

ONE STAGE TECHNIQUE FOR THE CORRECTION OF COMPLEX AORTIC COARTATION WITH EXTRAANATOMIC BYPASS

P.B. YILMAZ MD,
M. KARACI AR, MD,
K. KARAMAN, MD,*
L. ONAT MD,*

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Background: Several techniques of repair are available for the correction of complex aortic coarctation. Thoracic aortic coarctation accompanied by a second surgically reparable lesion is a rare combination in adult patient. When there is an additional cardiac problem that requires surgical correction it is preferable to correct both lesions simultaneously and through the median sternotomy incision.

Methods: Between February 1996 and March 1997 three adult male patients were admitted to the hospital presented with coarctation and additional cardiac pathologies: ascending aortic dissection and severe aortic valve insufficiency (27 year-old), VSD (16 year-old), and three vessel disease (56 year-old). In these patients concomitant cardiac operations were performed during the cooling period: Bentall procedure, VSD repairment, and Coronary artery bypass grafting (CABG) operation respectively. In all cases, the Dacron grafts were anastomosed extra-anatomically between the arcus aorta and the descending thoracic aorta using total circulatory arrest method at 18 C. The difference of this technique from the previous similar procedures is that the conduit was anastomosed to distal thoracic aorta and was passed through the left lung and the main pulmonary artery anteriorly. The proximal anastomosis was fashioned end-to-side to the internal side of the arcus aorta without using aortic clamp.

Results: All three patients survived and were discharged home in good condition and all patients are NYHA class I at 6 years postoperatively. Postoperative angiography was taken in a patient who has undergone the Bentall procedure and there was no graft kinking or any other problem. Postoperative echocardiography had shown there were no graft kinking in other patients.

Conclusion: We conclude that one-stage repair of coarctation with associated lesions can be performed very safely using this technique and there was no graft kinking risk.

From:

Kadir Has University, Florence
Nightingale Hospital,
Dept. of Cardiovascular Surgery
*Kadir Has University, Florence
Nightingale Hospital,
Dept. Of Radiology

**Address for
reprint:**

A. Bülent Polat MD.,
Consultant Cardiovascular Surgeon,
Dept. of Cardiovascular Surgery,
Florence Nightingale Hospital,
Abidei Hürriyet Cad. 290
Şişli /Istanbul, TÜRKİYE.

Coarctation of the aorta is a common congenital anomaly, which was first surgically corrected more than 5 decades ago. A variety of approaches and surgical techniques have been described for the management of the aortic coarctation. Thoracic aortic coarctation and a concomitant the surgically reparable cardiac lesion is a rare but serious problem in the adult patient. Surgical options comprise either a two-stage approach or a one-stage repair of the coarctation and the second pathology.

The optimal operative approach to these combinations of lesions remains still unsettled. No single technique is applicable to all patients, and the surgeons must adapt their strategy to deal with the specific problems of each patient. We describe a new technique of connecting the arcus to the descending aorta using an intrathoracic conduit and as well as correction of the other cardiac anomalies simultaneously through the median sternotomy.

MATERIALS AND METHODS

SURGICAL TECHNIQUE

The chest is entered through the standard midline sternotomy approach. Cardiopulmonary bypass (CPB) was instituted using bicaval and routine ascending aortic cannulation. Systemic deep hypothermia (18 C) is used in addition to tepid blood cardioplegic arrest using either the antegrade and retrograde route. In our patients, concomitant cardiac operations (case 1: Bentall procedure, case 2: Coronary artery bypass grafting (CABG), and case 3: VSD closure) were performed during the cooling period. Following these procedures the heart was lifted, and the posterior pericardium was incised below the level of the inferior pulmonary veins to expose the descending thoracic aorta. When circulatory arrest was established, the Dacron grafts (Haemoshield) were anastomosed to the distal thoracic aorta end-to-side fashion without using any clamp. The graft was clamped and CPB started for checking whether there was any leakage from anastomosis or not. If so, supplemental stitches were put on the anastomosis. The proximal anastomosis was fashioned end-to-side to the internal side of the arcus aorta without using any clamp in another short period of total circulatory arrest. In the patient who required CABG, the LAD-LIMA distal and proximal anastomosis were performed during rewarming period. CPB was discontinued with no residual gradient between ascending aorta and the distal region of conduit. Hemodynamic stability of the patients were obtained by adrenaline and noradrenaline infu-

sion during operation and the first two days of postoperative period.

