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Apical Suction Device Facilitating Off-Pump Bypass for Recurrent Coarctation: Case Report

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ABSTRACT

Apical suction devices to perform complete surgical revascularization without cardiopulmonary bypass have been recently introduced in cardiac surgical practice. We have increasingly explored the possibility of using these devices to perform other procedures on a beating heart that have previously necessitated the need for cardiopulmonary bypass. We present a case of recurrent coarctation in which an ascending-to–abdominal aorta bypass graft was successfully facilitated by the use of an apical suction device. The surgical technique and advantages and disadvantages of this method are highlighted.

INTRODUCTION

The incidence of recurrent aortic coarctation has been reported as being somewhere between 5% and 50%, depending on the type of previous surgical repair, patient age at repair, and the diagnostic criteria considered [Kappetein 1994, Van Heurn 1994]. Significant re-coarctation is characterized by a postoperative arm-to-leg peak systolic pressure gradient of greater than 20 mm Hg across the previously repaired area. The repair of complex forms of recurrent aortic coarctation involve either anatomic or extra-anatomic bypass procedures, the majority of which require cardiopulmonary bypass (CPB) [Jakob 1988, Badmanaban 2002].

Advances in off-pump coronary artery bypass surgery (OPCAB) have led to the development of specialized devices that allow exposure and stabilization of all the surgical territories of the heart without CPB. Of these, apical suction devices allow displacement and lifting of the heart while minimizing hemodynamic instability by preventing the distortion of the right ventricle and mitral valve annulus. We have previously reported our experience of using these suction devices in an expanded role for procedures for which CPB would normally be required, namely pericardiectomy, division of adhesions during redo operations, penetrating trauma of the posterior and inferior left ventricular wall, and epicardial microwave ablation for chronic atrial fibrillation [Athanasiou 2003]. In this report, we present a novel use of an apical suction device to facilitate extra-anatomic aortoaortic bypass, avoiding CPB in a patient with recurrent coarctation.

CASE REPORT

A 31-year-old female patient presented 12 years after a surgical repair for long-segment postductal hypoplastic coarctation involving resection and placement of a 10-mm Gortex interposition graft. Her symptoms included bilateral lower limb paresthesia and exertional pain with reduced exercise tolerance. Computed tomography and magnetic resonance angiogram both revealed a thrombosed surgical graft in the proximal descending thoracic aorta (Figure 1). Extensive collaterals on the anterior, lateral, and posterior aspects of the thoracic wall and significant calcification of the descending and supraceliac part of the thoracic aorta were noted. Renal function was noted to be normal.

OPERATIVE TECHNIQUE

The operation was performed under general anaesthetic, using a midline sternotomy and a transverse upper abdominal incision to access the ascending and abdominal aorta, respectively. A Medtronic Starfish III (Medtronic, Minneapolis, MN, USA) apical suction device was used to lift the heart upward and position it outside the pericardial cavity, a maneuver that would normally require CPB (Figure 2). The posterior pericardium was opened, allowing access to the descending thoracic aorta, and a 2-cm incision was made anterior to the aortic hiatus. A collagen-impregnated Dacron (Hemashield) graft (14 mm) was passed through this opening from the abdomen into the chest, immediately anterior to the aorta. The proximal end of the conduit was anastomosed on the right side of the ascending aorta with application of a side-bite clamp. The graft was then directed around the right border of the heart and anastomosed onto the infrarenal aorta in a similar fashion. Total anaesthetic time was 3 hours with a total blood loss of 300 mL. The patient had an uneventful recovery and was discharged home on the fifth postoperative day.

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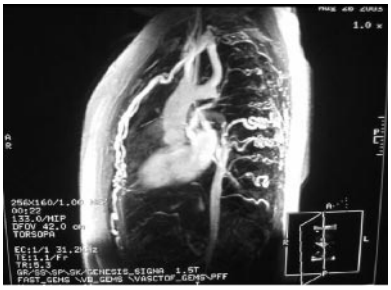

Figure 1. Magnetic resonance angiogram revealing a thrombosed surgical graft in proximal descending thoracic aorta.

COMMENT

Currently there are 3 treatment options for aortic recoarctation, namely balloon aortoplasty, anatomical repair, and extra-anatomic bypass grafting. We have found the last of these to be greatly facilitated by an apical suction device.

Vijayanagar et al described exposure of the descending thoracic aorta through the posterior pericardium via a median sternotomy [Vijayanagar 1980]. A subsequent modification by Sweeney et al permits simultaneous intracardiac repair when necessary [Sweeney 1985]. Since these initial descriptions, other investigators have adopted the posterior pericardial approach to the descending aorta, resulting in various modifications [Caspi 1997, Connoly 2001, Rokkas 2002]. The use of CPB was mandatory in the majority of these cases because of the hemodynamic instability associated with mobilization of the heart and subsequent exposure of the descending thoracic aorta.

Wukasch et al described a variation of the ascending aorta-to–infrarenal abdominal aorta bypass graft performed in 9 patients in whom the distal anastomosis was made to the supraceliac abdominal aorta [Wukasch 1977]. This procedure has not been adopted widely because, in addition to sternotomy, it has required laparotomy with the use of CPB in all reported cases.

In this case, significant calcification of the descending aorta made extraanatomic bypass grafting more attractive. By using an apical suction device, we were able to manipulate the heart without compromising hemodynamic stability and thus avoid CPB. Other merits of the technique described include a very small central tendon incision in the diaphragm, minimizing potential risk of left phrenic nerve damage, and avoidance of aortic cross-clamping, minimizing the risk of left recurrent laryngeal nerve injury, chylothorax, or spinal cord ischemia.

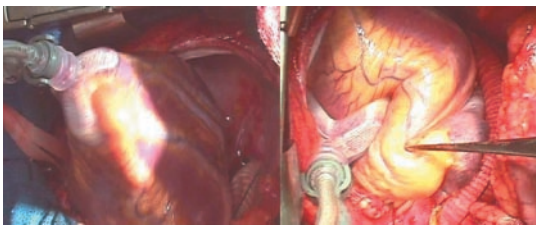

Figure 2. Apical suction device used to lift the heart upwards and position it outside the pericardial cavity.

We have previously shown that suction devices can improve surgical performance and precision in operations in which optimal visualization and reduction of target movement is critical, and that these devices have the added advantage not only of being safe and relatively noninvasive, but also of allowing the surgical assistant to be freed up to help with other aspects of the procedure [Athanasiou 2003]. Although the management of recurrent aortic coarctation must be individualized for every case, extra-anatomic ascending-to–abdominal aorta grafting via the pericardial cavity represents a safe technique, which may be augmented by the use of apical stabilization devices. This will ensure hemodynamic stability while avoiding the need for CPB.

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