Subclavian artery flap aortoplasty versus excision with extended end to end anastomosis in surgical management of aortic coarctation in infants (in first year of life)

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Abstract
Background: Subclavian flap aortoplasty and excision with extended end-to-end anastomosis are widely used techniques for surgical repair of coarctation of the aorta in infants during the first year of life. **Aim of the study:** Compare and analyze early and mid-term results of aortic coarctation repair using both techniques. **Methods:** Operative database showed 80 infants; 45 and 35 infants underwent excision with extended end to end anastomosis (group1) and subclavian flap aortoplasty (group2), respectively, from Jan. 2014 to June 2016. Infants with aortic coarctation ± other simple congenital anomalies were included, and those with complex cardiac disorders, or who had other cardiac procedures were excluded. **Results:** Early, five patients (3 in group1& 2 in group2) had a residual narrowing, while at 6 months follow up for (77/80) infants; 7 (5 in group1& 2 in group2) and at 12 months for (73/80) infants; 7 (4 in group1& 3 in group2) had a systolic blood pressure gradient >20mmHg. Recoarctation dictating intervention happened in 0 cases early, 7 cases (3 in group1& 4 in group2) within 6 months and 9 cases (5 in group1& 4 in group2) within 12 months. **Conclusion:** Infants under 1 year of age shows that both techniques are equally effective having similar rates of recoarctation during mid-term follow-up.
Keywords: **Subclavian Artery; Flap Aortoplasty; Aortic Coarctation; Infants**

INTRODUCTION

Coarctation of the aorta (CoA) is an important cause of secondary hypertension **(1)**. It is histologically characterized by localized medial thickening and in-folding with superimposed neointimal tissue. This thickening may be discrete (shelf-like), or, more commonly, involve a large portion of the juxtaductal aorta. CoA may manifest in the initial few weeks of life, but can remain undiagnosed until late adolescence or even adulthood **(2)**. It is most commonly associated with bicuspid aortic valve, patent ductus arteriosus, ventricular septal defect, and hypoplastic left heart syndrome. CoA may have a higher preponderance in males, although the true prevalence in both genders may be underestimated **(3)**.

CoA can be categorized into coarctation of the native aorta or recoarctation. This later terminology includes restenosis postsurgical repair or restenosis post-percutaneous repair. Most native coarctation is identified in childhood but may be missed until adulthood in a small percentage of asymptomatic patients **(4)**. Moreover, 10 % of patients who undergo surgical correction for CoA as an infant develop re-coarctation either in early childhood or as adults **(5)**. This group of patients represents a special population because of the need for serial surveillance and because of challenging treatment options. Surgical repair of aortic re-coarctation is challenging because of

associated comorbidities such as hypertension, worsening heart failure and left ventricular hypertrophy. All these factors increase perioperative mortality during open repair **(6)**.

The aim of this study was to compare and analyze results of surgical repair of aortic coarctation either by subclavian flap aortoplasty or excision with extended end to end anastomosis in primary coarctation.

PATIENTS AND METHODS

This study is a prospective clinical trial that was carried out at the Pediatric Cardiac Surgery Department, Aboulreesh Hospital, Faculty of Medicine, Cairo University and Pediatric Cardiac Surgery Center at Egypt's Children Aboulreesh Hospital, General Authority for Health Insurance.

Eighty patients with coarctation of the aorta were operated using either resection with extended end to end anastomosis or subclavian flap aortoplasty between January 2014 and June 2016. The choice of technique was dictated by the anatomical variant of coarctation, on the individual pathology and surgical experience.

Inclusion and exclusion criteria: All patients were in the first year of life, with aortic coarctation ± hypoplastic aortic arch ± other simple congenital anomalies, and were planned for aortic coarctation repair and PDA closure without any cardiac procedure. We excluded patients who had aortic coarctation with other complex cardiac disorders, whose ultimate fate would be univentricular repair, and those who need aortic coarctation repair (including PDA closure) and other cardiac procedure (e.g. PAB).

Data collection: For each patient the following data were recorded: Preoperative data of symptoms including: Dyspnea, Tachypnea, Cyanosis, Acidosis, Failure to thrive, Decreased urine output, Diaphoresis, Cardiac arrest, Bradycardia, Frequent respiratory infections, Cold extremities, and Others, associated cardiac anomalies, date of surgery, age and weight at surgery, type of surgical technique, concomitant surgical procedures, early and midterm at 6 months and 12 months surgical results in terms of: LV posterior wall and IVS thickness, ECG evidence of LVH, need for re-operation because of development of re-coarctation or other cardiac lesion, residual/recurrent pressure gradient, evaluated at cuff/Doppler at rest. A pressure gradient >20 mmHg was considered significant, systemic hypertension, requiring medical treatment and mortality.

Preoperative evaluation: All preoperative evaluation and assessment of the patients was done on an outpatient clinic basis: Detailed history and clinical examination. Resting twelve leads Electrocardiogram **(ECG), Chest X-ray** (postero-anterior view) was examined for evidence of lung congestion and diagnosis of any associated cardiac anomalies. Cardiac size was evaluated by measuring the cardiothoracic ratio and chamber enlargement. **Transthoracic echocardiographic** evaluation was the cornerstone in patient's evaluation. Each patient was examined by 2-D, M-mode and color Doppler echocardiography before surgery. Doppler echocardiography was used to measure the gradient at the site of coarctation and to identify the pattern of diastolic runoff typically seen in patients with severe obstruction.

