Aortic root aneurysm in an adult patient with aortic coarctation: a single-stage approach

Olga G. Ananiadou*, Charilaos Koutsogiannidis, Fotini Ampatzidou and George E. Drossos

INTRODUCTION

Uncorrected aortic coarctation is seldom seen in adulthood, and a considerable number of patients remain asymptomatic until adulthood, when coarctation might be discovered incidentally on investigation for systemic hypertension. The frequency is even lower for concurrent cardiac pathology (aortic aneurysm, valvular disease and ischaemic heart disease). According to Liberthson et al. [1], the incidence of associated cardiac anomalies is greater in patients presenting after the age of 30 years (40%) than in those presenting at a younger age (27%).

Management of this lesion set poses a great surgical challenge since no consensus on the optimal approach exists. Various approaches have been proposed, staged procedures using sternotomy and thoracotomy, catheter-based interventions with second-stage sternotomy, however, the single-stage ascending-to-descending aortic bypass grafting with a posterior pericardial approach through a median sternotomy is a valid alternative technique that allows simultaneous intracardiac repair and provides good results [2]. Although this approach can sometimes be extended, concurrent repair of both lesions avoids the haemodynamic derangement of the second lesion when operating on only one lesion at a time [3].

This report describes an adult case of one-stage combined correction of paraductal coarctation and aortic root aneurysm via a median sternotomy.

CASE-SURGICAL TECHNIQUE

A 37-year old male, who had been treated for severe hypertension, was referred for further evaluation. On admission, the blood pressure in the upper extremities was 190/110 mmHg, with no palpable pulses in the lower extremities. Echocardiography revealed concentric left ventricular hypertrophy with an ejection fraction of 55%, minimal aortic valve regurgitation, an aortic annulus that was 33 mm in diameter with a dilation of the sinus of Valsalva of 69 mm and an aortic coarctation with a minimum diameter of the aortic stenotic region of 5 mm and a 60 mmHg gradient. Thoracic magnetic resonance angiography (MRA) was used to define the anatomy and severity of the lesions (Fig. 1). There were normal coronary arteries. Cerebral MRA showed the absence of the left posterior communicating artery. We decided that he should undergo a single-stage operation involving valve-sparing root replacement and transpericardial ascending-to-descending aorta bypass grafting.

At operation, routine anaesthetic procedures were employed and cerebral saturation was monitored (INVOS 4100; Somanetics, Troy, MI, USA). After a standard median sternotomy, the ascending aorta was completely mobilized to the aortic arch. Single arterial cannulation was performed high in the aortic arch below the innominate artery and the right atrium was cannulated with a two-stage cannula. Cardiopulmonary bypass (CPB) was implemented with systemic cooling to 23°C. Both antegrade
and retrograde cardioplegia and topical ice hypothermia were used to provide myocardial protection. The ascending aorta was cross-clamped and cardioplegia was used to arrest the heart. After excising the aneurysm, a standard valve-sparing aortic root remodelling was performed, consisting of the excision of all the native aortic tissue except for a small rim around the valve leaflets. A 30-mm Dacron graft was fashioned into three scallops at one end and sutured to the residual aortic tissue, followed by coronary reimplantation. With the cross-clamp in place, the heart was then retracted superiorly and the descending aorta exposed just above the diaphragm by incising the posterior pericardium. A side-biting vascular clamp was applied and an 18-mm Dacron graft was sutured in an end-to-side manner to the descending aorta. The graft was allowed to fill in a retrograde manner and placed in a curvilinear fashion around the right atrium and anastomosed to the side of the ascending aortic graft. Figure 2a shows the intraoperative finding after aortic root replacement and ascending-to-descending bypass. At the end of the procedure, after rewarming to 37°C, the patient was easily weaned off CPB with a slight dose of epinephrine and norepinephrine; total CPB and aortic cross-clamp times were 277 and 240 min, respectively.

The postoperative course was uneventful, and the patient was discharged on postoperative day 7 in good condition. One month after the repair, the patient continued to do well, and a follow-up computed tomographic angiogram revealed a satisfactory repair (Fig. 2b). Histopathological examination of the aorta revealed medial degeneration.

**DISCUSSION**

Ascending aorta and aortic valve diseases are more frequently associated with uncorrected aortic coarctation. Coarctation, though localized abnormality, should be regarded as a diffuse arteriopathy; probably related to a developmental abnormality of neural crest tissue that may influence medial degeneration and cause aortic dilatation. It is also postulated that aneurysmal dilatation is the result of long-standing hypertension and gradual weakening of the arterial wall. In such combined lesions, it is generally accepted that a one-stage approach using CPB and ascending-to-descending aortic bypass grafting through the posterior pericardial approach is a safe technique, allowing the concomitant repair of associated cardiac defects through the same access, avoiding the potential complications of an anatomic repair [3]. If the associated cardiac lesion necessitates an operation with the aid of CPB, transpericardial descending aortic exposure by retracting the heart medially with the pump running is a logical alternative.

Vijayanagar et al. were the first to describe performing the ascending-descending aorta bypass (though, routing the graft around the left side of the heart) combined with aortic valve replacement entirely through a sternotomy incision, in 1980. Since then, this technique modified by Powell, who routed the graft around the right margin of the heart [4], has been mostly selected.
for complex aortic pathology in patients who need concomitant cardiac repair [3]. In a series of 18 complex cases treated with this surgical approach, Connolly et al. [2] reported excellent results with no surgical mortality or graft-related complications. Regarding the choice of the valve-sparing root replacement procedure, in our institution, it is primarily decided on the basis of root anatomy. For patients with a dilated aortic annulus or Marfan syndrome, root replacement with reimplantation of the aortic valve has been performed to correct or prevent annular dilation as reported by David and colleagues. If root dilation is predominantly at the sinotubular level, as in our patient, remodeling of the aortic root as reported by Sarsam and Yacoub is chosen [5]. Our strategy for selecting the graft size was according to the size of the aortic annulus.

Despite the aortic gradient, the management of CPB with one arterial line and systemic core cooling proved to be a satisfactory and safe alternative, with adequate flow to the whole body. Of note, in the face of an incomplete circle of Willis, cerebral perfusion was well maintained with an arterial perfusion cannula placed close to the aortic arch, in order to avoid insufficient brain perfusion with the right unilateral perfusion technique. Also, there was no significant decrease of regional cerebral tissue oxygen saturation intraoperatively. The cardiac procedure took precedence over coarctation repair and the distal and proximal extra-anatomic bypass graft anastomoses were performed with the heart arrested and decompressed for a more accurate rooting of the graft from the aorta, around the right margin of the heart. The complex pathology of aortic coarctation with aortic root aneurysm, presenting in adulthood, posed a tactical challenge. Extra-anatomic aortic bypass appeared to be a valuable addition to the surgical repertoire for the management of this complex aortic problem. The one-stage procedure might therefore be a useful treatment alternative in selected patients with this combination of diagnoses.

Conflict of interest: none declared.

REFERENCES