Percutaneous Plumonary Valvuloplasty in Critical Plumonary Valve Stenosis

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ABSTRACT:

BACKGROUD:

Critical plumonary valve stenosis represents an emergency and immediate treatment is mandatory. Percutaneous plumonary valvuloplasty is the treatment of choice for isolated plumonary valve stenosis

OBJECTIVE:

Results and complications, of this procedure in our cath. Lab.

PATIENTS AND METHODS:

From January 2006 to August 2009, 28 neonates and infants with critical plumonary valve stenosis (mean age 33.5 days : range 6-88 days) underwent percutenous plumonary valvulopalsty. All patients were cyanosed, and the clinical diagnosis was confirmed by cross sectional and Doppler echocardiography

RESULTS:

The plumonary valve was successfully crossed in all patients. The trasvalvular gradient dropped from 86.9+_21mmgh to 33.2+_20.9mmgh, the mean right ventricular systolic pressure dropped from 100.4+_2o.7mmgh to 54.2+_20.9mmgh, and oxygen saturation increased from 81+_8% to 97+_2% .There were 9(32.1%) major complication including 4(14.2%) death ,3(10.7%) hemopericardium reguiring drainge and transfusion, and two(7.1%) patients developed considerable venous congesation . During a mean followup of 1.6 years , 19(86.3%) of the 22 patients remain free of important restenosis.

CONCLUSION:

Percutaneous plumonary valvuloplasty is effective procedure of first choice in treatment neonates and infants with critical plumonary stenosis

KEYWORDS: critical plumonary stenosis, balloon valvuloplasty

INTRODUCTION:

When the degree of valvular plumonary stenosis is severe enough to cause a decrease in fetal right ventricular output, a larger than normal atrial right to left shunt is established in utero, this condition has been termed critical plumonary stenosis 1,2 .The plumonary valve is pinhole, and the right ventricle is often hypoplastic because of severe hypertrophy and the effects of reduced flow through the right ventricle during development at birth. Affected infants are cyanotic and have systemic or suprasystemic right ventricle pressure 3,4.

Before catheterization, these patients usually require stabilization and intiation of a prostaglandin E1 infusion to maintain ductal patency 5,6.

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Critical plumonary valve stenosis represents an emergency and immediate treatment is mandatory 7.

We report our experience with 28 consecutive neonates and infants with critical stenosis of the plumonary valve in whom this treatment was attempted.

PATIENTS AND METHODS:

During a period of January 2006 to August 2009 percutaneous balloon dilation of the plumonary valve was attempted in 28 consecutive infants with clinical and echocardiography diagnosis of critical plumonary valve stenosis admitted to the Ibn-Al Bitar Centere for Cardiac Surgery.

The average age at cardiac cathetrization was 33.5 days(range 6-88days) .

All patients were cyanosed , and the clinical diagosis was confirmed by cross sectional and Doppler echocardiogragpy using Vivid 3 NewPro machine.

Percuraneous transluminal balloon valvulopasty was performed under general ansethesia in all cases.

The femoral vien was acrossed percutaneously and a 5-6 F sheath was introduced into the vien. Arterial pressure was monitored continuously by femoral arterial lines.

Following right heart catheterization , biplane right ventricle angiograghy was carried out. The plumonary valve annulus was measured in the laterial projection (figure 1A and B).

After confirming the diagosis , an attempt to cross the valve was made by positioning a 5 F Judkins right catheter or less frequently a 5 F multipurpose catheter in the right ventricle out flow using 0.021 inch , 0.018 inch,or 0,014inch steerable superfloppy guide wire to cross the valve.

Once the valve was crossed , the appropriate exchange guide wire tip was positioned in the peripherial left plumonary artery , or in the right plumonary artery, and less frequently through the patent ductus arteriosus.

Single stage balloon valvuloplasty , using low profile balloon (Tyshak) was used in fiften patients , in five patients high pressure balloon (Zmed) was used.