Echocardiographic assessment was done 3 times on all patients, 24 hours before and 24 hours after surgery rather than immediate postoperative echo in ICU. Two-dimensional and Doppler echocardiographic imaging studies were performed using a Vivid 3 Imaging System (GE, USA) in accordance with institutional guidelines. All echocardiographic studies were done by one echo cardiologist before and after repair.

Both the abdominal and descending aorta were evaluated during Doppler echocardiography.

Echocardiographic indices performed were as follows: Deceleration time (DT). Systolic acceleration time, Pressure half-time (PHT) was the time interval for the peak pressure gradient to be reduced by one half (PHT = 0.29 × DT). Abdominal aortic pulse delay was quantified by measuring the time to peak velocity in the abdominal aorta and comparing it with the same value measured from flow at the aortic annulus. This value should be indexed to the heart rate by dividing the absolute value by the square root of the PR interval **(127).** Pulsatility index was the systolic velocity minus diastolic velocity divided by the mean velocity [(systolic velocity - diastolic velocity)/mean velocity] **(7).** Early diastolic velocity (EDV) was maximum diastolic velocity in early diastole **(8).** Late diastolic velocity (LDV) was maximum diastolic velocity in late diastole (atrial contraction), peak systolic velocity. Velocity time integral was the area under the velocity curve. Time to peak systolic velocity was the time from onset of the QRS complex to peak systolic velocity measured by pulse wave Doppler echocardiography and pulse delay index.

Multislice computed tomography (MSCT), computed tomography (CT) and magnetic resonant imaging (MRI): In each patient, the CT and MSCT scan extended from just the thoracic inlet to the top of the diaphragm, to assess the aortic arch and its branches, presence of associated anomaly, coarctation site, length and diameters, collateral circulation.

Intraoperative management:

Surgical techniques:

Resection with extended end to end anastomosis (GROUP I): Surgeries were performed through a left posterolateral thoracotomy; the child's rectal temperature was allowed to drift to 34.5°C. The aortic arch, brachiocephalic vessels, patent ductus arteriosus, and descending thoracic aorta were dissected free. Extensive mobilization of the left subclavian, left carotid and innominate artery allow the arch to "come down" to facilitate an anastomosis without tension. Adequate (but not excessive) mobilization of the descending thoracic aorta is obtained by dividing intercostal collaterals. Only as many collaterals as needed are taken. The distal clamp is placed well below the anticipated incision line and is used to apply traction, "pulling" the descending thoracic aorta up to the anastomosis site. Heparin is not administered. The anastomosis is constructed with running 6-0 or 7-0 polypropylene suture. The initial sutures are placed posteriorly in a "parachute" fashion with most of the posterior sutures placed before pulling the loops tight. Anterior suture line sometimes was made by interrupted sutures securing first and last ones to posterior suture line to prevent future recoarctation. When the anastomosis is completed a long, oblique suture line is the final result. Following repair by any technique, the distal clamp is removed first, after the proximal clamp has been slowly opened, great care is taken to maintain proper ventilation and baseline systemic blood pressure for at least the next 5 minutes as a precaution against sudden development of intractable ventricular fibrillation 3 to 4 minutes after release of the clamp (de-clamping syndrome). It may be necessary for the anesthesiologist to give sodium bicarbonate or an infusion of a pure peripheral vasoconstrictor (or both) just before clamp removal in particularly unstable infants or in those with prolonged clamp times.

