Original Paper

COARCTATION OF AORTA MANAGED BY BALLOON ANGIOPLASTY

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Abstract

A retrospective study was carried out on 50 patients at Paediatric cardiology unit of Combined Military Hospital, Dhaka to analyze the outcome of balloon angioplasty of coarctation of aorta. The study period extended over two years starting from January 2007. Age of the patient varies from 7 days to 28 years. Twenty two (44%) patients were female and rests were male. Native coarctation was in 44 cases (88%) and post surgical re-coarctation was in 5 cases (10%). Neonatal critical coarctation was 19 (38%). Twelve (24%) cases were detected when they were investigated for hypertension. Abdominal coarctation was found in 6 cases (12%). Multiple coarctations were found in 3 (6%) cases. Two cases (4%) had balloon angioplasty twice as they developed re-coarctation. No intra-operative or post-operative complication was observed in any cases of this series. Data were collected by chart review. No test was performed on any of the subjects as part of study protocol. Coarctation balloon angioplasty of coarctation of aorta is a safe and effective measure to treat coarctation of aorta.

Key words : Balloon angioplasty, coarctation of aorta.

Introduction

Coarctation of Aorta is a common congenital defect which comprises about 8% of all congenital lesions. Most of the cases are detected in childhood and treated accordingly but some of the cases may also be detected in adolescents and adults in the context of investigation for hypertension[1]. Coarctation varies considerably in its anatomy, physiology, clinical presentation, treatment-options and outcome. Though it is usually a discrete lesion, coarctation may consist of a long segment stenosis, may be associated with tubular hypoplasia of transverse arch or abdominal in location[2]. In some rare cases more than one coarct area may be found along the course of aorta. Critical coarctation at the level of isthmus typically presents in infancy and is a medical emergency. The natural history of untreated coarctation is that of premature death from stroke and coronary heart disease or sudden death. Relief of anything more than mild obstruction is usually indicated[1].

Materials and Methods

Study design : Retrospective study which was carried out in paediatric cardiology unit of Combined Military Hospital (CMH) Dhaka from January 2007 to December 2009.

Indication for intervention : Any patient with diagnosis of discrete coarctation of aorta by echocardiography or MRI and a resting systolic gradient by sphygmomanometer between the upper and lower limbs of >20 mm Hg were offered balloon angioplasty as an alternative to surgery. Neonates and young infants were also included in the study as paediatric surgical facility in full range is not yet available in study center.

Exclusion criteria : Coarctation of aorta associated with other lesions which cannot be managed non surgically. Long segment coarctation and hypoplastic transverse arch were also excluded.

Technique : Informed consent was taken before the procedure. All the patients were sedated with injection ketamine and midazolum. After proper draping, right heart catheterization was performed. An end hole catheter was introduced through retrograde approach and exchanged with pigtail catheter placing the tip of the catheter in the ascending aorta. Aortogram was performed in left anterior oblique (15 - 20) and lateral view to visualize the area of coarctation. Pressure gradient between ascending aorta and RFA was measured in all cases. A 0.035 mm x 260 cm wire was exchanged with pigtail catheter keeping the tip just above the aortic valve. Patients were heparinized with 100 u/kg heparin immediately after vascular entry. Balloon diameter initially chosen was equal or up to 2 mm more than the size of the aorta at the level of subclavian artery and not greater than the diameter of aorta at the level of diaphragm. Short inflation time was utilized and repeated for 2/3 times. An aortogram was repeated to check the lesion and pressure gradient measured again between ascending aorta and RFA. If no significant change noticed then next larger balloon was used in similar manner. Eighty percent increase in diameter of coarctation area and pressure gradient of less than 20 mm Hg was considered as successful intervention.

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Data collection : Pressures of the aorta above and below the level of coarctation were measured before and after balloon angioplasty. Diameters of aorta at various levels were measured.

Aortic arch measurement: Transverse arch was measured between brachiocephalic and left common carotid artery. Isthmus, coarctation segment and diameter at the level of diaphragm were also measured. Where duration of procedure was long, additional 75 u/kg heparin was given. Pedal pulse and blood pressure of the patients were monitored at 15 minutes interval in first hours, 30 minutes interval in next two hours and hourly interval in next 6 hours. If pedal pulse was found absent after one hour, heparin infusion was started at the rate of 15 u/kg/hrs after a bolus dose of 75 u/kg dose.

Follow up: Patients were followed up at regular interval depending on their clinical status. Echocardiography was performed immediately after the procedure and before discharge. Most of the patients were discharged 24 hours after the procedure. Only neonates were discharged 72 hours after the procedure.

Results

Twenty eight (56%) of the patients were male and 22 (44%) were female (table - I).

Table - I: Sex distribution of the patients (n=50).

Sex	Number	Percentage
Male	28	56
Female	22	44

Fig-1: Severe coarctation of the aorta.

Most of the cases were neonates (38%) and only 10% cases were of more than 15 years of age (table II). Thirty eight percent of the patients were presented with feature of congestive heart failure or acute renal failure in the neonatal period (table-III). Twenty eight percent patient had incidental finding of murmur when they referred to doctor for other illness. Twenty four percent patients had headache or hypertension or history of convulsion for

Table - II: Age distribution of the patients (n=50).