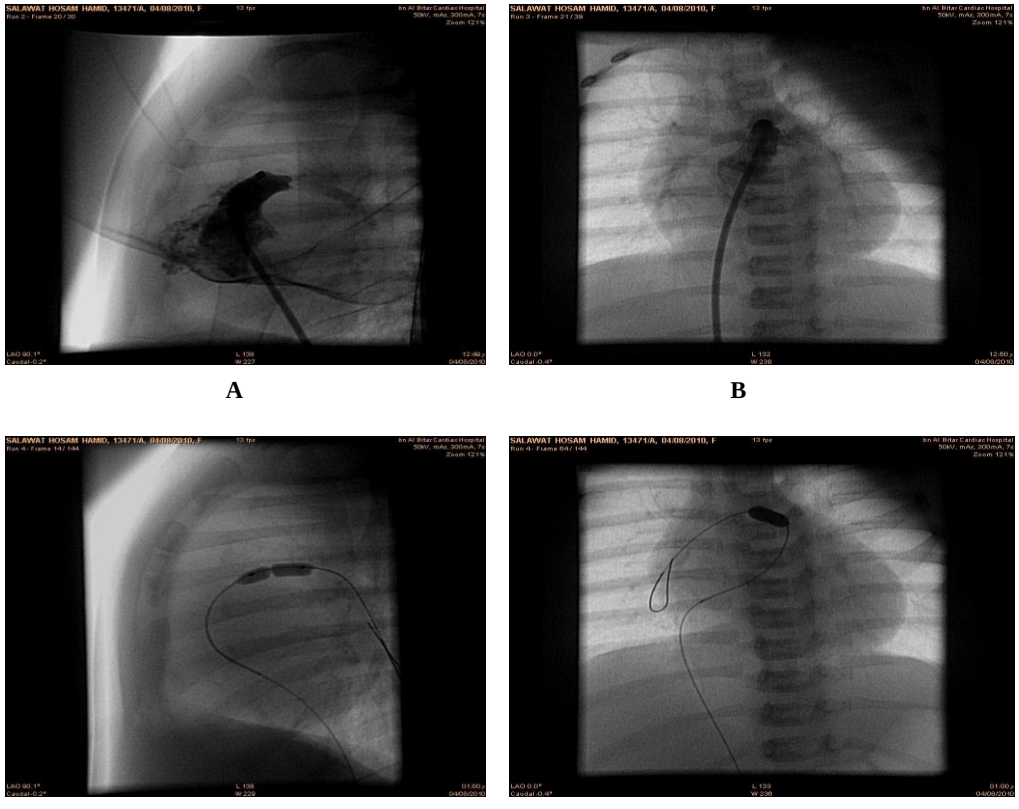
In eight patients progressive dilatation stratagy was employed , beginning with 3-4mm coronary balloon catheter followed by the appropriate size of balloon for meassured annulus size , aiming for a balloon annulus ratio between 1.1and 1.4.

The inflation – deflation cycle lasted 10-15 sec.(figure 1 C and D).

Repeated hemodynamic measurement were made after completion of the procedure.

Repeated angiograghy was not routinely performed.

Doppler echocardiographic evaluation of the residual systolic pressure gradint across the plumonary valve and the degree of tricuspid valve regurgitation were performed the next day and at subsequent follow-up examination



A **B**

C **D**

Figure 1: Right ventricular angiogram (A) left lateral projection (B) anteroposterior projection, showing atiny jet of contrast across stenosed plumonary valve . (C) and (D) showing guid wire in distal right pluomary artery and 4mm coronary angioplasty balloon inflated across the plumonary valve. (Waisting of the balloon by the stenosed valve is visible

RESULTS:

The plumonary valve was crossed and dilated in all cases(100%) .The mean age was 33.5+_22.4days (range 6-88days), the mean valve annulus diameter was 7.1+_1.9mm (range 4-11mm), and the peak transvalvular gradient 86.9+_21mmgh (range 50-140 mmgh)as shown in table (1).

The table (2) summarieses the haemodynamic changes. There was a significant decrease in right ventricular pressure , in right ventricular to systemic pressure ratio, and in the transvalvular systolic gradient after balloon dilatation.