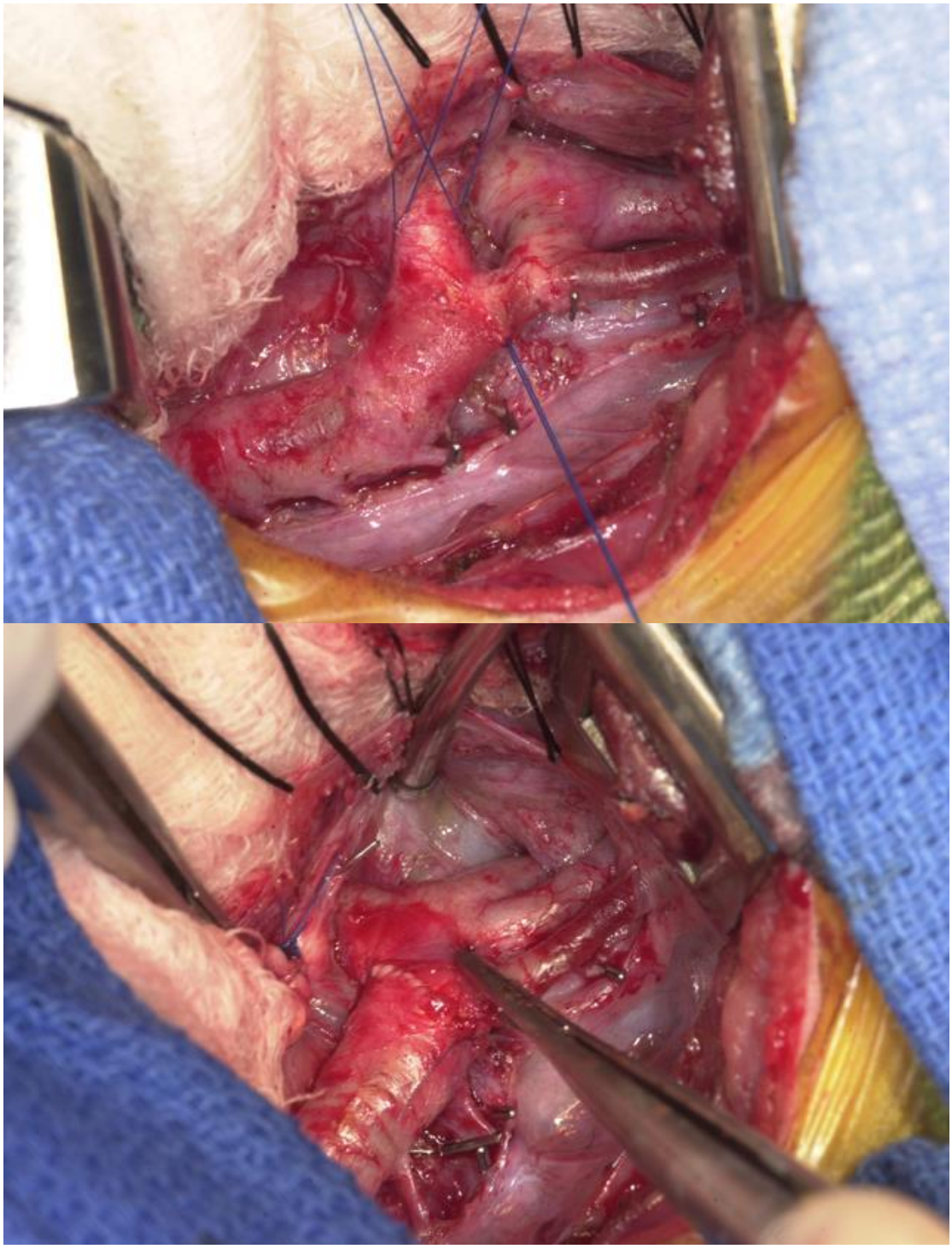

Figure 1: Extended end to end anastomosis

Subclavian flap aortoplasty (GROUP II): When GROUP II is performed; the distal transverse aortic arch, isthmus, left subclavian artery, proximal descending aorta, and ductus arteriosus are mobilized. Clamps are placed across the transverse aortic arch and the descending aorta well beyond the level of the coarctation. Heparin is not given. Occasionally it may be necessary to sacrifice one or two pairs of intercostal arteries above the level of the distal clamp.

Postoperative evaluation

Intra-operative assessment: The coarctation repair and anatomy after incision of the aorta depending on assessment of discrepancy between 2 sides of repair either on 2 anastomotic ends or flap lying on aorta.

Measurement of pressure gradients: The gradients were measured by direct invasive arterial lines in upper and lower limbs and Echocardiography: A blood-pressure gradient of 20 mmHg or greater was considered significant. Recoarctation was defined as a systolic blood-pressure gradient of greater than 20 mmHg between the right arm and right leg with upper extremity hypertension. A blood pressure gradient greater than 30 mmHg with arterial hypertension was considered an indication for reintervention.

Follow up of repair efficacy: Post-operative assessment was made by Echocardiography, and CXR +/- (invasive and/or non-invasive arterial monitoring) and/or (Multislice CT and/or Cardiac catheterization) in some cases.

Follow up efficacy parameters: Post-operative pressure gradient (PG) (recurrence or residual obstruction), LV posterior wall and interventricular septum (IVS) thickness, ECG evidence of left ventricular hypertrophy (LVH) and recoarctation was defined on the basis of the need for reoperation or the systolic arm-to-leg pressure gradient measured by ultrasound technique.

Statistical analysis: using SPSS version 22 (Statistical Package for Social Sciences). Demographic variables and echocardiographic parameters of patients and controls were compared using unpaired Student's t test. Risk factors for operative mortality were tested with Fisher's exact two-tailed test. All data are presented as mean ± standard deviation, or as percentages, and a probability (p) of 0.05 or less was required as evidence of a statistical significant difference between groups.

RESULTS

Eighty patients with coarctation of the aorta, after signing an informed consent document by a parent, were operated upon using either resection with extended end to end anastomosis (n= 45 patients, 43.75%) or subclavian flap aortoplasty (n= 35 patients, 56.25%) between January 2014 and June 2016.

In our study, the Mean ± SD age of the patients was in Group I (6.5 ± 1.4 months), in the range of 0.8 and 9.6 months while in Group II (6.4 ± 1.5 months), in the range of 0.7 and 9.3 months. There were seven neonates (below 1 month) included in this study**. Table 1**

Table 1: Shows the demographic characteristics of the included patients

Demographic data	GROUP I (n= 45)	GROUP II (n= 35)
Age (months)		
Mean ± SD	6.5±1.4	6.4±1.5
Range	0.8-9.6	0.7-9.3
Weight (kilograms)		
Mean ± SD	8±2.2	7.9±2.3
Range	3.4-10.5	3.3-10.2
Gender		
Male n (%)	18 (53%)	16 (47%)
Female n (%)	21 (46%)	25 (54%)

