

Impact of Various Types of Corrective Procedures for Coarctation of Aorta in Adults on Long Term Re-Coarctation and Systolic Hypertension

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Abstract: *Coarctation of the aorta is the sixth most common lesion in congenital heart disease and represents a spectrum of aortic narrowing that varies from a discrete entity to tubular hypoplasia. This congenital entity while diagnosed in adult is associated with multiple morbidities and certain degree of mortality. Removing the obstruction relieves the patients of the symptoms and improve quality of life. This study outlines the different options and surgical strategies for this disease in the adult and their long term outcomes, hence providing insights to approach this challenging condition.*

Keywords: coarctation, re-coarctation, hypertension

1. Introduction

Coarctation of aorta is occasionally diagnosed in adults, more frequently so in India due to ignorance and less access to medical care. Uncorrected coarctation can result in congestive heart failure, myocardial infarction, aortic rupture, stroke or infective endocarditis (1). Surgical correction of coarctation in adults has been associated with long term control of hypertension (2). Surgery in this group is rendered difficult by inelastic aortic tissues and multiple thin walled collaterals. Results of various surgical techniques and their impacts on re-coarctation have not been studied in adults. In this report, we present our experience with repair of coarctation of the aorta in adults with long term follow up and the effect of the repair on the hypertension and re-coarctation.

Patients and methods

A total of 31 patients above the age of 18 years underwent coarctation repair at this institute between 2005 and 2010 from the general area Pune, Solapur and Kolapur. The most common presenting complaints in these patients were headache, lower limb claudication, dyspnea and atypical chest pain (table 1). All patients underwent echocardiography. Preoperative clinical and echocardiographic data is presented in (table 2). All patients underwent surgical correction; one patient underwent emergency retrieval of the ruptured balloon and the stuck stent along with guidewire through the mid line sternotomy. All other patients underwent correction through left posterolateral thoracotomy.

Operative techniques

Muscle splitting posterolateral thoracotomy was performed through the intercostal space in all patients. Standard clamp and sew techniques was used in all patients. We did not use shunts or left heart bypass in any of the patients. Midline sternotomy was used only for repair of pre-subclavian coarctation under total circulatory arrest. The gradient across the repair was measured by needle and pressure monitoring line before the chest was closed.

Patients were ventilated and shifted to intensive care unit. All patients had similar degree of paradoxical hypertension that was managed by beta-blockers and sodium nitroprusside. The patients were extubated on the first post-operative day and started on oral feeds. Calcium channel blockers and beta-blockers were used for blood pressure control. Anti-platelet drugs were used but not oral anti-coagulant drugs.

All patients were followed up at three days, three months and yearly thereafter. Each patient underwent physical examination with upper and lower limb pressure recording, echocardiography and chest x ray. Pull-back gradient would be most reliable but catheterization study was not done due to the invasive nature of the procedure.

Surgical procedures

Resection and end to end anastomosis (n=12)

The coarctation segment was excised after mobilizing the arch and the descending thoracic aorta adequately. The bronchial arteries and the aneurysmal intercostal and other collateral arteries were ligated when necessary to construct a

tension free anastomosis with running (4-0) polypropylene sutures.

Resection and interposition graft (n=17)

For long segment coarctation with minimal collaterals, the diseased segment was excised and a 16-20mm woven Dacron patch interposed with 4-0 polypropylene sutures. When the left subclavian artery was dilated with extensive collaterals and intercostal arteries, a jump graft was fashioned with 20mm Dacron tube graft from the origin of the left subclavian to the descending thoracic aorta. One patient was taken up in emergency from catheterization laboratory for retrieval of ruptured balloon, stent along with guide wire followed by resection and end-to-end anastomosis of the coarctation segment.

Patch aortoplasty (n=02)

A generous aortotomy was made across the coarctation and an oversized woven Dacron patch was fashioned to extend 0.5 to 1 cm on either sides of the coarctation segment onto the subclavian artery in case of post subclavian coarctation or onto the left common carotid artery in case of pre and juxta subclavian coarctation. The coarctation shelf was excised in all cases.

2. Results

Early results

There was no early mortality. Three patients underwent re-exploration for bleeding from chest wall collaterals. One elderly patient who underwent jump graft developed paraplegia. Six patients had pulmonary complications that resolved with physiotherapy and antibiotics. Hypertension was easily controlled in all the patients. Rest of the patients had uneventful post-operative recovery and were discharged on Beta-blockers and Calcium channel blockers.

Late results

All patients were followed for a mean of 4.6 years (ranges 1-8 years). Follow up was 89% complete. All the patients, except 04 patients, were symptom-free. Mean preoperative gradient had come down significantly in all groups (Table 2). Three patients were in NYHA functional class II and all other patients were in class I.

Re-coarctation

One patient each in resection and end to end anastomosis and patch aortoplasty group had severe recoarctation defined as gradient exceeding 40mmHg (Table 2). The patients in the patch aortoplasty group who had severe hypoplasia of the arch and descending thoracic aorta and had residual high gradients after the completion of the surgical procedure. There was no statistically significant difference regarding gradients at follow up among the different surgical groups (Table 3), however there was trend towards higher re-coarctation gradients in the resection and end to end anastomosis groups which may be due to anastomosis being under tension. There was no relationship between the high gradient and the follow up blood pressure.

