CHIRURGIE CARDIAQUE / CARDIAC SURGERY

SURGICAL TREATMENT OF AORTIC COARCTATION IN ADULTS

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Abstract:
Objectives: Surgical treatment of aortic coarctation in adults may be feasible. Limited studies have reported the surgical outcomes of coarctation repair in this particular population. The aim of this retrospective study was to determine the impact of coarctation surgical repair on arterial blood pressure in adults more than 18 years of age. **Methods:** We retrospectively reviewed all patients who underwent operation between 2011 and 2019 in our adult cardiovascular surgery department. Only patient with isolated aortic coarctation without complex congenital heart diseases were operate. All patients were operating by left posterolateral thoracotomy. **Results:** The mean age was 27.33 ± 5.9 years, and 9 patients (%) were asymptomatic. Reconstruction of aortic coarctation with end-to-end anastomosis was performed in majority in majority of patients (73.33%). There was no in-hospital mortality. Two patients were lost for follow-up. In remain 13 patients, the mean postoperative systolic blood pressure was 122.00 ± 13.86 mm Hg versus 168.33 ± 19.45 mm Hg (t=8.48, p=0.000), and mean gradient was 7.87 ± 5.93 mm Hg. Nine patients were normotensive; among then, 5 were normotensive without any antihypertensive drugs at last follow-up. **Conclusion:** Patients with native adult aortic coarctation have low in-hospital morbidity when treated with an open surgical reconstruction. However, long term surveillance is mandatory to identify patients with potential systemic hypertension.
Keywords: Coarctation of aorta, surgery, adults.

Résumé

Objectifs : Le traitement chirurgical de la coarctation de l'aorte est possible chez l'adulte. Il existe peu d'articles sur la chirurgie de la coarctation dans cette classe. L'objectif de cette étude était d'évaluer l'impact de la chirurgie sur l'évolution de l'hypertension artérielle. **Patients/Méthodes** : Il s'est agi d'une étude rétrospective, réalisée dans le service de chirurgie cardiovasculaire de l'hôpital universitaire international Cheikh Zaid de Rabat. Tout patient opéré pour coarctation de l'aorte, et ayant un âge d'au moins 18 ans a été inclus. Tout cas de cardiopathie complexe a été exclus. **Résultats** : L'âge moyen était de 27.33 ± 5.9 ans, neuf patients (%) étaient asymptomatiques. L'approche thérapeutique end-to-end a été la plus utilisée avec 73.33%. Il n'y a pas eu de mortalité hospitalière. Deux patients étaient perdus de vue, parmi les treize restants ; la pression artérielle systolique post opératoire était de 122.00 ± 13.86 mm Hg Vs 168.33 ± 19.45 mm Hg (t=8.48, p=0.000), et le gradient était de 7.87 ± 5.93 mm Hg. Neuf patients étaient devenus normotensifs, parmi eux, cinq ne prenaient aucun médicament anti-hypertensif au dernier contrôle. **Conclusion** : Les patients adultes avec coarctation aortique native peuvent être traités chirurgicalement avec une mortalité et morbidité faible. Cependant, la surveillance à long terme est nécessaire pour le suivi de l'impact de la chirurgie sur l'hypertension artérielle.

Mot clés : Coarctation, aorte, chirurgie, adulte.

Introduction

Since the first surgical repair of aortic coarctation by Crafoord and Nylin in 1945 Surgical techniques have evolved, aiming to reduce early and late mortality as well as minimise long-term sequelae such as re-coarctation and late aneurysm[1]. Many questions remain unanswered about benefits of coarctation repair in adults. Unrepaired aortic coarctation results in high morbidity and mortality from hypertension and associated problems including myocardial infarction, heart failure, aortic rupture, infective endocarditis, coronary disease and inracranial hemorrhage[2,3]. Usually, when patients are younger than 10 years at operation, the survival probability is highest. Several reports indicated poor resolution on hypertension postoperatively in older patients[4.5]. Some authors, suggest that the best age for coarctation repair is approximately 1.5 years [6]. Meanwhile, few data suggest that, surgical repair even in adluts, is safe and improve systemic hypertension[7].The purpose of this study, was to evaluate the fate of hypertension after surgical repair of aortic coarctation in adults.