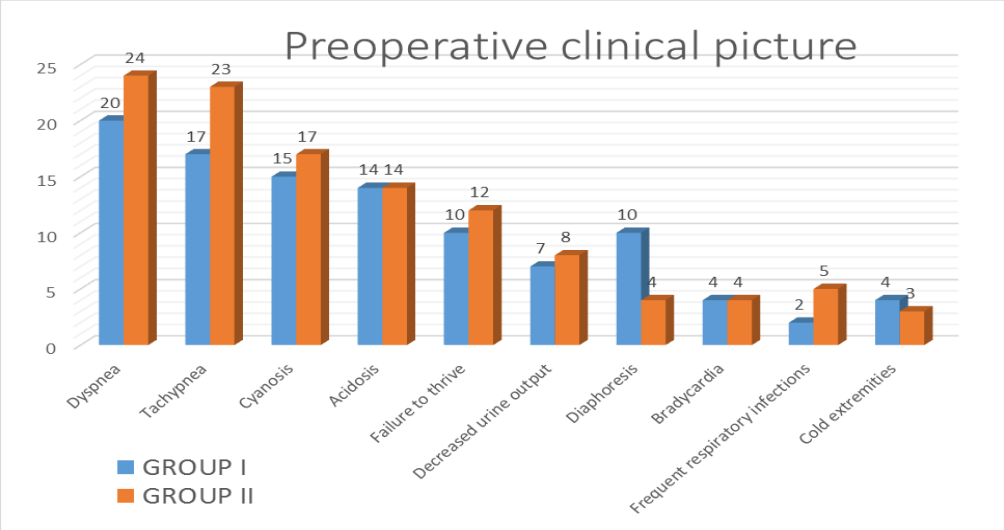

Figure 2: Preoperative symptoms and findings

Only 18 patients (22.5%) had isolated coarctation. The remaining 62 patients had one or more associated congenital cardiac anomalies, shown in Table 3. The three most commonly-associated lesions were ventricular septal defect (n= 39, 48.75%), patent ductus arteriosus (n= 39, 48.75%), and atrial septal defect (n= 14, 17.5%). Groups were similar in number of patients with associated anomalies

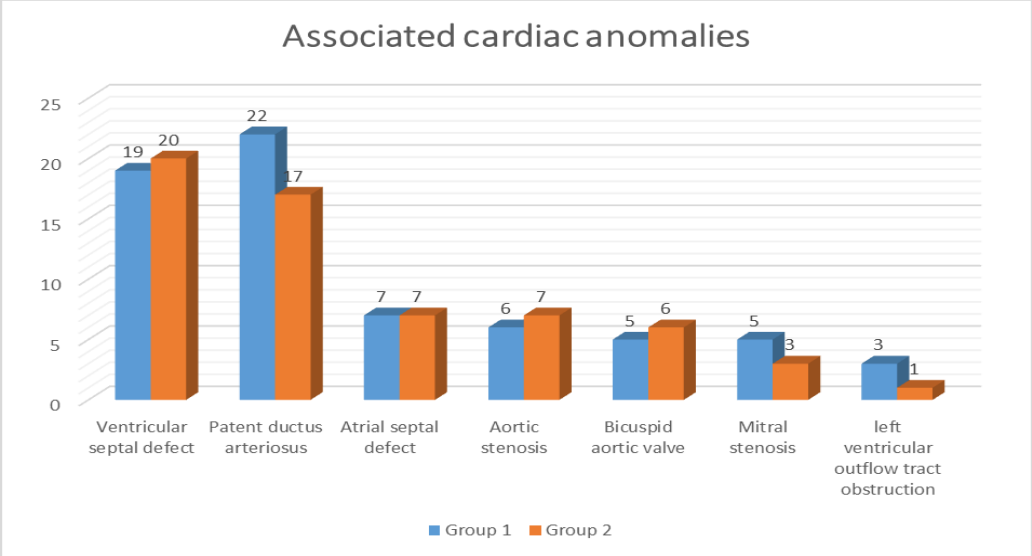

Figure 3: Associated cardiac anomalies

The patients underwent Doppler echocardiography at the time of enrolment and after intervention. All preoperative Doppler echocardiographic profiles of the aortic arch and descending aorta are given in **(Table 2).**

Table 2: Preoperative echocardiographic findings

Doppler echocardio-graphic profile	GROUP I		GROUP II	
	Aortic arch	Descending aorta	Aortic arch	Descending aorta
PSV (m/s)	0.59 ± 0.13	3.86 ± 0.77	0.57 ± 0.14	3.89 ± 0.75
EDV (m/s)	0.41 ± 0.14	1.94 ± 0.66	0.43 ± 0.13	1.95 ± 0.68
LDV (m/s)	0.27 ± 0.09	0.87 ± 0.51	0.31 ± 0.08	0.86 ± 0.50
AT (m/s)	230.07 ± 75.3	101.30 ± 56.11	227.07 ± 76.48	103.40 ± 55.12
PHT (m/s)	189.30 ± 92.86	166.78 ± 81.75	194.39 ± 91.86	162.68 ± 83.72

Mean velocity (m/s)	0.37 ± 0.11	1.85 ± 0.44	0.39 ± 0.09	1.87 ± 0.45
D/S ratio velocity	0.71 ± 0.23	0.50 ± 0.15	0.73 ± 0.25	0.50 ± 0.15
VTI	30.96 ± 9.31	153.84 ± 54.29	32.88 ± 9.52	152.85 ± 56.40
Time to peak systolic velocity (m/s)	375.60 ± 76.44	234.50 ± 44.40	370.61 ± 76.40	242.59 ± 41.06
Pulse delay	-	8.12 ± 3.35	-	8.13 ± 3.36
Pulsatility index	-	0.87 ± 0.30	-	0.89 ± 0.33
Mean PG	19.81 ± 7.96		20.18 ± 7.32	

Forty five patients underwent coarctation repair via extended end to end anastomosis approach, whilst subclavian flap aortoplasty was performed in thirty five cases (**Figure 4)**.