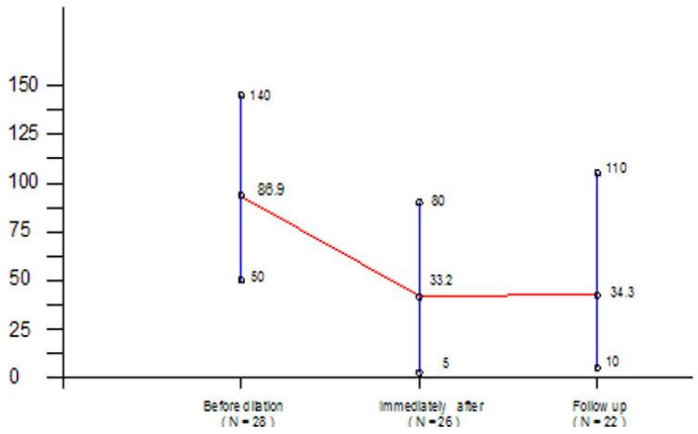
Two (7.1%) patients required surgery. The mean duration of fluorocopy was 24.4+_11.6 minutes (range 10-48 minutes)., the mean duration of fluoroscopy for patients with single stage balloon valvuloplasty was 19.4+_6.8 minutes , and the mean fluoroscopy time for patients with progressive dilatation stratagy was 37.1+_ 12 minutes.

Table 1: Characteristics of patients with critical valvular plumonary stenosis.

Variable	Patients (n=28)(mean+_SD)
Age (days)	33.5 +_22.4 (6-88)
Body weight (kg)	3.75 +_1.2 (2.3-7)
Plumonary valve annulus(mm)	7.1 +_1.9 (4_11)
Peak transvalvular pressure gradient(mmgh)	86.9+_ 21 (50-140)

Table 2: Haemodynamic changes (mean+_ SD) after balloon dilatation

	Before balloon dilatation	After balloondilatation	P value
Right ventricular pressure (mmgh)	100.4+_20.7 (65-155)	54.2+_20.9 (30-105)	<0.0001
Right ventricular/ systemic ratio(mmgh)	1.3+_0.32 (1.1-2)	0.6+_0.3 (0.2-1.2)	<0.0001
Transvalvular gradient (mmgh)	86.9+_21 (50-140)	33.2+_20.9 (10-85)	<0.0001
Systemic oxygen saturation	81+_8% (60-92)	97+_2 (84-100)	<0.001



Before dilation (n=28) Immediately after (n=26) Follow up (n=22)

Figure 2: Change in mean transvalvular systolic pressure gradient after balloon dilation

Complications:

Minor immediate complications included transiet bradycardia and hypotension on balloon inflation in all the patients.

There were 9 (32.1%) major complications , including 4 (14.2%) death. Two patients were died on the table, the 1st one aged 10 days and annulus size 5mm, high pressure balloon (Zmed) size 8mm was used for valve dilatation.

The 2nd patient , aged 27 days and annulus size 7mm, high pressure balloon (Zmed) size 10mm was used for balloon dilatation.

The 3rd patient , aged 18 days and annulus size 6mm, was died 12 hrs after successful balloon dilatation using progressive dilatation stratagy. Beggining with 4mm coronary balloon followed by using Tyshak balloon size 8mm.

The 4th patient, aged 48 days anullus size 9mm, was died 36 hrs after successful balloon dilatation using progressive dilatation stratagy begging with 4mm coronary balloon followed by Tyshakballoon size 8, 12mm respectively.

Three (10.7%) patients developed hemopericardium that required drainge and blood transfusions immediately following the procedures . All patients were successfully resuscitated wirh no long term sequela.

Another two (7.1%) patients developed considerable venous congestion immediately after the procedures , which resolved completely over 72 hrs.

Follow up:

During a mean follow-up of 1.6 (range 0.4-3) years , the initial good result of balloon dilatation was maintained in 19 (86.3%) of the 22 patients .

At the least follow up , the Doppler meassured peak velocity was < 3.0m/s – equevalant to gradient of < 36 mmgh (figure 2).

Three patients (13.6%) underwent repeated valvuloplasty at 5, 7, 12 months respsctively, after the 1st procedure because of signficant residual stenosis . The peak systolic doppler gradients were 60 , 78, 110 mmgh respectively.