Age	Number	Percentage
Up to 28 days	19	38
> 28 days to 1 year	03	06
> 1 year to 5 years	09	18
> 5 years to 15 years	13	26
> 15 years	05	10

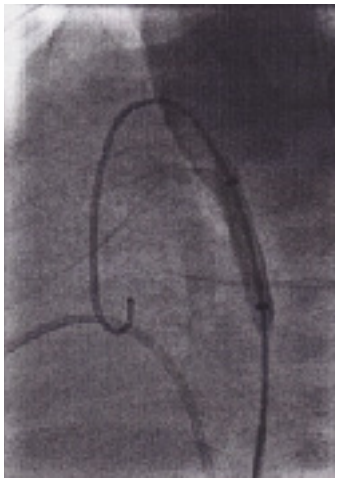

Fig -2 : Balloon angioplasty procedure with inflated balloon inside the coarct segment.

Median age 4.8 years which they were investigated and found as coarctation of aorta. Ten percent of the cases were post-surgical re-coarctation cases and they were identified as re-coarctation during follow up. Majority of the cases (78%) had coarctation near the origin of subclavian artery (table-IV). Four percent (02 cases) had coarctation in multiple site which were located in thoracic and abdominal aorta. These two cases were investigated and later diagnosed as polyarteritis nodosa.

Table - III : Mode of presentation (n=50).

Presentation	Number	Percentage
Neonatal presentation with heart failure/renal failure	19	38
Incidental finding of murmur	14	28
Work up for hypertension	12	24
Post surgical case	05	10

Ninety percent of cases showed more than 30 mm of Hg pressure gradient across coarct segment during angiography (table-V). Balloon diameter used for various age group was selected depending on age (table-VI). Minimum balloon size was 4mm and maximum was 20 mm.

Fig-3 : Aortogram after balloon angioplasty procedure.

In 48 (96%) cases pressure gradient reduced to below 20 mm Hg after balloon angioplasty. In two (4%) cases pressure gradient dropped to below 30 mm Hg.

Table - IV: Site of coarctation in Aortogram (n=50).

Site	Number	Percentage
Near the origin of left subclavian artery (at the insertion of ductus arteriosus)	39	78
InThoracic aorta	02	04
Multiple coarctation	02	04
In Abdominal Aorta	06	12

Aneurysm formation and dissection was not observed in any of the cases. In two cases there was re-stenosis after 6 months of intervention and balloon dilatation was repeated. Pedal pulse loss was encountered in 4 (8%) cases and heparin infusion was given. Thrombophlebitis was noticed in 1 (2%) case and was treated accordingly.

Table-V : Pressure gradient range across coarctation segment (n=50).

Range	Number	Percentage
20 - 30 mm Hg	05	10
30 - 50 mm Hg	24	48
> 50 mm Hg	21	42

Table-VI : Balloon diameter used for the cases (n=50).

Age	Balloon size
Neonate	4 mm - 8 mm
Infants	6 mm -10 mm
Less than 5 years	6 mm -12 mm
> 5 - 15 years	8 mm -14 mm
> 15 years	10 mm -20 mm

Table-VII: Out come of the cases (n=50).

Parameter	Number	Percentage
Pressure gradient less than 20 mm Hg	48	96
Pressure gradient less than 30 mm Hg	02	04
Aneurysm formation	Nil	--
Re intervention	02	04
Femoral pulse loss	04	08
Aortic dissection	Nil	--
Thrombophlebitis	01	02

Discussion

Coarctation of aorta accounts for 5%-8% of congenital heart disease[3]. Coarctation of aorta was the first congenital heart defect to be reported surgically in 1945 by Crofoord[4]. Balloon angioplasty for coarctation was first reported in 1982[5]. Balloon angioplasty for coarctation was first performed at reported center in the year 2000 which was the first reported case in Bangladesh[2]. Coarctation is more common in male than female[6,2]. This study also showed male preponderance (1.27:1). The management of patient presenting with neonatal coarctation is revolutionized by invention of prostaglandin E and its use to restore the patency of the ductus[7]. It was found here that 19 (38%) cases of coarctation were in neonates and early detection of the cases are possible now a days. Fourteen cases were completely asymptomatic and were identified incidentally when they reported to Pediatricians/physicians for other reasons. Majority of the cases were asymptomatic older children, adolescents and adults found in some other studies[8,9]. The indications for balloon angioplasty of aorta are :

- Native or recurrent obstruction with gradient > 20 mm Hg.
- Coarctation where there is left ventricular hypertrophy or systemic hypertension or extensive collaterals.

At reported centre balloon angioplasty was performed for post surgical re-coarctation in 5 cases. One study showed excellent outcome of balloon angioplasty of re-coarctation which was published in 2008[9]. Another study in Yale university school of medicine showed good outcome of balloon angioplasty of surgical re-coarctation[10]. In present study outcome was excellent. Re-intervention was required in two cases only 6 months after the first intervention. In a study carried out in hospital for sick children Toronto, Canada showed good outcome and concluded the study by saying that balloon angioplasty is a safe and effective treatment for native coarctation of aorta[11,12]. Major drawback of the procedure is that it may cause recoil of the vessel wall and restenosis[13]. Balloon angioplasty may cause aortic wall dissection in 1-4% cases and aneurysm formation in 4-11.5% cases[14,15]. In this study no such complication was noticed.

Conclusion

Trans-catheter therapy for native and recurrent coarctation is effective with good short and intermediate term outcome. Reported study supports the previous studies showing that balloon dilatation is safe and effective treatment for native as well as post surgical coarctation of aorta in children, adolescents and adults. Even infantile coarctation has good outcome and it is a safe and effective procedure for the centers where surgical help is not available.

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