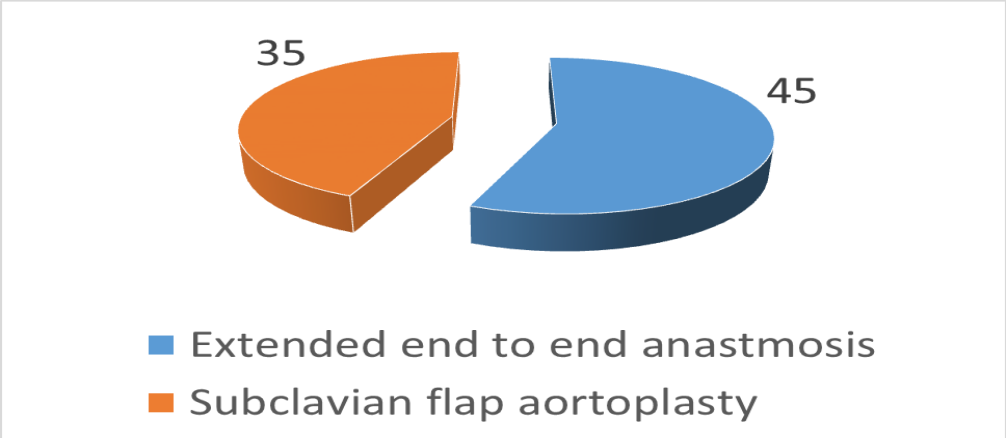

Figure 4: Extended end to end anastomosis versus subclavian flap aortoplasty.

Five patients had a residual obstruction (systolic blood pressure gradient> 20 mmHg across the area of repair) postoperatively. Three were in the extended end to end anastomosis group and two in the subclavian flap aortoplasty cohort. Postoperative systolic blood pressure gradient reduction to ≤20 and ≤10 mmHg was achieved in 93.75% (95% confidence interval, 89.95 to 97.55) and 91.5% (86.1 to 96.9%) of patients undergoing extended end to end anastomosis, and in 96.5% (94.5 to 98.5%) and 93.8% (88.5 to 99.1%) of patients undergoing subclavian flap aortoplasty, respectively. **Table 3**

Table 3: [A] Early postoperative pressure gradient changes, [B] postoperative deaths and survival, and [C] postoperative complications

[A]Pressure gradient	**GROUP I**	**GROUP II**
Residual obstruction (> 20 mm Hg)	5.25% [3% to 7.5%]	3.5% [3.25% to 4.75%]
≤20 mm	93.75% **[**89.95 to 97.55**]**	96.5% [94.5 to 98.5%]
≤10 mm	91.5% [86.1 to 96.9%]	93.8% [88.5 to 99.1%]
[B] Deaths and survival	**(n= 45)**	**(n= 35)**
Deaths, n (%)	0 (0%)	0 (0%)
[C] Complications	**(n= 45)**	**(n= 35)**
Bowel ischemia	1 (2.22%)	2 (5.7%)
Renal failure	4 (9%)	1(3%)
Prolonged intubation and ventilation problems	2 (4.44%)	3 (8.6%)
Respiratory problems	4 (9%)	4 (11.4%)
Bleeding	7 (15.5%)	6 (17.2%)

Chylothorax	7 (15.5%)	7 (20%)
Acute limb ischemia	0 (0%)	3 (8.6%)
Data are presented as % [95% confidence interval]		

Recurrent coarctation requiring reoperation occurred in none of the patients during the first week post-surgery. Reoperation free rate was 100% in both groups early postoperatively**. Table 4**

Table 4: [A] Early postoperatively LV posterior wall and [B] IVS thickness and ECG evidence of left ventricular hypertrophy (LVH)

[A] Outcome	GROUP I	GROUP II	Mean difference	Confidence interval	P value
LV thickness	13.1	12.8	0.3	-0.2 to 0.8	0.1
IVS thickness	12.3	11.9	0.4	-0.3 to 1.1	0.13

[B] Left ventricular	Hypertrophy (LVH)	
ECG	GROUP I (n= 45)	GROUP II (n= 35)
Hypertrophy	13 (29%)	10 (28.6%)
Normal	32 (71%)	25 (71.4%)

The incidence of organs dysfunction was statistically insignificant different between both extended end to end anastomosis and subclavian flap aortoplasty groups. There were 3 organs dysfunction in each group (including heart failure and renal failure) **(Table 5).**

Table 5: Secondary outcome measures

Outcome	GROUP I (n=45)	GROUP II (n=35)	P value
Mechanical ventilation	2 (4.44%)	3 (8.6%)	0.32
Length of ICU stay	50.12 ± 5.2	48.97 ± 2.1	0.308
organs dysfunction	3 (6.66%)	3 (8.6%)	0.54