CASE 1

A 27-year-old- male patient presented with congestive heart failure. At presentation to our clinic, angiography and echocardiography demonstrated severe aortic coarctation and additional ascending aortic aneurysm (7 cm Diameter) associated with aortic valve regurgitation (at least, degree 3). Severe cardiomegaly and poor left ventricular function was also noted (ejection fraction: 27%).The Bentall procedure (30 mm Haemoshield graft and 23 mm St Jude Aortic valve) was performed and the second Dacron graft (22 mm Haemoshield) was interpositioned extra-anatomically between the arcus aorta and the descending aorta (Figure 1). Postoperatively, he made a good recovery and was discharged on the tenth postoperative day. Following-up echocardiography and angiography on 45th postoperative day confirmed of patient's extra-anatomic graft with no evidence of kinking or compression, and a well functioning prosthetic valve.



Fig 1: Second case's MR angiographic examination following six years period was showed no graft kinking and any other problem.

CASE 2

A 56-year-old male patient presented with unstable angina pectoris and poorly controlled hypertension. Angiography showed the coarctation of the aorta and triple vessel disease with left ventricle hypertrophy. Coronary artery bypass grafting (saphenous vein grafts to the right descending posterior and obtuse marginal branches and left internal mammary to the left anterior descending artery) (CABGx3 : Ao-RDP, Ao-OM, LIMA-LAD) was performed and the Dacron (22 mm Haemoshield) graft was interpositioned between the arcus and descending aorta with the same technique. The patient was discharged on the postoperative ninth day without any complication. Six months later, the patient was in stable condition with adequate function of both ventricles and a substantial decrease in left ventricular hypertrophy as assessed by echocardiography. It has also revealed a good functioning graft.

CASE 3

A 16-year-old boy presented with coarctation of aorta and VSD. Echocardiography showed a membranous VSD and a serious coarctation. In operation, the VSD was closed using a Dacron patch and the Dacron (16 mm Haemoshield) graft was interpositioned extra-anatomically between the arcus aorta and the descending aorta as in the previous cases. Echocardiography revealed that there was no residual VSD and graft kinking or gradient between arcus and descending aorta. In postoperative angiography, there was no graft kinking or any problem. The patient went on to make straightforward recovery, being discharged on the eleventh postoperative day.

RESULTS

There were no early or late deaths. None of the patients required reoperation for bleeding. Mean total circulatory arrest time was about 20

minutes and there was no spinal cord ischemia, no left phrenic or left recurrent laryngeal nerve damage, and no chylothorax. All three patients survived and were discharged home in good condition and all patients are NYHA class I at 6 years postoperatively. Postoperative control echocardiography were taken in all patients and control angiography was taken in case 1 had shown that there was no graft kinking or any other problem. Left ventricular hypertrophy regressed in all patients. None of the patients had clinical or echographic signs suggestive of a restrictive graft.

DISCUSSION

Coarctation of the descending thoracic aorta generally presents in childhood. The aortic coarctation in adult patients is extremely rare; only a few cases where it is the sole congenital malformation or where it is combined with other defects in the same patient have been reported.

Definitive surgical procedure for the correction of aortic coarctation presenting initially in teenagers and adults, remains an issue. A variety of approaches and surgical techniques have been described for the management of aortic coarctation. The well defined techniques are patch aortoplasty, resection with end- to-end anastomosis, graft interpositioning and local extraanatomic bypass. In adults the histological examination of the aorta reveals extensive medial degeneration with loss of elastic tissue in the vicinity of the coarctation.² Repair of coarctation with a synthetic patch is not advised in adults patients because of increased incidence of aneurysm formation at the suture line. Adult patients with complex forms of aortic coarctation remain a technical challenge and represent a high-risk group for postoperative mortality and morbidity.³ In this population, end-to-end anastomosis and even interposition grafting or patch graft aortoplasty have been thought to have a prohibitive risk of intraoperative, postoperative, or long-term complications. Paraplegia remains the most feared complication of operation for aortic coarctation. Brewer

et al. reported that 0.41% developed postoperative neurological deficits.⁴ In adulthood, the dependency of the spinal cord blood supply on fewer radicular arteries increases the risk of paraplegia developing during the postoperative period.² An alternative method of repair in adults is the intrathoracic lateroisthmic bypass grafting technique which consists of inserting an interposition end-to-side graft from the left subclavian artery to the descending aorta. This technique has the potential advantage of a lower risk of paraplegia or renal failure. Grinda et al. defended that the lateroisthmic bypass graft is the first choice of procedure, and the ascending aorta-descending aorta bypass graft should be reserved for failure of previous lateroisthmic bypass grafting. Their two of 14 patients previously have lateroisthmic bypass were reoperated and ascending-descending aortic bypass grafting were performed.⁵