Hypertension

Hypertension was well controlled in most patients, mean pressure in the last follow up was 134.1mmHg. 18

patients (32%) were off anti-hypertensive medications, while 18 (32%) and 17(%) patients required two and one anti-hypertensive respectively. 7 patients continued to have blood pressure fluctuations indicating poor control. There was no statistical correlation between the residual gradient and the severity of hypertension at follow up or the number of the drugs required for pressure control (P=0.489) (Table 3).

3. Statistical Analysis

Continuous variables are expressed as mean (standard deviation). Statistical comparisons of means were done using ANOVA Microsoft Excel and SPSS for window version 11.0 (Chicago, USA) were utilized for data analysis. P value less than 0.05 was considered for statistical significance.

4. Discussion

The aim of surgery in patient with adult coarctation is to improve the distal perfusion and prevent or control upper body hypertension. The principles governing intervention in any case of coarctation is obstruction creating a gradient of 40mmHg or more, fifty percent or more narrowing of the lumen and a high resting gradient confirmed by catheterization(2). It is recommended that coarctation be repaired before school going age for best result (3), however, it has been found that hypertension regresses even in the older age group and the requirement for the anti-hypertensives is reduced following corrective procedures.(1,4).

In our series, the mean age at repair was 32 years, and this group of patients had been identified as hypertensive and were treated for varying periods of time before being identified as having coarctation. All patients were on anti-hypertensive at the time of surgery, many of them were poorly controlled.

Surgical procedures in younger children and infants are well defined with mobilisation, extended resection and end to end anastomosis which is associated with the best outcomes i.e. the least re-coarctation rate (5). Re-coarctation has been reported as 12-15% in recent series of extended arch anastomosis in infants (5). We believe that some degree of re-coarctation will remain a problem as long as autologous ductal tissue is used for reconstruction. The mechanism of anastomotic narrowing includes failure of tissue growth at the suture line, active narrowing secondary to fibrosis or technically inadequate anastomosis (2). In our series, we have encountered narrowing with all techniques of repair. Narrowing occurs in the prosthetic group probably due to clotting and subsequent fibrosis at the suture line (2). Some gradient can be expected even in the prosthetic group as there is arch hypoplasia in all these patients (6).

Paraplegia has been reported after surgery for coarctation of aorta. However, adult patients with large numerous collaterals have lower risk of paraplegia when these collaterals are preserved during the surgery. One of our patients developed paraplegia probably due to inadequate collaterals and long aortic cross clamp time. An element of risk remains even when all precautions are taken. Left heart

bypass can be used in selected cases with in adequate collaterals and complex anatomy. Paradoxical hypertension occurred in some patients post operatively and required sodium nitroprusside infusion for control. Beta adrenergic blockers, diuretics and calcium channel blockers resulted in excellent pressure control at discharge. At follow up 40% had normal pressure not requiring antihypertensive, 32 % requires 2 antihypertensive drugs and 14 % had poorly controlled hypertension requiring augmented drug dosages. Other series have documented the beneficial effect of surgery in this older group of patients with only 54% and 31% requiring medication at a mean follow up of 2.3 years and 5.2 years respectively (1)(9). The number of patient requiring the anti-hypertensives decreases with time; many patients could be weaned off the drugs in the first year of the follow up.

Pitfalls in this study are the retrospective and nonrandomized nature of the study and the small number of the patients in each group.

5. Conclusion

In conclusion, a variety of options are available for surgical management of coarctation of aorta in adults. Resection and end -to-end anastomosis, if possible is favored owing to best anatomical alignment and usage of own tissue. Prosthetic graft and patch repair are also associated with good short and long term results. Hypertension is well controlled in all patients with decreasing trend in numbers of anti-hypertensives. Longer follow up will be required to determine the ultimate benefit of coarctation repair in adult patients.

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Table 1: Patient demography and clinical characteristics

1	Total number of patients	31
2	Males	29
3	Female	2
4	Age: mean	32
Main Clinical presentations		
5	Headache/ giddiness and hypertension	16
6	Lower limb claudication	10
7	Dyspnoea on exertion and fatigue	4
8	Cerebrovascular accidents / syncope	1

Table 2: Pre-Operative TTE characteristics

Site of coarctation	
Juxtaductal	11
Pre-ductal (presubclavian)	1
Post-ductal	19
Mean gradient	76mmHg
Mean pre-operative systolic pressure	160
Long segment coarctation (>3cm)	4

Table 3: Post-operative outcome

Procedure	Pre-op mean gradient(mmHg)	Follow up mean gradient(mmHg)	Pre-op mean SBP (mmHg)	Follow-up mean SBP (mmHg)	Noof antihypertensives required per patient at 4.6 year follow up
RIPG(12)	120	13.4	174.6	132	0.7
REEG (16)	96.8	16.3	157.7	130.g	0.9
Patch(02)	121	17.2	152	141	1.5
JG (01)	83.5	17.8	178	147	1.3

RIPG- Resection and interposition graft,
 REE- Resection and end-to-end grafting,
 Patch- patch aortoplasty,
 JG- jump grafting.