LV hypertrophy was shown in 8 patients (18%) in the extended end to end anastomosis group and 6 patients (18%) in the subclavian flap aortoplasty group. The odds of LV hypertrophy did not favor either of the two procedures (Odds ratio= 1, 95% confidence interval [0.76, 1.4], P value= 0.43). **Figure 5**

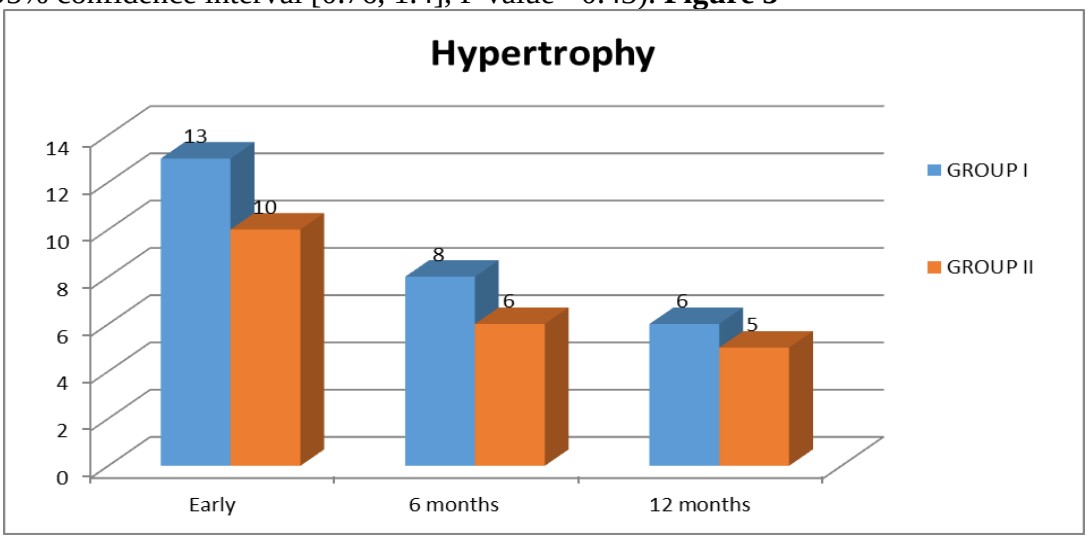

Figure 5: Hypertrophy early, 6 months, and 12 months postoperatively.

Table 6: [A] 6-months postoperative pressure gradient changes, [B] mortality and survival rate, [C] postoperative LV posterior wall and IVS thickness, [D] 6-months postoperative recoarctation data and [E] 6-months postoperative complications

[A] Pressure gradient	GROUP I (n= 44)	GROUP II (n=33)		
Residual obstruction (> 20 mm Hg)	11% [9.5% to 12.5%]	6% [4.3% to 7.7%]		
≤20 mmHg	88.6% [83.1 to 93.1]	94% [90 to 98%]		
≤10 mmHg	95% [92 to 98%]	93.8% [88.5 to 99.1%]		
Data are presented as % [95% confidence interval]				
[B] Outcome	GROUP I (n=45%)	GROUP II (n=35%)		P value
Deaths, n (%)	1 (2.2%)	2 (5.7%)		0.23
Data are presented as n (%)				
[C] Outcome	GROUP I	GROUP II	Mean difference	Confidence interval	P value
LV thickness	11.3	10.8	0.5	-0.1 to 1.1	0.09
IVS thickness	11	10.7	0.3	-0.2 to 0.8	0.11
Data are presented as n (%)					
[D] **Outcome**	**GROUP I (n= 44)**	**GROUP II (n= 33)**		
Recoarctation	3 (7%)	4 (12%)		
Data are: n (%)				
[E] **Complications**	GROUP I (n= 44)	GROUP II (n= 33)		
Respiratory problems	5 (11.4%)	4 (12%)		
Heart failure	1 (2.3%)	2 (6%)		

The cumulative deaths reached seven cases by the end of 12 months postoperatively. There were three (8.5%) deaths in the subclavian flab aortoplasty group and four (9%) in the end to end anastomosis group; these deaths were attributed to severe congestive heart failure and digitalis toxicity.

