

## Efficient and Safe Technique for Repair of Adult Re-Coarctation or Coarctation with Concomitant Cardiovascular Pathologies

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### Abstract

**Introduction:** Undiagnosed aortic coarctation discovered in the adults represents surgical challenge due to more extensive pathological changes and collateralized circulation. Although a considerable number of cases can be relieved through catheter intervention, still some cases are not suitable for this approach. Five to 30% of patients with previous coarctation repair have re-coarctation and require re-intervention and some cases are associated with concomitant cardiac pathology. Ascending to descending aortic bypass graft via the posterior pericardium allows simultaneous intracardiac repair or an alternative approach for these groups of patients.

**Patients and methods:** We reviewed the data of 7 patients that underwent extra-anatomic ascending to descending aortic bypass grafting through median sternotomy between February 2011 to December 2014. Concomitant procedures performed in 5 patients included the following; ventricular septal defect closure (VSD), coronary artery bypass grafting (CABG), mitral valve replacement (MVR), aortic valve replacement (AVR), and resection of a subaortic membrane. They were 5 males and 2 females with mean age 37 years ranging from 18 to 45 years old.

**Results:** All patients survived the operation and were alive with patent CoA bypass graft at a mean follow up of  $21.6 \pm 10.0$  months. No graft-related complications occurred. Systolic blood pressure decreased after surgery by an average of 46 mmHg.

**Conclusion:** Ascending to descending aortic bypass through a median sternotomy and posterior pericardiectomy is safe technique when patients present in adulthood with re-coarctation and concomitant cardiac lesions.

**Keywords:** Aortic coarctation; Recoarctation; Extra-anatomical bypass; posterior pericardiectomy

### Introduction

Aortic coarctation is known as a local tightening of the aortic wall due to a local abnormality of the aortic media layer causing a reduction or complete obstruction of its lumen. Of all congenital heart defects, aortic coarctation occurs in about 8-10% of the cases and may be isolated or accompanied by other congenital defects. Through a left lateral thoracotomy, the surgical treatment of the coarctation has been achieved by many techniques which were reproducible, safe, and effective [1-3].

Ten to fifty percent of the corrected patients will experience a re-coarctation depending on their ages during the primary correction and most importantly the implemented surgical technique; the highest is with patch aortoplasty [4].

Combining a correctable intracardiac disease with primary or recurrent coarctation especially in the adult's pretense a surgical dilemma. Lesions amenable to stenting will pave the surgical approach for one stage repair while those un-stable lesions will remain problematic. Extra-anatomical bypass of the coarctation has been described with good [5,6].

In 1980 the exposure of the descending thoracic aorta through posterior pericardiectomy has been described by Vijayanagar et al. permitting a new approach for simultaneous intracardiac repair [7,8].

### Patients and Methods

The clinical, laboratory and imaging data of these patients have been obtained via reviewing the hospital records. All patients an extra-anatomic ascending to descending aorta bypass grafting for correction of aortic coarctation or re-coarctation through median sternotomy incision between February 2011 and December 2014.

All patients had a preoperative transthoracic echocardiography and multislice CT aortography with 3D reconstruction to evaluate the aorta from the root till common femoral arteries and to delineate the anatomical features of the coarctation, additional imaging (coronary angiography) done in 3 patients.

### Operative techniques

We utilized the median sternotomy incision as the surgical approach for all cases. After heparinization, aortic, right atrial single stage or bi-caval cannulation and LV vent through the right superior pulmonary vein.

After the establishment of cardiopulmonary bypass, the decompressed beating heart is retracted by the assistant toward the patient head (cephalad). After careful inspection of the anatomical features, the posterior pericardium is opened through a longitudinal incision over the descending thoracic aorta which was dissected and taped. We partially occluded the descending aorta lumen by C-shaped partial occlusion vascular clamp to facilitate the Dacron graft anastomosis. The Dacron grafts anastomosis were done using 4/0 polypropylene suture in running through and through fashion and oriented to be an end side. After completion of the anastomosis, the side biting clamp is removed and the anastomosis is inspected for bleeding. Passing anterior to the esophagus; the Dacron graft is routed posterior to the inferior vena cava and anterior to the right inferior pulmonary vein.

## Results

There were seven patients with mean age  $30 \pm 10.7$  years. Two patients were females and five were males, the other patient's data shown in Table 1.

They were operated for re-coarctation or coarctation of the aorta associated with additional pathologies (VSD, Mitral regurgitation, aortic valve stenosis, subaortic membrane and coronary artery disease) (Table 2).