DISCUSSION:

Plumonary balloon valvuloplasty for congenital critical valvular plumonary stenosis is effective and currently considered the theraputic modality of choice for the treatment of critical plumonary valve stenosis in infants and neonates regardless of valve morphology.[1, 8,9]

From reports early in the balloon valvuloplasty and even later , the mortality rates of various forms of surgery to relieve critical stenosis by closed or open valvotomy, with or without cardioplumonary bypass, were considerably high. [10 ,11]

In a prospective multi-institutional report involving 101 babies with critical plumonary stenosis, the mortality rate in 62 patients who underwent surgery using a variety of teqchniques was 22.6% , whereas the mortality rate among 34 who underwent balloon dilatation was 6%.It is perhapse in the light of this experience and rapid improvement in the balloon valvuloplasty that this procedure remain the preferred mode of treatment in many institutions.[13 ,14, 15]

Our series analysed on an intention-to-treat basis 28 unselected consecutive patients presenting with critical stenosis of plumonary valve and intact ventricular septum. The results show that balloon dilatation is an effective form of emergency treatment.

In our study 4(14.2%) death occurred. Ej Ladasans et al 9, Gildein Hp et al 7, were reported mortality rate 7% and 6% respectively . High mortality in our study due to shortage of facilites in our cath lab.

Two patients died because of rupture of the valve annulus due to using of high pressure balloon (Zmed) . This was potentially avoidable , because the selection of more appropriate low profile balloon (Tyshak) was unavialable in our cath lab. at that time.

The other two patients died , despite successful relief of obstruction, these patients might be unable to sustain sufficient forward flow through the plumonary valve to maintain adequate saturations; because of their severely hypoplastic , non compliant right ventricles.

These infants need to be maintained on prostaglandien E2 infusion (not avaliable in our hospital), because ducal constriction is not tolerated immediately [1, 8] .

A major complications in the form of hemopericardium and severe hemodynamic decompensation occurred in 3 (10.7%) patients . This result is nearly similar to what was reported by Gildein, HP . et al 7

Balloon dilatation in neonates is often a technically difficult procedure , crossing the plumonary valve is often the most difficult part of procedure[16, 17].

We now routinely attempt to cross the valve with the Judkins right coronary catheter and steerable floppy- tipped quide wires of 0.014, 0.018, or 0.021 inch diameter.

The maen fluorosopy time was 24.4+_ 11.6 min. A similar peroid of fluoroscopy (26+_15 min.) was reported by Ab dul Aziz Bilkis et al. [8]

The duration of fluoroscopy is apotential risk to these babies because the dose of radiation received during the long screening times required for

successful dilatation is not known. Fletcheret et al calculated the radiation doses received by neonates during routine radiographgy and estimated the risks of malignant disaese from fluoroscopy in different situations. 18 The risk of malignant disease was though to be as high as 1 in 150 for some routine catheterisations compared with 1 in 280000 for single chest radiography.

The use of Judkins right coronary catheter with superfloppy quide wire and low profile balloon facilitates crossing of the plumonary valve and allows performance of balloon valvuloplasty in a single stage ; [19,20] this enhances time efficiency, and shortens exposure to radiation. Basil Thanopoulos et al reported,that the use of 4f cobra type 1 catheter facilitates crossing of the plumonary valve and allows performance of balloon valvuloplasty in single stage. [21]

In spite of the much improved ability to deliver and correctly position the balloon catheter over the stenotic valve , a small number of patients still required surgical intervention to relieve either valvular stenosis resistant to dilation or subvalvar obstruction. This group may be those with smaller tricuspid valves , plumonary valves , and right ventricles [22, 23] .

In our series , 2(7.1%) infants required surgery. These infants had severe dysplastic immobile valves, associated hypoplastic right ventricles. Ab dul Aziz Bilkis et al , reported that (9%) required surgery , due to right ventricle hypoplasia and dysplastic plumonary valve. [8]

In our series , restenosis requiring further balloon valvuloplasty developed in (13.6%) . This is likely due to the inappropriate selection of balloon sizees . The balloon / annulus ratio used in our study was 1.1-1.4 . P. Degregorioe tal reported restenosis rate 9.5% [19].

Ej Ludusans et al showed that restenosis requiring further treatment developed in 60% of the patients with balloon / annulus ratios < 1.0 and in 14% in whom the balloon / annulus ratio was > 1.0.9

CONCLUSION:

Percutaneous balloon is effective procedure of first choice in treatment of neonates and infants with critical stenosis . It is likely to be the only procedure necessary for the majority of these patients.

Stabilization of the patients before cathaterization , and choice of appropriate size low profile balloon , have increased the success and safety of balloon dilation.

Sinlge stage balloon valvuloplasty enhances time-efficiency and shortens exposure to radiation.

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