

Our experience with surgical repair of isolated adult aortic coarctation

Khaled M. Awadalla¹, Ahmed Sultan¹, Mina Wahba²

¹Department of Cardiothoracic Surgery, Faculty of Medicine, Cairo University, Egypt

²Department of Cardiothoracic Surgery, Faculty of Medicine, Beni-Suef University, Egypt

ABSTRACT

Background: Adult aortic coarctation is a relatively common congenital heart disease. Nowadays there is trend for percutaneous management of adult aortic coarctation but the outcome is still debatable. **Objective:** To assessment of the surgical outcome of isolated adult aortic coarctation. **Methods:** This was a retrospective study including 18 patients who had open surgical repair of isolated adult aortic coarctation between January 2012 and April 2018 in multiple centres in Department of Cardiothoracic Surgery, Faculty of Medicine, Cairo University. Surgery was done through left posterolateral thoracotomy with resection and interposition graft technique. **Results:** The mean age of patients was 29 years (range from 18-42) of them 10 were males (55.56%) and 8 were females (44.44%). Two patients (11.11%) had surgery for re-coarctation and the other 16 patients (88.89%) had surgery for native coarctation. Left heart bypass was required in 4 (22.22%) patients. There was no mortality in our study group. Morbidity happened in four patients (22.22%) in the form of bleeding and re-exploration in two patients (11.11%), recurrent laryngeal nerve injury in one patient (5.56%) who had hoarseness of voice, and chylothorax in one patient (5.56%). There was no stroke, spinal cord insult (paraparesis, paraplegia), respiratory failure (reintubation, tracheostomy), renal impairment, empyema, sepsis, multiple organ failure or phrenic injury. 10 patients (55.56%) of our study group had refractory hypertension. **Conclusions:** Surgical repair of isolated adult aortic coarctation by resection and interposition graft technique had good outcome with no mortalities, acceptable morbidities with refractory hypertension in most of the patients.

Key words: Adult aortic coarctation, Outcome, Surgical repair.

Correspondence

Dr. Khaled M. Awadalla,
Department of Cardiothoracic
Surgery, Faculty of Medicine, Cairo
University, Egypt
E-Mail address:
khaled.mortada@gmail.com

INTRODUCTION

Aortic coarctation is one of the common congenital anomalies that is commonly diagnosed and managed during infancy and childhood. It occurs with a rate of 1 in 2500 live births, with a percentage of 4% to 5% of the congenital heart disease.¹ However, it can be only diagnosed during adolescents or adulthood for the first time,² as native coarctation or as re-coarctation post-surgery or balloon angioplasty with or without stenting.³⁻⁶

Native coarctation usually presents with hypertension, decreased femoral pulsation and heart murmur, neglected cases may present by heart failure, aortic aneurysm or dissection with early mortality that usually occurs during the 3rd or 4th decades.⁷

Re-coarctation usually occurs post balloon angioplasty and usually associated with late formation of aneurysm,^{5,8} and usually treated again through percutaneous intervention. Endovascular has the advantage of being less invasive but has the disadvantage of less durability than the open surgical repair.⁹

Aortic coarctation may be associated with another cardiovascular anomalies like bicuspid aortic valve (BAV) that may occur up to 40-80%.^{2,10}

Surgical management is still the best option with the best outcome in children, nowadays endovascular repair is increasing in adult but the outcome is still debatable.¹¹

The aim of this study was to assess the surgical outcome of isolated adult aortic coarctation.

PATIENTS AND METHODS

Between January 2012 and April 2018, we had 18 patients who were operated upon for isolated adult aortic coarctation in Department of Cardiothoracic Surgery, Faculty of Medicine, Cairo University. Surgery was done through left posterolateral thoracotomy with resection and interposition graft technique and we collected their data and outcome (Figures 1 and 2).



Figure 1: Preoperative exposure of aortic coarctation via posterolateral thoracotomy and dissection of mediastinal pleurae

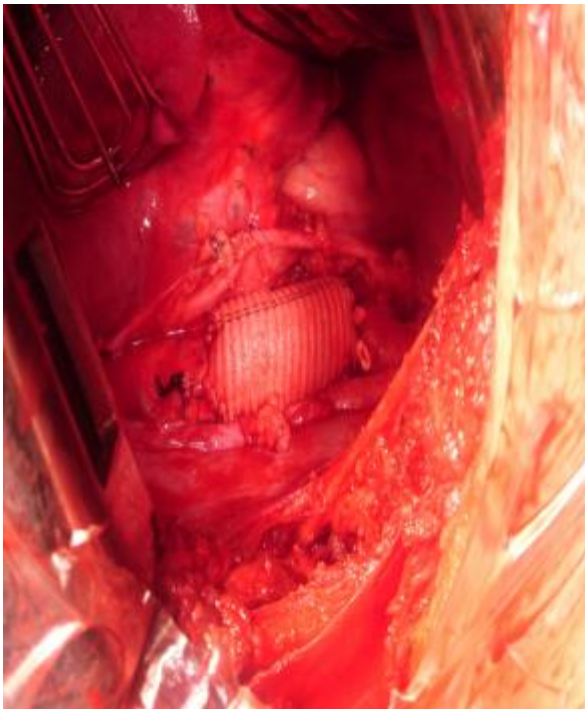


Figure 2: Excision of coarctated segment and Dacron tube graft interposition

Preoperative Assessment

Preoperative assessment data was collected for all our patients including:

1. Their medical history, clinical examination findings and identified risk factors.
2. Full laboratory results.
3. Electrocardiogram (ECG) result.

4. Chest X ray result.

5. Transthoracic echocardiography result.

6. Computed tomography (CT) angiography (3D) or magnetic resonance imaging (MRI) result.

Type of Anaesthesia used

General anaesthesia was used in all patients with double lumen endotracheal tube and all of our patients were transferred to the ICU postoperatively on mechanical ventilation.

Operative Technique

With right lateral decubitus position through left fifth intercostal space thoracotomy, test clamping was done if no significant drop of the femoral blood pressure surgery was done with simple aortic clamping; if significant drop happened left sided bypass was used.

Ethical consent

An approval of the study was obtained from Cairo University Academic and Ethical Committee. Every patient signed an informed written consent for acceptance of participation in the study. This work has been carried out in accordance with The Code of Ethics of the World Medical Association (Declaration of Helsinki) for studies involving humans.

Statistical analysis

The collected data were coded, processed and analyzed using the SPSS (Statistical Package for the Social Sciences) version 22 for Windows® (IBM SPSS Inc, Chicago, IL, USA). Qualitative data were represented as frequencies and relative percentages. Quantitative data were expressed as mean \pm SD (Standard deviation) and range.

RESULTS

Table 1 showed patients' demographic and baseline clinical data.

Table 2 showed preoperative preparations and investigations results were collected and Echo, CT and MRI findings.

Table 3 showed two patients had surgery for re-coarctation (post ballooning) and the other 16 patients had surgery for native coarctation. All the 18 patients had surgery through left posterolateral thoracotomy with resection and interposition graft technique. Left heart bypass was used in 4 patients. After surgery all patients were transferred to the ICU on mechanical ventilation. Operative and ICU data.

Table 4 showed hospital stay ranged from 6-18 days. There was no mortality in our study group. Postoperative complications are shown in table 4. 10 patients of our study group had refractory hypertension.

Table 1: Patients' demographics and baseline clinical data

Age	Age range	18-42
	Mean \pm SD	29 \pm 12.5
Sex	Male	10 (55.56%)
	Female	8 (44.44%)
BMI	Mean \pm SD	27.24 \pm 2.13
Smoking	Smoker	6 (33.33%)
	Non smoker	12 (66.67%)
Diabetes	Diabetic	3 (16.67%)
	Non diabetic	15 (83.33%)
Hypertension		18 (100%)
Asymptomatic		4 (22.22%)
Symptomatic		14 (77.78%)
	Dyspnoea	6 (33.33%)
	Palpitations	6 (33.33%)
	Chest pain	4 (22.22%)
	Headache	7 (38.89%)
	Vertigo/dizziness	2 (11.11%)
	Abdominal pain	1 (5.56%)
	Claudication/limb pain	4 (22.22%)
Fatigue	3 (16.67%)	

SD; Standard Deviation, BMI; Body Mass Index

Table 2: Echo, CT and MRI findings

	Number of patients (%)
Echo	
*EF	
\geq 50%	16 (88.89%)
30–49%	2 (11.11%)
< 30%	0 (0%)
*LV	
Normal	4 (22.22%)
Dilated	3 (16.67%)
Hypertrophied	5 (27.78%)
Dilated + hypertrophic	6 (33.33%)
CT and MRI	
Juxtaductal coarctation	11 (61.11%)
Postductal coarctation	7 (38.89%)

Table 3: Operative and ICU data

Data	Number of patients (%)
Operative	
Simple cross clamp	14 (77.78)
Cross clamp time(min.) mean \pm SD	25.7 \pm 10.4
Total surgery time (min.) mean \pm SD	98.4 \pm 32.2
Left heart bypass	4 (22.22%)
Cross clamp time (min.) mean \pm SD	43.8 \pm 13.7
Left heart bypass time(min.) mean \pm SD	125.2 \pm 38.1
Total surgery time (min.) mean \pm SD	189.1 \pm 41.3
ICU	
Mechanical ventilation duration (hours) mean \pm SD	7.4 \pm 1.9
Blood loss (ml) mean \pm SD	340.5 \pm 82.1
Blood transfusion (unit) mean \pm SD	2.5 \pm 0.7
Re-exploration for bleeding	2 (11.11%)
ICU stay (day) mean \pm SD	2.8 \pm 0.9

