

# Journal: Systematic Review in Pharmacy

## Short Term Follows Up for Stenting Coarctation Of Aorta in Adult

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### Abstract

**Background:** coarctation of aorta occur in 6 % of patient with congenital heart disease, balloon dilation, stenting and surgery have been proved as modality of treatment coarctation of aorta. Usually untreated coarctation of aorta may lead to renal, vascular and cardiac complication that start to appear at beginning of fourth decade of life.

**Aim:** Mortality and morbidity rate among patients use uncovered stent in treating adult coarctation of aorta and short term outcome.

**Patient and method:** 75 patients with coarctation of aorta 30 male (40%) and 45 female (60 %) was involve in this prospective longitudinal study, there age range from 16 to 41 year, for all echocardiography, CT chest done to confirm diagnosis then all undergo catheterization of aorta with 2 sheath one femoral and other radial to measure pressure gradient across stenosis and stent localization follow by stenting with pre and post dilation if needed then measure pressure gradient across stent.

**Result:** all patients stent by uncovered stent including for 2 case with interrupted coarctation, immediately after stent pressure gradient fall almost all our patient then follow up 6 month, 1 year by angiography assessment with CT chest show no stent fracture or aneurysm in aorta at stent site.

**Conclusion:** uncovered stent appear to be safe in treating coarctation of aorta with less morbidity and mortality. It has advantage that no side branch loss especially in case of coarctation at subclavian artery (preductal). It required small femoral sheath size (less than 11 French) so less access site complication.

**Keywords:** coarctation of aorta, adult congenital heart disease, hypertension, interventional cardiology

### INTRODUCTION

Coarctation of the aorta (CoA), is a congenital disease in

which the aorta is tightening, occurs most commonly following to the ductus arteriosus, also, coarctation can be

defined as constriction of aorta of different degree that may occur at any part from transverse arch of aorta to iliac bifurcation but most commonly appear just below the beginning of subclavian artery<sup>1,2</sup>. This constriction of aorta may lead to total cut of aorta with fibrous remnant which is called interrupted coarctation of aorta or may lead to just narrowing of aorta which is called un interrupted coarctation of aorta, with variable degree of constriction from mild without hemodynamic consequence to severe with hemodynamic consequence and this is usually assessed by invasive hemodynamic measurement.<sup>3</sup> On embryonic base CoA can be classified into post ductal and preductal according to presence of constriction pre or post to subclavian artery.<sup>4</sup> It may be a part of manifestation of turner syndrome, and in 70% of patients is associated with bicuspid aortic valve also it may be associated with mitral valve anomalies and the presence of sub aortic stenosis characteristic for presence of coarctation.<sup>6</sup> Physiologically coarctation of aorta lead to development of collateral flow that lead to pass blood from up to down and by pass the coarctation.<sup>5</sup> In infancy it is usually asymptomatic while in childhood and adolescence patients may complain from weakness or pain in leg related to motion.<sup>6</sup> Usually untreated coarctation of aorta may lead to renal, vascular and cardiac complication that start to appear at beginning of fourth decade of life.<sup>7,8, 12, 13</sup> Treatment of coarctation of aorta include surgical and interventional where surgical depend on end to end anastomosis or prosthetic patch aortoplasty or grafting, in interventional management depend on balloon angioplasty specially for children or stenting for adult.<sup>9</sup> Post coarctation correction, possible surgical complication including hemorrhage, re-coarctation, paradoxical hypertension, stroke, and aneurysm.<sup>15, 16</sup> The location of the obstruction in a patient with coarctation of the aorta (typically just distal to the takeoff of the left subclavian artery) creates not only an increase in left ventricular afterload, but also differential hypertension, with high pressures. Studies suggest that balloon angioplasty and surgical correction are equally effective in reducing the peak systolic pressure gradient early after intervention; however, the surgical approach is associated with higher immediate procedural complications and longer hospital stays, whereas balloon angioplasty is associated with a higher incidence of re-coarctation (up to 25%) and aneurysm (7%) formation at follow-up.<sup>9</sup> The manifestations of aortic coarctation depend on the severity of obstruction. In neonates, severe obstruction may develop rapidly following closure of the arterial duct, causing cardiac failure, systemic hypoperfusion and acidosis. In infants, aortic obstruction may develop more slowly if there is delayed ductal constriction.<sup>10</sup>

**Aim of study:** Mortality, morbidity and short-term outcome among patients underwent uncovered stent implantation in treating adult coarctation of aorta

## MATERIALS AND METHODS

### Patients

75 patients with coarctation of aorta, all these persons had been selected from those patients visit the cardiology consult department in Al-najaf cardiac center or from private clinic from the period January 2018 to January 2019. For all patient's data collected about age, sex, blood pressure, laboratory finding of glucose, renal function, lipid profile. For all echocardiography study done, and after diagnosed to have coarctation of aorta, CT chest done to confirm the diagnosis with stenosis of aorta more than