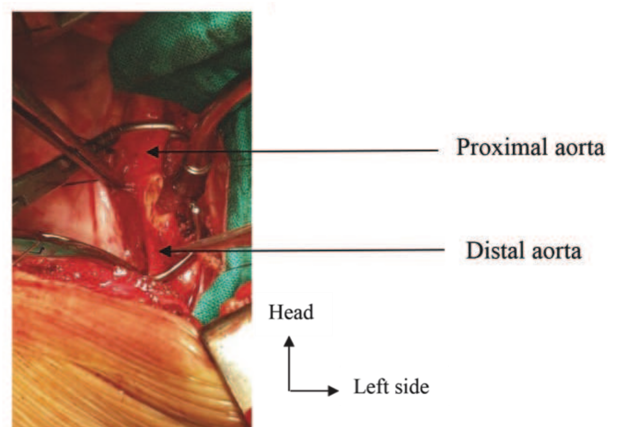
Patients and Methods

We carried out a retrospective study, between 2009 and 2012, 15 adults (≥ 18-years old) underwent repair of aortic coarctation, at cardiovascular surgical department of International Teaching Hospital Cheikh Zaid at Rabat. Patients presenting to this service above age 18 years, with simple aortic coarctation (defined as having no associated congenital heart disease (CHD) except bicuspid aortic valve, persistent ductus arteriosus) were included. Five patients

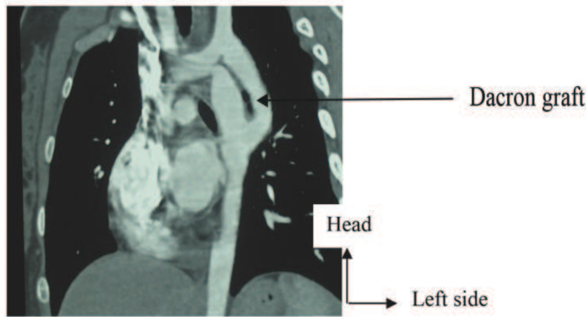
with aortic coarctation in conjunction with other complex CHD were excluded. There included double-inlet RV in 1 patient, Eisenmenger's syndrome due to unrepaired VSD in 1 patient, subaortic stenosis in 2 patients, and Shone's complexe in 1 patient. Preoperative symptoms are summarized in table I. Six patients (%) presented with at least one symptom. For the other 9 patients, the diagnosis made by physical examination was prompted by the discovery of high blood pressure. Clinical findings were a systolic murmur in 2 patients, and femoral pulses were absent in 10 patients. Preoperative and postoperative blood pressure measurements were obtained simultaneously in the left and right arms and lower limbs. In accordance with guidelines established by Joint National Committee, criteria for hypertension, systolic arterial hypertension was defined as follows: mild if systolic blood pressure ranged between 140 and 159 mmHg ; moderate, 160 to 179 mmHg ; severe, 180 to 210 mmHg ; and very severe ≥ 210 mmHg. According to those criteria, and at preoperative evaluation, 4 patients had moderate, 9 had severe, and 2 patients had very severe hypertension. The patients were divided into groups according to the number of antihypertensive drugs taken before surgery and at the time of the last follow up. The drugs included diuretics, beta blockers, vasodilators, calcium channel blockers, angiotensin-converting enzyme inhibitors and angiotensin II receptors inhibitors. Left ventricular hypertrophy was found on electrocardiogram in all patients, rib notching was present in 13 patients, and a dilated mammary artery was found in 2 patients. Two patients had a bicuspid aortic valve with no regurgitation. Coarctation repair was carried out through left thoracotomy. End to end anastomosis was the principal surgical approach in 11 patients (picture 1), resection with interposition of a Dacron tube graft (size 22) in 2 patients, patch aortoplasty with Dacron in 1 patient, and in one case we realized an extra-anatomic shunt; the coarctation was bypassed by a Dacron tube graft between the ascending and descending aortas (picture 2). All 15 patients presented a systemic hypertension. Variables analyzed were sociodemographic, clinical, echocardiographic, therapeutic data and evolution. Data are presented as the mean ± standard déviation, Systolic gradient across the coarctation before and after repair were compaired using a paired *t* test. A value of *p* less than 0.05 was considered significant.

Symptoms	N° of Patients	%
Vertigo	5	33
Asthenia	4	27
Palpitations	4	27
Syncope	2	13
Claudication	3	20
Angina pectoris	1	7

Table I: Preoperative symptoms in 6 patients*
*Nine patients (60%) were asymptomatic.