Table 4: Postoperative complications, mortality and outcome

Hospital stay	Range Mean \pm SD	6-18 9 \pm 3.5
Mortality		0 (0%)
Morbidity		4 (22.22%)
	Stroke	0 (0%)
	Spinal cord insult (paraparesis, paraplegia)	0 (0%)
	Recurrent laryngeal injury	1(5.56%).
	Phrenic nerve injury	0 (0%)
	Respiratory failure (reintubation, tracheostomy)	0 (0%)
	Renal impairment	0 (0%)
	Chylothorax	1 (5.56%)
	Empyema	0 (0%)
	Sepsis	0 (0%)
	Multiple organ failure	0 (0%)
	Bleeding and reopening	2 (11.11%)

DISCUSSION

Aortic coarctation is considered an infancy disease and usually diagnosed and managed before school age.¹² Adult coarctation may be not diagnosed during childhood and first diagnosis is at older age or restenosis in previously treated cases either by endovascular or by surgery due to growth failure of the anastomotic site or a small subclavian flap used. So, lifelong follow up for previously treated cases is a must.¹³

Usually, presentation of adult aortic coarctation appears in the form of hypertension in the upper part of the body, which causes headache, dyspnea, palpitation, chest pain and hypoperfusion of the lower part of the body, which causes lower limb claudication and weak pulses.¹⁴

If adult aortic coarctation not treated usually the patient die in before the 5th decade secondary to hypertensive complications.¹⁵ So, it should be treated if presented with any of the following, pressure gradient across the coarctation >20 mm Hg, uncontrolled hypertension, aneurysm or left ventricular hypertrophy.¹⁶

In the current study the mean age of patients was 29 years (range from 18-42) of them 10 were males (55.56%) and 8 were females (44.44%). BMI was 27.24 \pm 2.13 (mean \pm SD), 6 (33.33%) were smoker and 12 (66.67%) were non-smoker, 3 (16.67%) were diabetics and 15 (83.33%) were non-diabetics, all of the 18 (100%) patients had hypertension. Four (22.22%) patients were asymptomatic at presentation and accidentally discovered during check-up while the other 14 (77.78%) patients were symptomatic. Abjigitova *et al.*¹⁷ had 90 patients underwent surgery with end-to-end anastomosis in 57% patients, the median age was 24 years old (20-36 years) of them 39 (43%) were asymptomatic at presentation and 51 (57%) were symptomatic. Charlton *et al.*¹⁸ had 29 patients above 16

years old had open surgical repair for aortic coarctation, their mean age was 42 years (range, 17-69 years), of them 15 (52%) patients were males and 14 (48%) were females, 10 patients were asymptomatic.

In our study group two patients (11.11%) had surgery for re-coarctation (post ballooning) and the other 16 patients (88.89%) had surgery for native coarctation. All the 18 patients had surgery through left posterolateral thoracotomy with resection and interposition graft technique. Left heart bypass was used in 4 (22.22%) patients. Abjigitova *et al.*¹⁷ had 9 (11%) patients had left heart bypass, 49 (57%) patients had end-to-end anastomosis, 11 (13%) patients had extended end-to-end anastomosis, 11 (13%) patients had patch aortoplasty and 15 (17%) patients had graft interposition. Charlton *et al.*¹⁸ operated upon 9 (31%) patients who had recurrent coarctation after previous repair and 20 patients had native coarctation. 93% of them had resection and interposition graft replacement.

In our study group hospital stay ranged from 6-18 days with a mean \pm SD of 9 \pm 3.5. There was no mortality in our study group. Morbidity happened in four patients (22.22%) in the form of bleeding and re-exploration in two patients (11.11%), recurrent laryngeal nerve injury in on patient (5.56%) who had hoarseness of voice, chylothorax in one patient (5.56%). There was no stroke, spinal cord insult (paraparesis, paraplegia), respiratory failure (reintubation, tracheostomy), renal impairment, empyema, sepsis, multiple organ failure or phrenic injury. 10 patients (55.56%) of our study group had refractory hypertension. Abjigitova *et al.*¹⁷ had one in hospital mortality, 77% of their study group had refractory hypertension for decades. Two patients had left recurrent laryngeal nerve, two patients were reoperated upon for bleeding or tamponade, none of their patients had in patient stroke, spinal insult, respiratory or renal failure. Charlton *et al.*¹⁸ had no in

hospital mortality, paraplegia or stroke. Six patients had acute kidney injury postoperatively, one of them required dialysis but he had stage 3 renal insufficiency preoperatively the other patients recovered. Twelve patients required mechanical ventilation for more than 24 hours due to respiratory failure one of them required tracheostomy. Three patients had chylothorax that was treated medically and one patient had recurrent laryngeal nerve paralysis.