50%, then all undergo catheterization of aorta with 2 sheath one femoral and other radial to measure invasive pressure gradient across the stenosis and if gradient more than 20 mmHg then intervention indicated or according to other indication list mention below. In Cath lab the femoral access done by modify seldenger approach after local anesthesia with 5 cc xylocaine, anterior wall puncture done by seldenger needle and after blood came through the needle which confirm that it in the vessel lumen at that time introducer wire pass through the needle and act as rail to pass the sheath with introducer (dilator) to the vessel and prevent vascular injury or perforation, after that when sheath passed to the vessel wire and introduce were removed and sheath was flushed with heparinized saline, we use 6 Fr sheath size for femoral access.

Radial access done by seldenger approach, after local anesthesia with 2 cc xylocaine and localization of radial artery, the needle pass through anterior wall and when blood appear further push needle through posterior wall then with wire introduce the needle pull back and blood appear again so the wire pass to vessel and act as rail for sheath same as modified seldenger approach, after flushing the sheath blood pressure measure and if acceptable then cocktail given to prevent vascular spasm which contain xylocaine and heparin and nitrate and adenosine. We use then multipurpose guide catheter with guide wire through femoral sheath to reach coarctation and use pigtail catheter with guide wire through radial sheath to reach coarctation after pass from brachiocephalic artery to descending aorta, at that time pressure gradient through coarctation can measure.

If coarctation indicated for intervention then we try to pass guide wire with multipurpose guide catheter through coarctation until reach aortic sinus then exchange with stiff guide wire then replace sheath with bigger one as balloon and stent need bigger one usually we use 9 Fr size sheath.

Localization of stent position by radial contrast injection with fluoroscopy follow by stenting with palmar uncovered stent, pre and post dilation if needed then measure pressure gradient across stent, success of procedure is defined as pressure gradient across coarctation zero mmHg. For all patients invasive blood pressure measurement before and after stenting during catheterization pre and distal to stenosis with follow-up by upper limb blood pressure measurement by sphygmomanometer on both arm in day 1, first month, 6 months and 1 yr. For all patients follow up with CT of chest done after 6 month and 1 yr. for any aortic wall injury or aneurysm develop.

### Indication for intervention in coarctation of aorta patient

Angiographic indication if invasive blood pressure across the stenosis more than 20 mmHg or stenosis of aorta more than 75%

### Inclusion Criteria

1. Native or recurrent aortic coarctation
2. pressure gradient across the stenosis invasively more than of 20 mm Hg
3. CT scan of aorta show interrupted or un interrupted aorta
4. Symptomatic patient with invasive pressure gradient > 20 mmHg across the stenosis.

### Exclusion Criteria

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1. Control blood pressure in pregnancy
2. Aneurysm of aorta fit for surgery.
3. Stent coarctation previously
4. Invasive pressure gradient < 20 mmHg across the stenosis.
5. Patient refusal

### Statistical analysis

For continuous variables we use mean, standard deviation as descriptive statistics, for categorical variables we use number, percentage, as descriptive statistics, for analysis we use paired t test for continuous variables and chi square for categorical variables. All calculations done by EXCEL Microsoft 2016 software.

### RESULT

Over 12 month's period of the study, 75 patients with coarctation of aorta were assessed including 45(60%) women and 30 (40%) men. The age range was 16 years to 41 years with the mean age 25.7 years (SD  $\pm$ 6.6) as seen in table (1), after diagnosis of coarctation all those patients enrolled in this research then invasive blood pressure measured in descending and ascending aorta before and after intervention done with pressure gradient across the stenosis to determine indication and success of intervention, no death or complication happened during intervention, after stent implantation sudden elevation of blood pressure seen in 5 patients (15%), almost all patients experienced an immediate reduction in mean systolic blood pressure pre coarctation (from  $159.80 \pm 20.5$  to  $120.87 \pm 31$  mm Hg), (95% confidence interval of this difference From 30.5 to 47.4) (P value is less than 0.0001) as seen in table (2). At the 6-month

follow up we found that 88.4% get better blood pressure control (no need for antihypertensive medication with normal blood pressure reading on measurement by sphygmomanometer on both arm) also became at same improvement at the 1-year checkup visit at which 84.9% control blood pressure (no need for antihypertensive medication with normal blood pressure reading on measurement by sphygmomanometer on both arm) as seen in table (3). 69 patients (92% of those who had a stent implanted) returned for the 6-month follow-up evaluation, 53 patients (70% of those who had a stent implanted) returned for the 1-year follow-up evaluation, at 6 month and 1 year for patient return for follow up CT angiography done in 39/69 patients (52% of those who had a stent implanted) at 6 month and in 18/45 patients (24% of those who had a stent implanted) at 1 year show no aortic wall injury or aneurysm development, and at 1 yr. follow-up no mortality occur as seen in Algorithm 1.