Picture 1: Operative view of End to End Anastomosis



Picture 2: Sagital view, postoperative result of a proximal and descending aorta bypass.

Results

1) Socio-demographic data

Mean age was 27,33 ± 5.49 years (extremes, 18-36 years). Median was 27, the value of Q1 was 23, and Q3 was 32. Sex-ratio was 2. Table II, illustrates repartition of patients by age and sex.

2) Surgical procedures

The End to end anastomosis was the most frequent surgical procedure practice surgical intervention (73.33%). Table II.

Type of surgery	M		F		Total	
	n	%	n	%	n	%
End to end Anastomosis	7	70,00	4	80,00	11	73,33
Dacron graft interposition	2	20,00	0	0,00	2	13,33
Subclavian flap aortoplasty	0	0,00	1	20,00	1	6,67
Subclavian-aortic bypass	1	10,00	0	0,00	1	6,67
Total	**10**	**100**	**5**	**100**	**15**	**100**

Table II: Repartition of patients according to type of surgery and sex.

3) Hypertension

All patients were hypertensive before surgery. Systolic blood pressure in patients ranged from 140 to 200 mm Hg, with a mean of 168.33 ± 19.43 mm Hg. Mean diastolic blood pressure was 90 ± 12.5 mm Hg (range, 65 to 135 mm Hg). Hypertension was severe in 6 patients, moderate in 4, and mild in 5. The peak systolic gradient across the coarctation in 12 patients 64.93 ± 19.74 mm Hg (Range 38 to 120 mm Hg); the gradient across the coarctation segment could not be assessed in the other 3 patients who had very little forward flow in the aorta. Most patients (11/15, 67%) were on a regimen of at least one antihypertensive drug (figure 2).

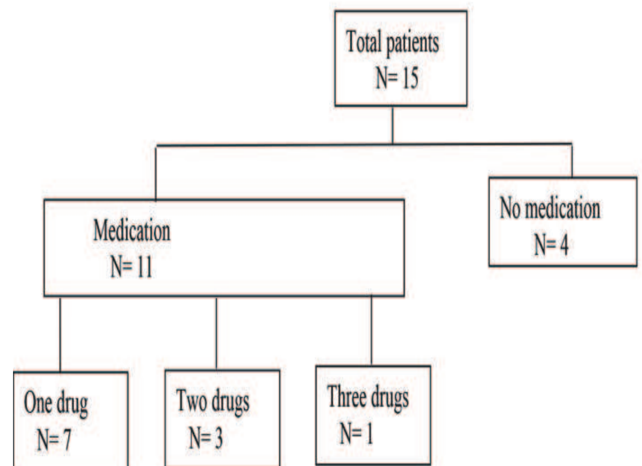


Figure 2: Preoperative anti-hypertensive medication.

Patients were followed up after coarctation repair for 5 to 27 months (mean, 13.73 ± 7.95 months). There was no death. Of all patients with pre-operative hypertension, two were lost to follow-up, remain 9 patients were normotensive (systolic blood pressure < 140 mm Hg) at the most recent follow-up. Mean systolic blood pressure after

the correction in the 13 hypertensive patients who were followed up completely was 122.00 ± 13.86 mm Hg (Range:100-150 mm Hg); compared to the pre-operative value, difference was significant (T=8.48, P=0.000). Mean sistolic blood pressure (65 ± 9.5 mm Hg) was also significantly reduced (T=5.9, P=0.000). Post-operative gradient across the repaired segment was trivial (≤ 10 mm Hg) in 8 patients, mild (≤ 20 mm Hg) in 4 patients, and moderate (> 20 mm Hg) in one patient. Mean post-operative gradient across the repaired segment was 7.87 ± 5.93 mm Hg. Table III, summarizes peri-operative evolution of pressures and gradients.

Variables	Mean	SD	T	P	IC95%
Pressures					
Pre-operative	168,33	19,43			
Post-operative	122,00	13,86			
Paired T test : Pre-operative-Postoperative	46,33	21,17	8,48	0,000	[34,61 ;58,06]
Gradients					
Pre-operative	64,93	19,74			
Post-operative	7,87	5,93			
Paired T test : Pre-operative-Post-operative	57,06	20,58	5,9	0,000	[45,67 ;68,46]

Table III: Comparison between pre-operative and Post-operative pressive gradient.
T : Student Test ; SD: Standard deviation

Five (55%) patients were taking no medication at the last follow-up. Two of the 4 other patients required only a single agent, one required two drugs, and one three drugs. Figure 3 showed post-operative hypertensive status and medication.

