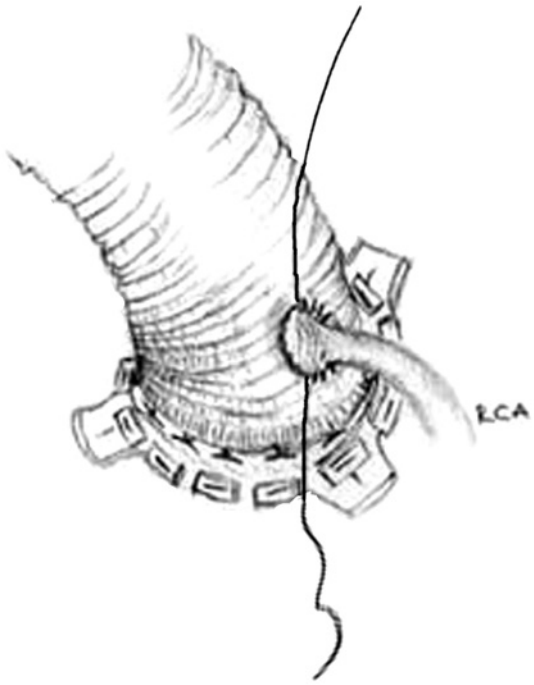

Figure 2. The ostium of the right coronary artery is anastomosed to the composite graft in end-to-side fashion with continuous 5-0 polypropylene sutures.

3 had aneurysms in reimplanted left coronary arteries only, and 7 had aneurysms in reimplanted right coronary arteries only [Meijboom 2002]. The same report noted a 56% incidence of this type of aneurysm in Marfan patients who were ≤35 years of age at the time of surgery

Figure 3. The site of anastomosis of the right coronary artery as it appears when completed.

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[Meijboom 2002]. In Marfan cases, the risk of false aneurysm or late dilatation of the anastomosis site after composite graft replacement can be reduced by keeping the diameter of the reimplanted tissue small.

In cases of aortic dissection, the dissection usually does not extend to the coronary artery ostia. When this type of lesion does involve an ostium, the classic approach is one of two options: implant with a coronary button after reinforcing the button with interior and exterior strips of Teflon felt, or reinforce the coronary button with gelatin-resorcin-formaldehyde glue and place sutures buttressed with an exterior strip of Teflon felt. If the button includes a torn or otherwise damaged aortic wall, there is higher risk that a pseudoaneurysm will form in time.

Various types of biologic glues are used to secure graft anastomoses in aortas that have become fragile due to acute aortic dissection during surgery. However, use of these products to treat acute type A aortic dissection is associated with local tissue damage, local inflammatory response, and increased risk of pseudoaneurysm formation and subsequent redissection of the aortic root [Kazui 2001]. Also, progressive narrowing of the left and right coronary arteries has been reported after use of gelatin-resorcin-formaldehyde glue for treating this type of dissection [Martinelli 2000].

In both our cases, instead of using an interposition saphenous vein graft, we mobilized a slightly longer segment of right coronary artery than usual and implanted this without creating an aortic button. This new technique is preferred for cases in which an aortic dissection extends to the ostium of the right coronary artery, and is particularly useful for patients with primary aortic disease, such as Marfan syndrome or bicuspid aorta.

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