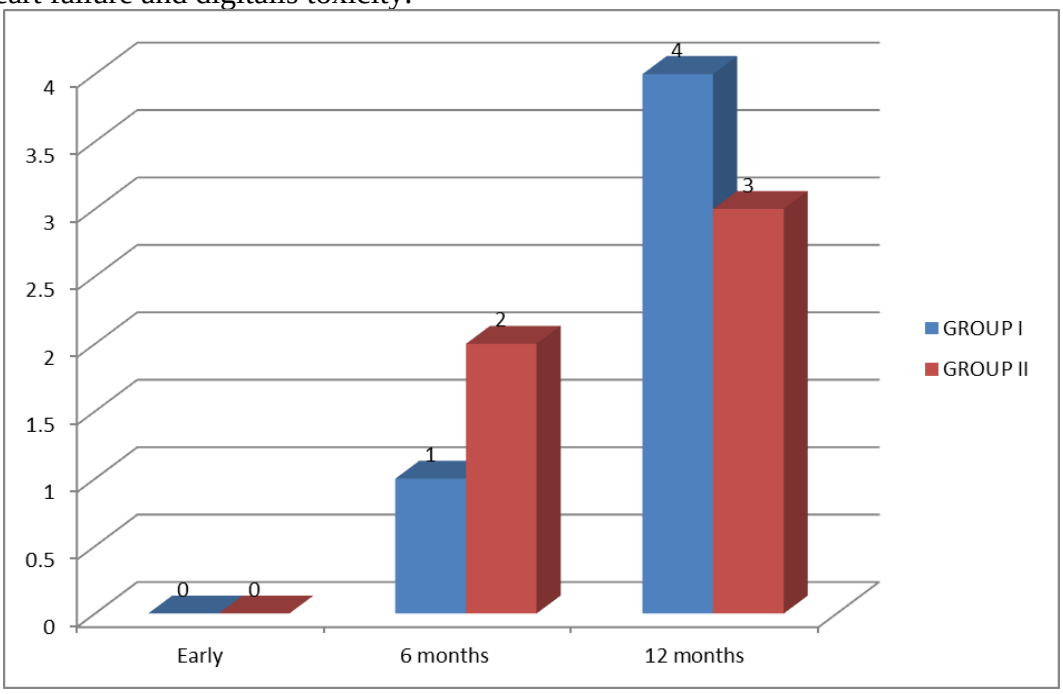

Figure 6: Mortality early, 6 months, and 12 months postoperatively.

Figure 7: demonstrate the means for survival time and probability of survival in both groups having a non significan difference between both groups (.972).

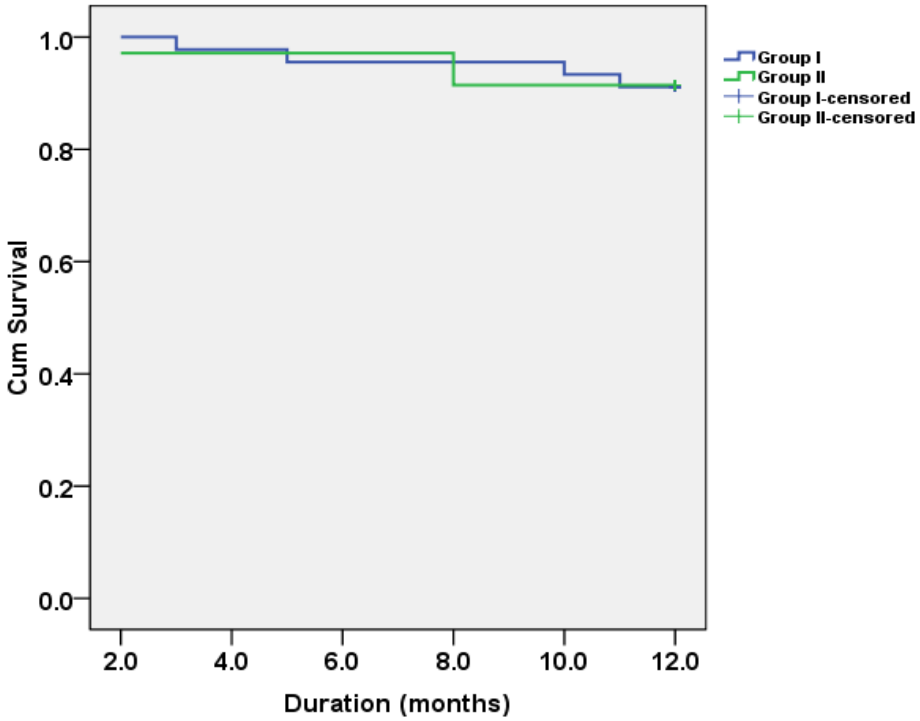

Figure 7: Kaplan_Meier curve for probability of survival in both groups

DISCUSSION

Our study compared two of the most commonly performed operations for coarctation of the aorta in children extended end to end anastomosis and subclavian flap aortoplasty.

In our study, age of the patients in Group I was (6.5 ± 1.4 months), in the range of 0.8 and 9.6 months while in Group II was (6.4 ± 1.5 months), in the range of 0.7 and 9.3 months. According to a study performed by Messmer and his colleagues **(9)** the median age was 0.7 months. In a study performed by Backer and his colleagues **(10)**, mean age of the patients was 39.8 ± 17.2 months. In another study by Van son and his colleagues **(11)**; mean age of the patients was 0.20 ± 0.24 years. In a long term follow up study by Beekman and his colleagues **(12)**; mean age of the patients was 1.54 ± 0.93 months.

Regarding preoperative symptoms, forty-four patients (n= 44, 55%) presented with dyspnea, half of the included participants (n= 40, 50%) had attacks of tachypnea, forty percent (n= 32, 40%) of the study participants were cyanosed, twenty-eight patients (n= 28, 35%) presented with symptoms of acidosis, twenty-two coarctation patients (n= 22, 28%) failed to thrive, decreased urine output manifested in 15 (18.75%) patients.

In our study, 62 patients (n= 62, 77.5%) had one or more associated congenital cardiac anomalies, in which ventricular septal defect was the most common (n= 39, 48.8%). In another study by Cobanoglu et al., All six operative deaths (6.97%) were in patients with associated ventricular septal defects **(13)**. Backer et al., reported that of 55 patients, 20 patients had a ventricular septal defect, and 9 patients had other associated intracardiac lesions **(14)**.