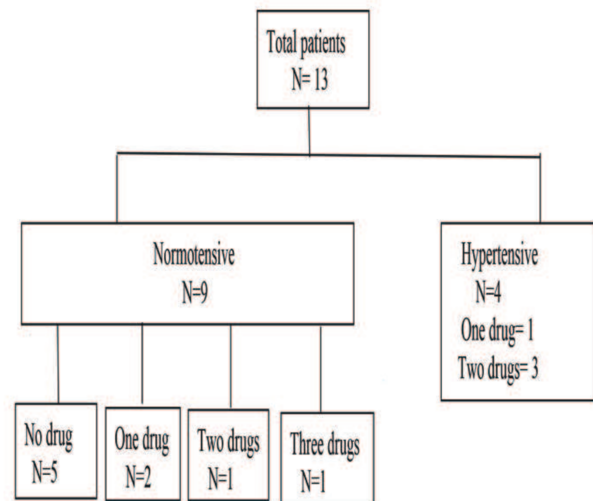


Figure 3: Post-operative anti-hypertensive medication

3) Associated anomalies

A bicuspid aortic valve was associated with the coarctation in 2 patients and their valves were functional with no significant gradient at first examination. A moderate enlargement of the internal mammary arteries in 2 patients.

Discussion

The natural history of the coarctation has been well documented by Campell[2], who demonstrated that 50% of untreated patients were dead by the age of 30 years, 75% at 46 years, and 90% at 58 years. Comparing these data with normal life expectancy tables, we observed that there was a high increase in mortality during the third to fifth decades of life. Age at the time of initial repair of coarctation is the most important predictor of late

hypertension[8,9]. For this reason, there has been some reluctance to refer older adults for coarctation repair, and it has been suggested that patients with repaired coarctation of the aorta, may be "fixed but no cured"[10]. Presbitero and al, whose postoperative follow-up ranged from 15 to 30 years, reported improved life expectancy after surgery[11].In our series, end to end anastomosis remained the cornerstone of aortic coarctation. A graft interposition was used whenever adequate resection of the narrowed segment resulted in too great discrepancy to permit direct suture of the aorta. In one case, we used a bypass between proximal and distal aortas. Certains surgical difficulties may be noted during aortic coarctation repair in adults, such as; thickness of the aortic wall, severe calcifications, difficulties in aortic arch mobilization, and large collateral arteries with aneurysmal dilatation. In these cases, a prothesis should be used to avoid traction on aortic ends. In some cases, bypass grafting between the proximal aorta and the distal aorta should be the procedure of choice. Aris and al, performed operations on 8 patients over 51 years using this technique and achieved good results[12]. This procedure requires less aortic dissection, can be peformed with a partially occluding clamp, and does not compromise the spinal cord vascularization. Persistent hypertension or hypertension recurring or developing after coarctation repair is the most important factor of morbidity and mortality associated with advancing age in patients. Some series, found that the younger the age the operation was performed the greater the postoperative reduction in blood pressure[13-15]. Also, late hypertension was more common when the operation was delayed until the age of 20 years.In our study, all patients had systolic preoperative hypertension. Of these, two were lost to follow-up and 9 (69%) were normotensive at the recent follow-up. The mean systolic blood pressure was significantly less than the preoperative value. This result is in agreement with Y and al, that found hypertensive patients had significantly improved systolic blood pressure postoperatively, and the majority were normotensive[16,17]. The mean post-operative gradient across the repaired segment was significantly reduced. Another finding was that 5 (38%) patients were taking no medication at the last follow-up. Persistent hypertension after aortic coarctation repair is multifactorial[18-20]. In adults, these factors include; anatomic aortic alterations, functional and structural wall alterations of thoracic peripheral vessels, poor compliance of arterial tree, endocrine factors, and altered renin-angiotensin system[21]. After repair, patients have an increased sympathetic discharge at peak exercise leading to increased peripheral resistances.

Conclusion

Thus, with small number of patients, the results of this study confirm that surgical repair of aortic coarctation in patients older than 18 years of age reduces systolic hypertension. However, we think in the future realize study in large cohort, and appreciate the incidence of ischemic heart disease and also major cardiovascular and cerebro-vascular events (MACCE).

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