

## Pulmonary Valvuloplasty: Analysis of Fifteen Cases

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### Summary :

*Fifteen cases of severe pulmonary valve stenosis (PS) had undergone cardiac catheterization and pulmonary valvuloplasty in Cardiac Catheterization Laboratory (CCL) of Combined Military Hospital (CMH) Dhaka from July 2001 to December*

*2002. 14 cases (93.33%) had excellent result and only one case had unsatisfactory result. In that case valvuloplasty was done on three occasions and each time she developed severe stenosis 3-6 months within the procedure. Now she is waiting for surgery.*

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### Introduction :

Pulmonary valve stenosis (PS) is a condition where pulmonary valve cannot open normally. Isolated pulmonary valve stenosis is a relatively common anomaly, with a prevalence estimated as high as 10 percent of all congenital heart disease<sup>1-2</sup>. Majority of patients with valvar pulmonary stenosis are asymptomatic and discovered only during routine examination<sup>3</sup>. Mild stenosis usually improves with growth but severe stenosis often becomes worse<sup>3</sup>. Balloon valvuloplasty is the non-surgical approach for treatment which was first described in 1979<sup>4</sup>. The technique is relatively straight forward and the result is excellent<sup>5-6</sup>. In this study 15 cases of severe pulmonary valve stenosis were treated with balloon valvuloplasty with excellent outcome.

peak pressure gradient (PPG) of >60 mmHg across the pulmonary valve. Patient with critical pulmonary stenosis had severe pulmonary stenosis along with serious symptoms. The 15 cases who had pulmonary valvuloplasty were referred to the paediatric cardiology out patient department by the paediatricians. Out of 15 cases 8 cases had incidental findings of murmur when they reported to the paediatricians for other reasons. Five cases had exertional dyspnoea, one had chest pain and another one with critical PS had cyanosis.

Before cardiac catheterization complete workup of the patients were done. Chest X-ray, electrocardiogram (ECG) and Doppler echocardiography was done and patients who fulfilled the selection criteria were selected for cardiac catheterization. After cardiac catheterization 13 cases were excluded and 15 were finally selected for valvuloplasty on the same sitting. Sizes of the balloons were selected after measuring the pulmonary valve annulus from the Right Ventricular (RV) angiogram in lateral view. After valvuloplasty patients were kept in observation for 24 hours and then they were discharged with an appointment for echocardiography and follow up at 1, 3, 6, 12, 18, 24 months interval and yearly thereafter. So far follow up upto 6 months has been completed in all cases.

### Materials and Methods :

This is a retrospective study carried out in the cardiac catheterization laboratory (CCL) of Combined Military Hospital (CMH) Dhaka over a period of 30 months from July 2001 to December 2002. Total twentyeight cases were prepared for pulmonary valvuloplasty but 13 cases were postponed after cardiac catheterization because of presence of subvalvular stenosis along with valvular PS or dysplastic pulmonary valve. The inclusion criteria for the patients were (a) severe or critical pulmonary valve stenosis (b) isolated valvular stenosis without any association with subvalvular or supra valvular stenosis (c) Absence of other cardiac lesions which necessitates open-heart surgery. Patients with dysplastic pulmonary valve and mild to moderate pulmonary stenosis were excluded from the study. Patients who had mild pulmonary valve stenosis had pressure gradient of < 40 mmHg across pulmonary valve and those who had moderate stenosis had gradient of 40 – 60 mmHg across the pulmonary valve. Patient with severe pulmonary stenosis had

### Procedure

#### *Equipments:*

Balloon – weight, age and pulmonary valve annulus determined the size of balloons.

Guide wire – super stiff guide wire was used.

Preparation of balloon – balloons were prepared by aspiration and flushing. The air inside the balloon and vent were replaced with contrast solution. Dilution of 1:8 of omnipaque 350 and saline used. Right ventricular (RV) angiogram was performed first to see pulmonary valve annulus.