Regarding the surgical approach, our study included 45 patients who underwent resection with extended end-to-end anastomosis and other 35 patients who underwent

subclavian flap aortoplasty. In comparison to other studies, Cobanoglu et al. reported 86 infants under 3 months of age underwent surgical repair of coarctation (39 resections and end-to-end repair, and 47 subclavian flap angioplasty procedures) **(13).** In another study by Van Son et al., Subclavian flap aortoplasty was performed in 19 patients and resection and extended end-to-end anastomosis in 51 patients **(11).**

No intra-operative mortality occurred throughout the 80 cases included in this trial. Cobanoglu *et al.* reported six intra-operative mortalities that were significantly associated with ventricular septal defect.

Postoperatively, five patients (three were in the extended end to end anastomosis group and two in the subclavian flap aortoplasty cohort) had a residual obstruction, defined as systolic blood pressure gradient> 20 mmHg across the area of repair.

In comparison to other studies, Corno et al., showed that seven of 91 infants developed post-operative residual coarctation. Jacques et al., reported that three patients (2 from subclavian flap aortoplasty and 1 from extended end to end anastomosis group) successfully underwent transfemoral balloon angioplasty for residual coarctation with gradients exceeding 30 mm Hg between 7 and 15 months after the initial procedure **(15).**

Post-treatment systolic blood pressure gradient reduction to ≤20 and ≤10 mmHg was achieved in 93.75% (95% confidence interval, 89.95 to 97.55) and 91.5% (86.1 to 96.9%) of patients undergoing extended end to end anastomosis, and in 96.5% (94.5 to 98.5%) and 93.8% (88.5 to 99.1%) of patients undergoing subclavian flap aortoplasty, respectively.

In our study, no early post-operative mortalities were recorded for either of the two operations. There were six operative deaths (6.9%) seen in former series, of infants of less than 3 months of age, and all these patients had an associated ventricular septal defect. This is in accordance with previous reports in which the operative risk increased with the presence of hemodynamically-significant associated cardiac defects, and also in a large multi-center series of seriously ill neonates. In addition, the operative mortality was 3%, in which the neonates had undergone resection and end-to-end anastomosis with associated cardiac defects **(16)** whereas there were no operative deaths in infants with no associated cardiac defects **(17).**

Postoperatively, other echocardiographic findings were; LV hypertrophy did not favor either of the two procedures (Odds ratio= 1.02, 95% confidence interval [0.38, 2.7], P value= 0.34). These findings were confirmed through electrocardiography (ECG), where 13 patients, out of 45 patients in the resection and extended end to end anastomosis showed electrocardiographic signs of ventricular wall hypertrophy, while 10 of 35 patients in the subclavian flap aortoplasty group showed similar signs. In a study by Beekman et al., left ventricular hypertrophy was found in 27% of cases, while aortic valve abnormalities were reported in 87% of patients. Chest radiograph showed cardiomegaly in 20% of cases, most of which had hypertension or aortic valve diseases **(12).**

In our study, recurrent coarctation requiring reoperation occurred in none of the patients during the first week post-surgery. Reoperation free rate was 100% in both groups early postoperatively. In former reports, the reported prevalence of recoarctation ranges between 3% and 41% in a survey of 11 major studies **(18).** The present study did not demonstrate a significant difference in the rates of recurrence between the two procedures on long-term follow-up.

Some adverse events occurred specifically in the subclavian flap aortoplasty group as acute upper limb ischemia, which occurred in 3 patients of that group. Our results are concordant with data from previous reports, encompassing patients who underwent

either extended end to end anastomosis or subclavian flap aortoplasty. A study by Van Son et al., showed that subclavian flap aortoplasty can have detrimental effects on the associated upper limb growth **(19).** Another study by Van Son et al., five children in the same group, all 5 years of age or older, complained of claudication in the left upper limb during strenuous exercise (in 4 while swimming and in 1 during gymnastics) **(11)**. In another study by Kopf et al., There were no instances of clinically apparent upper limb ischemia, brachial plexus injury, or stroke **(20)**.

Regarding post-operative mortality at six months, our study showed two (5.7%) deaths in the subclavian flab aortoplasty group and one (2.2%) in the end to end anastomosis group. In comparison to other studies, In a study by Corno et al., The mortality rate at 6 months was 2.7% (=1/37) in the adults, and 2.9% (=3/104) in children, and in both groups the mortality was unrelated to the aortic coarctation **(15)**.

At six months follow up, mean LV posterior wall thickness in the extended end to end anastomosis group at 6 months post operation was 11.3 mm, whilst it was 10.8 mm in the subclavian flap group. The mean difference in LV posterior wall thickness between the study arms was 0.5 mm, 95% confidence interval [-0.1 to 1.1]. These data are in accordance with the study by Sade et al., which showed that ultrasonographic measurements of both left ventricular posterior wall thickness and interventricular septum were comparable among the two groups at intermediate follow up timing.

CONCLUSION

In conclusion, in our series; infants under 1 year of age shows that both subclavian flap aortoplasty and extended end-to-end anastomosis are equally effective procedures for treatment of aortic coarctation in this age group and that they have similar rates of recoarctation during 6 and 12 months mid-term follow-up.

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