The mean CPB time was  $120.4 \pm 41$  min; the mean cross-clamp time in 5 cases associated with other procedures (mitral valve replacement,

aortic valve replacement, and closure of VSD, resection of a subaortic membrane and distal anastomosis for CABG) was  $31 \pm 8.1$  min.

Characteristics	Number
Mean age	37 (18-45) y
<b>Sex</b>	
Male	5
Female	2
Hypertension	5
Coronary artery disease	1
<b>Preoperative NYHA Class</b>	
I	2
II	3
III	2
IV	0

**Table 1:** Preoperative patient's data.

Pt.	Age (years)	Diagnosis	Additional procedure
1	18	Coarctation, Ventirecular septal defect	VSD Closure
2	36	Re-coarctation	-
3	45	Coarctation + Ischemic heart disease	CABG
4	23	Coarctation + Mitral regurgitation	MVR
5	40	Coarctation + aortic stenosis	AVR
6	28	Re-coarctation + subaortic membrane	Resection of subaortic membrane
7	20	Coarctation + hypoplasia of transverse arch	-

**Table 2:** Preoperative diagnosis and concomitant procedures.

The mean hospital stay was  $9.8 \pm 2.7$  days ranging from 8 to 15 days, and the mean ICU stay was  $44 \pm 14.9$  hours ranging from 28 to 72 hours.

No early or late mortality, none of the patients required re-exploration for bleeding, there were no postoperative paraplegia or any neurological abnormalities and chylothorax was not seen as well.

All patients survived the procedure and sent home in a good state. They had postoperative echocardiography and some of them also had CT scans demonstrated patency of all grafts.

All patients were discharged on warfarin for 6 months (INR 2-2.5) followed by clopidogrel 75 mg and aspirin 75 mg thereafter.

Systolic blood pressure decreased after surgery (154 mmHg for average pre-operative blood pressure versus 118 mmHg for average postoperative blood pressure).

## Discussion

Facing the situation of the presence of aortic coarctation or re-coarctation with concomitant surgically correctable cardiac pathology is problematic. Two surgical approaches have been described in the literature the 1st being simultaneous repair of the two lesions through a median sternotomy and the 2nd is utilizing two stages approach through attacking the coarctation primarily through thoracotomy incision then after a while correct the intracardiac pathology during a 2nd session via median sternotomy [7,9].

Adopting staged repair carries a high incidence of morbidity and mortality irrespective the result of the repair. Attacking the coarctation alone may lead to increased perioperative complications of the untreated intracardiac lesions; meanwhile leaving untreated coarctation exposes the patient to the high incidence of acute renal impairment and paraplegia as a result of defective distal organs perfusion [10,11].

Long-standing untreated coarctation as in adult patients has a more complicated pathology like long segment narrowing, wall calcification, and development of extensive collaterals that may complicate surgical repair. So in this group of cases adopting primary repair insue a great surgical challenge with the great incidence of complications such as recurrent laryngeal and phrenic nerves injury, chylothorax, spinal cord ischemia with resultant paraplegia [12].

Recently transcatheter intervention for repair of primary or recurrent coarctation progressed dramatically however it is not successful in all cases and the best option for repair of adult coarctation is still obscure.

After the 1st description of the technique of posterior pericardiotomy to expose the descending aorta and bypassing a coarctation through a tube graft anastomosed between ascending and descending aorta via median sternotomy [7,8] this technique had several modifications concerning graft routing [11].

A crucial step in the management of this subset of patients is the hemodynamic management post-operatively [10]. Suddenly relieve the chronically elevated blood pressure may affect the demanding hypertrophied cardiac muscle hence liberal and meticulous use of the vasopressors to manipulate the vascular resistance is mandatory to avoid ischemic complications. For that reason, weaning from bypass should be under adrenaline and noradrenaline infusion in that kind of patients. In our study, the most crucial point was the afterload management during weaning from bypass. We used vasopressors cautiously to maintain sufficient peripheral vascular resistance.

In our study, we have one patient with coronary artery disease with concomitant coarctation, in this patient we used saphenous vein to revascularize the left anterior descending and marginal arteries. We did not use the internal thoracic artery because of its greater susceptibility to atherosclerotic narrowing.

Follow up with our patients for a mean 21.6 +/- 10.0 months (range 10-36 months) showed that no late graft complications (thrombosis, pseudoaneurysm or luminal reduction). At follow up echocardiography and CT scan demonstrated patency of all grafts.

## Conclusion

Extra-anatomic coarctation bypass appears to be a safe, flexible and efficient method to deal with complex coarctation or re-coarctation

with or without concomitant cardiac disorders especially in adult patients.

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