Another well reported technique is ascending-descending aortic extra-anatomic bypass. More extensive extra-anatomic conduits have occasionally been described. Jacob et al. have reported a series of 10 ascending-descending aortic bypass grafts performed using a combined left thoracotomy (to perform the distal anastomosis) and median sternotomy where the proximal anastomosis is fashioned with side-biting clamp on the left-facing side of the ascending aorta.⁶

A second technique is the ascending aorta to distal abdominal aortic bypass graft described by Siderys et al. and subsequently reported in another 4 cases using a single midline incision from suprasternal notch to below the umbilicus. The graft is passed through a slit made in the center of the diaphragm and brought around the right side of the aorta.⁷ Some authors have suggested a one-stage procedure in recurrent coarctation associated with intracardiac pathologies. ⁸⁻⁹ Barron et al. have defined two new extra-anatomic bypass techniques.⁹ In the first case, the graft was anastomosed end-to-side to the descending aorta behind the left atrium and brought over the top of the left atrium between the ascending aorta and the superior vena cava. The proximal anastomosis was fash-

ioned end-to-side to the right-facing side of the ascending aorta using a side-biting clamp. And in case 2, they had done the distal anastomoses as same as our technique but the graft was then passed cranially through the oblique sinus and over the roof of the left atrium to lie beside the ascending aorta. As authors mentioned, the disadvantage of the technique is that it does not provide good access to the descending aorta if there should be bleeding from the distal anastomosis. They had suggested the use of gelatin-resorcin-formol glue that may contribute to decreasing the risk of bleeding, which is an acceptable idea ⁹ in the light of our experience. Thoracic aortic coarctation accompanied by a second surgically reparable lesion is a rare combination in the adult patient. When there is an additional intracardiac defect that requires surgical correction it is preferable to correct both lesions simultaneously and through the same incision because of the higher morbidity and mortality that would occur with staged procedures.¹⁰ Brewer et al. reported performing ascending-descending aortic bypass grafts by constructing the distal anastomosis through a left thoracotomy and the proximal anastomosis through a median sternotomy.⁴

Pethig et al. pointed out severe hemodynamic instability after relief of the aortic coarctation with an ascending-descending aorta bypass.¹¹ They thought that the hypertrophied left ventricle had adapted to high perfusion pressures, relief of isthmic stenosis resulted in a major drop in the ascending aorta postoperatively and this blood pressure appears to be inadequate to maintain sufficient myocardial pressure in hypertrophied left ventricles. The large conduit and peripheral vasodilatation may cause a rapid runoff and resultant coronary steal immediately after discontinuing CPB circulation. For that reason, weaning from bypass should be under high noradrenaline infusion in that kind of patients.

Mulay et al. reported three patients, the intracardiac pathologic lesions were corrected first, and the coarctation was repaired as a second-stage procedure 2 to 3 months later. They defined that the one-stage approach would have

caused a sudden decrease in systemic vascular resistance during coming off bypass and that could be the reason of hemodynamic instability as Pethig mentioned in their article.¹²

In our experience, the most crucial point was the afterload management during weaning from bypass. We believed the careful adrenaline + noradrenaline infusion is enough to provide sufficient peripheral vascular resistance. The use of CPB also adds safety for patients with unstable hemodynamics. Operating on the cardiac defect without addressing the significant coarctation may have led to significant underperfusion of organs distal to the and to leaving the left ventricle with a severe late pressure load because of hypertension and, as well as congestive heart failure.¹³⁻¹⁴

For the treatment of coarctation associated with cardiac anomalies, we have utilized the use of adult sized extra-anatomical conduit interposed between the arcus aorta and the descending aorta without side-biting clamp under total circulatory arrest. Hypothermic CPB and total circulatory arrest techniques lend a margin of a safety for spinal cord ischemia, especially if collateral circulation is not fully developed.¹⁵ We believe the use of CPB is the best method and total circulatory arrest provides very dry field for surgeon to perform aortic anastomosis and also reduces the risk of paraplegia.

If the patient needs aortic valve surgery and coarctation repair together we suggested definitely a one-stage procedure because if we choose a staged procedure, in the second operation, (repairing coarctation) the patient would be under heparine treatment because of previous aortic valve surgery and this may cause excessive bleeding during and after operation. Our technique's superiority against the previous methods are single incision or region, short graft length and not using/no necessity side-biting clamp. The use of total circulatory arrest has some risks but it has provided easy exposure of the distal thoracic aorta and avoided the necessity of side-biting clamp. Even though some authors have suggested different pathways for extra-anatomic bypass conduit our

technique might reduce the risk of kinking and long graft requirement. We conclude that one-stage repair of coarctation with associated lesions can be performed very safely using this technique and without the risk of graft kinking.

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