Procedure – Exchange wire was inserted through Goodale Lubin (GL) catheter and advanced into distal

pulmonary vessels. Catheter and sheath were removed together keeping the wire in position. The prepped balloon was inserted over the wire. Balloon was advanced to the pulmonary valve. Coordination with wire was maintained to prevent arrhythmia and damage to the distal pulmonary vessels. The balloon was inflated quickly. Inflation was stopped when the waist of the balloon disappeared. Gentle traction was given to keep the balloon in the annulus. The balloon then quickly deflated and withdrawn slightly to allow perfusion. Procedure was repeated 2-3 times before removing balloon. Balloon was then withdrawn and catheter reintroduced to pulmonary artery over the guide wire along with sheath. Withdrawal gradient was recorded across pulmonary valve and RV angiogram repeated to see the result. All the patients had out patient appointment at regular interval to see the result of the procedure.

#### Result :

Out of fifteen patients ten were female and five were male. Age varied from 26 days to 25 years. Right ventricular (RV) pressure was <100 mmHg in 8 cases

and it was 100 mmHg or above in 7 cases. Pressure gradient across pulmonary valve was between 60 to 80 mmHg in eight cases. Pressure gradient was >80 mmHg in rest 7 cases. In 10 cases pressure gradient across pulmonary valve dropped to 30 mmHg or less after valvuloplasty. In other 5 cases pressure gradient was more than 30 mmHg (table I). Table II showed symptoms on presentation. Most of the patients (53.33%) were asymptomatic. Table III showed out come of treatment. In all 15 cases immediate result was satisfactory but 6 months follow up showed restenosis in one case. Results were considered satisfactory when pressure gradient across pulmonary valve was reduced to 40 mmHg or less. One patient who developed restenosis at 6 months follow up was a neonate with critical PS. Her valvuloplasty was performed as a life saving intervention and immediate result was good. This procedure has saved her life at that time when surgery was not possible on her. Out of 15 cases 14 had peak pressure gradient of <40 mmHg in echocardiography at 6 months follow up and one had PPG >60 mmHg across pulmonary valve.

**Table-I**

*Patient data and analysis. n= 15*

Serial No	Age	Sex	Pressure inside right ventricle	Pulmonary stenosis gradient	Pulmonary valve annulus	Balloon size gradient	Post balloon
01	9½ yrs	F	75 mmHg	60 mmHg	16.5 mm	18x4	4 mmHg
02	8 yrs	F	85 mmHg	75 mmHg	17 mm	18x3	15 mmHg
03	16 yrs	F	85 mmHg	65 mmHg	15.5 mm	18x3	26 mmHg
04	7 yrs	M	75 mmHg	55 mmHg	13 mm	15x4	20 mmHg
05	3 yrs	F	80 mmHg	62 mmHg	13 mm	15x4	20 mmHg
06	3 yrs	F	160 mmHg	144 mmHg	10 mm	12x4	35 mmHg
07	5 yrs	M	110 mmHg	88 mmHg	9.5 mm	12x4	No gradient
08	25 yrs	M	80 mmHg	60 mmHg	16.5 mm	18x3	35 mmHg
09	3 months	F	76 mmHg	55 mmHg	12 mm	15x4	30 mmHg
10	8yrs	M	200 mmHg	180 mmHg	13 mm	15x4	38 mmHg
11	1½ yrs	F	105 mmHg	85 mmHg	13 mm	15x4	20 mmHg
12	26 days	F	102 mmHg	88 mmHg	7 mm	8x2	135 mmHg
13	1 yr	F	84 mmHg	70 mmHg	12 mm	14x3	30 mmHg
14	2 yrs	F	115 mmHg	96 mmHg	10 mm	12x3	20 mmHg
15	2 8 mo	M	100 mmHg	82 mmHg	13 mm	15x4	35 mmHg

**Table II***Symptoms on presentation: n = 15*

Symptoms	No of patient	Percentage
Asymptomatic	08	53.33
Exertional dyspnoea	05	33.33
Cyanosis (mild)	01	6.64
Chest pain	01	6.64

**Table III***Outcome of treatment: n = 15*

Outcome	Immediate	6 months after procedure
Satisfactory	15 (100%)	14 (93.33%)
Not satisfactory	0	1 (6.64%)

Note: Satisfactory result means PPG of 40 mmHg or less across pulmonary valve after valvuloplasty. Immediate pressure gradients were recorded in the cath lab after valvuloplasty.