CONCLUSION

Surgical repair of isolated adult aortic coarctation by resection and interposition graft technique had good outcome with no mortalities, acceptable morbidities with refractory hypertension in most of the patients.

Conflict of interest:

The authors declare no conflict of interest.

Sources of funding:

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Author contribution:

Authors contributed equally in the study.

REFERENCES

- Mitchell S, Korones S, Berendes H. Congenital heart disease in 56,109 births. Incidence and natural history. *Circulation*. 1971; 43: 323-332.
- Shepherd B, Abbas A, McParland P *et al*. MRI in adult patients with aortic coarctation: diagnosis and follow-up. *Clin Radiol*. 2015; 70: 433-45.
- Rao P, Galal O, Smith P *et al*. Five- to nine-year follow-up results of balloon angioplasty of native aortic coarctation in infants and children. *J Am Coll Cardiol*. 1996; 27: 462-470.
- Cowley C, Orsmond G, Feola P *et al*. Long-term, randomized comparison of balloon angioplasty and surgery for native coarctation of the aorta in childhood. *Circulation*. 2005; 111: 3453-3456.
- Rodes-Cabau J, Miro J, Dancea A *et al*. Comparison of surgical and transcatheter treatment for native coarctation of the aorta in patients > or = 1 year old. The Quebec Native Coarctation of the Aorta study. *Am Heart J*. 2007; 154: 186-192.
- Holzer R, Qureshi S, Ghasemi A *et al*. Stenting of aortic coarctation: acute, intermediate, and long-term results of a prospective multi-institutional registry—Congenital Cardiovascular Interventional Study Consortium (CCISC). *Catheter Cardiovasc Interv*. 2010; 76: 553-563.
- Campbell M. Natural history of coarctation of the aorta. *Br Heart J*. 1970; 32:633-40.
- Hu Z, Wang Z, Dai X *et al*. Outcomes of surgical versus balloon angioplasty treatment for native coarctation of the aorta: a meta-analysis. *Ann Vasc Surg*. 2014; 28: 394-403.
- Carr J. The results of catheter-based therapy compared with surgical repair of adult aortic coarctation. *J Am Coll Cardiol*. 2006; 47: 1101-1107.
- Baumgartner H, Bonhoeffer P, De Groot N *et al*. ESC Guidelines for the management of grown-up congenital heart disease. *Eur Heart J*. 2010; 31:2915-57.
- Stout K, Daniels C, Aboulhosn J *et al*. AHA/ACC Guideline for the management of adults with congenital heart disease: a report of the American College of Cardiology/American Heart Association Task Force on Clinical Practice Guidelines. *Circulation*. 2018; 139: 698-800.
- Kaushal S, Backer C, Patel J *et al*. Coarctation of the aorta: midterm outcomes of resection with extended end-to-end anastomosis. *Ann Thorac Surg*. 2009; 88: 1932-1938.
- Brown M, Burkhardt H, Connolly H *et al*. Coarctation of the aorta: lifelong surveillance is mandatory following surgical repair. *J Am Coll Cardiol*. 2013; 62: 1020-1025.
- Hager A, Kanz S, Kaemmerer H *et al*. Coarctation Long-term Assessment (COALA): significance of arterial hypertension in a cohort of 404 patients up to 27 years after surgical repair of isolated coarctation of the aorta, even in the absence of restenosis and prosthetic material. *J Thorac Cardiovasc Surg*. 2007; 134: 738-745.
- Verheugt C, Uiterwaal C, Grobbee D *et al*. Long-term prognosis of congenital heart defects: a systematic review. *Int J Cardiol*. 2008; 131: 25-32.
- Warnes C, Williams R, Bashore T *et al*. ACC/AHA 2008 guidelines for the management of adults with congenital heart disease: a report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines (Writing Committee to Develop Guidelines on the Management of Adults with Congenital Heart Disease). Developed in collaboration with the American Society of Echocardiography, Heart Rhythm Society, International Society for Adult Congenital Heart Disease, Society for Cardiovascular Angiography and Interventions, and Society of Thoracic Surgeons. *J Am Coll Cardiol*. 2008; 52: 143-263.
- Abjigitova D, Mokhles M, Witsenburg M *et al*. Surgical repair of aortic coarctation in adults: half a century of a single centre clinical experience. *European Journal of Cardio-Thoracic Surgery*. 2019; 56: 1178-1185.

18. Charlton K, Codreanu M, Leake S *et al.* Open repair of adult aortic coarctation mostly by a resection and graft replacement technique. *Journal of Vascular Surgery.* 2015; 61: 66-72.