**Table 1.** Patients demographic data

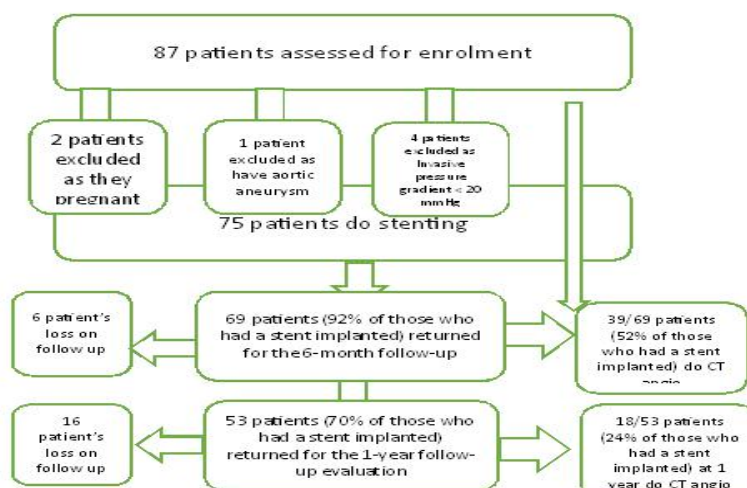
Parameter	No. (%) n=75
Gender (M:F)	30 (40%):45 (60%)
Age per year (Mean $\pm$ SD)	16-41 (25.7 $\pm$ 6.6)
hypertension	75
diabetic	3
smoker	5
Previous surgical correction	0
Interrupted CoA	2
Previous stenting	0
Associated bicuspid aortic valve	51 patients
Renal impairment	0
stroke	1
Left ventricular hypertrophy	59 patients

**Table 2.** comparison in mean systolic blood pressure measurement by catheterization before and immediately after stenting in patient's underwent intervention for CoA

Blood pressure	Pre stenting (n=75)	Post stenting (n=75)	P value
Pre coarctation systolic blood pressure (mmHg)	159.80 $\pm$ (20.5)	120.87 $\pm$ (31)	0.0001
Post coarctation systolic blood pressure (mmHg)	97 $\pm$ (14.6)	121.5 $\pm$ (24.7)	0.0001
Average difference in systolic blood pressure pre and post coarctation (pressure graident)	38 $\pm$ (12)	2 $\pm$ (3)	0.0001

**Table 3.** comparison between blood pressure reading at immediate and 6 month and 1 yr. after intervention in patient's underwent intervention for CoA

No. of patients On follow up Blood Pressure Measurement (mmHg)	Immediate Post intervention	6 month follow up	1 year follow up	P value
Normotensive	74(98.7%)	61 (88.4%)	45 (84.9%)	0.0001
Hypertensive	1(1.3%)	8 (11.6%)	8 (15.1%)	
Total	75(100%)	69(92%)	53(70%)	



**Algorithm 1.** patients flow diagram in patient's underwent intervention for CoA

## DISCUSSION

As hypertension has genetic and environmental risk factor, patient with coarctation carry both these factors.<sup>17</sup> <sup>18</sup> Untreated hypertension can lead to significant mortality and morbidity so management is vital for survival. <sup>19</sup> Our research focus on the benefit of reduced morbidity by treating coarctation of aorta by stenting, only 15 % of patients enrolled in research persist to have hypertension after 1 year follow up while 85 % of patients get rid of hypertension and this in concordance with COSTA 2 trail<sup>25</sup>. One possible complication of stenting aortic coarctation is stent fracture which may lead vascular injury, <sup>20,21</sup> in our research no case develop fracture of stent after 1 year follow up and this similar to COSTA 2 trail<sup>25</sup>. From other possible complication of stenting coarctation which less frequent are aortic wall injury, aneurysm and dissection of aorta that may develop after intervention and lead to morbidity and mortality, <sup>22,23,24</sup> with palmaz stenting of coarctation and on 1 year follow up no one of this complication occurs, this date also observe in COSTA 2 trail<sup>25</sup>

## CONCLUSION

uncovered stent appear to be safe in treating coarctation of aorta with less morbidity and mortality. It has advantage that no Side branch loss especially in case of coarctation at subclavian artery (preductal). It required small femoral sheath size (less than 11 French) so less access site complication.

## Recommendation

Use uncovered stent in treating indicated coarctation of aorta as primary modality of management as it regard as 1 year flow up show it safe with less mortality and morbidity.

## Limitation of study

1. Larger number patient's research needed to confirm this research finding
2. Midterm to long term follow up needed to identify morbidity and mortality.
3. Compare with other type of stent needed.
4. Compare with surgical result needed.
5. No control group available for more confirm mortality and morbidity benefit of stenting coarctation.

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