### Discussion

Balloon valvuloplasty for congenital pulmonary valvular stenosis is a safe and effective procedure and it is the initial treatment of choice<sup>7</sup>. Outcome for balloon valvuloplasty for critical PS in newborn babies is also excellent. One study conducted in Taiwan showed 79% definitive success of balloon valvuloplasty in neonates with critical PS<sup>8</sup>. In our study we had one patient with critical PS. She developed recurrent pulmonary stenosis and after repeating the procedure three times, she was referred for surgical valvotomy. Immediate result was satisfactory in this baby in every attempt but she developed restenosis within 6 months of the procedure. This procedure saved her life in every occasion when she was severely symptomatic and surgery was not available for her in any cardiac centre of Bangladesh. Sex distribution of patient is about equal, but in our study female were predominant (table I). Growth and development in patient with pulmonary stenosis is usually normal<sup>3</sup>. We had not seen any cases of growth failure in our study. Symptoms are rare in infants, with a notable exception in those with critical pulmonary stenosis<sup>9</sup>. In this study one patient had critical PS and she

presented with cyanosis in neonatal period. Most of our patients (53.33%) were asymptomatic (table II). Although immediate and intermediate term results after balloon dilatation of congenital stenotic lesions of the heart in children are well studied, long term results have not been documented<sup>10</sup>. In our study, follow up echocardiography at 6 months showed good result in 93.33% cases (table III). One study conducted in Osaka, Japan showed decrease of mean pressure gradient immediately after balloon valvuloplasty (BVP) from  $61 \pm 27$  mmHg to  $28 \pm 20$  mmHg and the reduced gradient continued at follow up in most cases<sup>7</sup>. We did only one adult valvuloplasty in this study who was 25 years old and he had excellent result till 6 months follow up. One study conducted on 34 cases of adult showed good medium term result<sup>11</sup>. Late result was shown good in another study in adult<sup>12</sup>. In our series no complications were encountered. But complications like acute pulmonary oedema, significant pulmonary valve incompetence following oversized pulmonary balloon valvuloplasty is quite common<sup>13-14</sup>. A long term follow up study in USA showed, six out of 107 consecutive patients undergone balloon valvuloplasty developed increasing pulmonary valve incompetence during follow up period of 0.5 to 10 years (mean 7.2years). In our series none of the patient had developed pulmonary valve incompetence.

The outcome of balloon valvuloplasty for critical pulmonary stenosis in young infants were studied in National Taiwan University Hospital, Taipei<sup>15</sup>. Out of 34 infants, procedure was accomplished in 28 patients and failed in six who subsequently required surgery. The study concluded that balloon valvuloplasty is the procedure of choice for critical pulmonary stenosis<sup>15</sup>. Another study conducted in King Faisal Specialist Hospital & Research Centre, Riyadh, KSA showed that phentolamine can improve clinical outcome after balloon valvuloplasty in neonates with severe pulmonary stenosis<sup>16</sup>.

### Conclusion :

It will take time to get long-term result on our patients. Short term (6 months) follow up with Doppler echocardiography showed excellent outcome in all except one though immediate result was good in all cases. The baby who had restenosis, also got the benefit of the procedure which saved her life for time

being and gave her a chance to travel abroad later for surgical valvotomy. It may be concluded that balloon valvuloplasty is the procedure of choice for severe and critical pulmonary valve stenosis. Surgery should be reserved for those with unsuccessful balloon valvuloplasty.

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