# Percutaneous Pulmonary Balloon Valvuloplasty in A Young Adult with Pulmonary Stenosis — A Case Report

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## Abstract

Percutaneous pulmonary balloon valvuloplasty is the treatment of choice for pulmonary stenosis but remains difficult to carry out in adults. This is a report on a young adult who was suspected of angina but echocardiogram revealed congenital pulmonary stenosis; safely and effectively treated by balloon valvuloplasty. This report includes a literature review that demonstrates the safety and efficacy of this technique in adults. ( J Intern Med Taiwan 2009; 20: 77-80 )

Key Words：Pulmonary balloon valvuloplasty; Pulmonary stenosis; Young adult

## Introduction

Pulmonary stenosis is a common disorder, accounting for 8-12% of all congenital heart defects. It is also the most common cause of right-side heart failure in children.[1] In the past, surgical repair was the only option. In 1954 Rubio-Alvarez et al., outlined a technique that could relieve pulmonary valve stenosis by catheter.[2] Twenty-five years later, Semb used an inflated balloon-tipped catheter to rupture a stenotic valve as it was withdrawn from the main pulmonary artery of the right ventricle.[3] Static balloon dilation was not introduced until 1982 by Kan et al.[4] This technique was used mostly in children, as stenotic valves in adults are more difficult to angiographically locate and define. This report illustrates a successful percutaneous pulmonary balloon valvuloplasty in a young adult with pulmonary stenosis and discusses its success rate, long term prognosis and complications.

## Case Report

The subject was a 25-year-old male factory worker with no history of cardiac problems. He complained of occasional chest tightness over a span of three days. He described a compressed sensation, confined to the anterior chest wall, which lasted from several minutes to several hours at a time. This sensation became more severe during exercise but was relieved somewhat by deep

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breathing. There was Grade IV/VI middle systolic crescendo-decrescendo murmur over the left sternal border with decreased heart sounds of P2. Chest x-ray revealed marked enlargement of the main pulmonary trunk extending into the left pulmonary artery. Transthoracic echocardiography revealed pulmonary valve stenosis with right ventricular (RV) wall hypertrophy; transpulmonary pressure gradient (PG) was 111 mmHg. Transesophageal echocardiography revealed a domed pulmonary valve with slight subvalvular hypertrophy and pulmonary root dilation (Figure 1).

Percutaneous pulmonary balloon valvuloplasty was performed four days after admission. During the procedure, a Swan-Ganz catheter was inserted through the left femoral vein, inferior vena cava (IVC), right atrium (RA), right ventricle (RV) into the right pulmonary artery (RPA) and pulmonary arterial wedge pressure (PAWP) for hemodynamic measurement. Through the pulmonary valve(PV), the Swan-Ganz showed transpulmonary PG was 126 mmHg and no PG over the right ventricle outflow tract (RVOT) and RV. The ratio of RV to systemic pressure was 1.55.

Detailed hemodynamic data included an RA pressure of 10/5/4 (A /V wave/mean pressure mmHg) , RV of 144/4 (syst./dias. pressure mmHg), PA of 18/8/13 (syst./dias./mean pressure mmHg), PAWP of 11/9/7 (A /V wave/mean pressure mmHg) and systemic aortic pressure of 93/67/81(syst./dias./ mean pressure mmHg). A 6 Fr. Pig-tail catheter was placed at RVOT with contrast injected into the main PA measured the PV opening and pulmonary annulus diameters were 6.32 and 29.13mm(Figure 2-a).

After these measurements, two Super-stiff wires(0.035 inch) were inserted into the left pulmonary artery (LPA). They were supported by a JR4-7Fr. guiding catheter from the right femoral vein. Two XXL balloons (Boston Scientific, USA; size : 14 x 4 x 75mm) were crossed over the PV

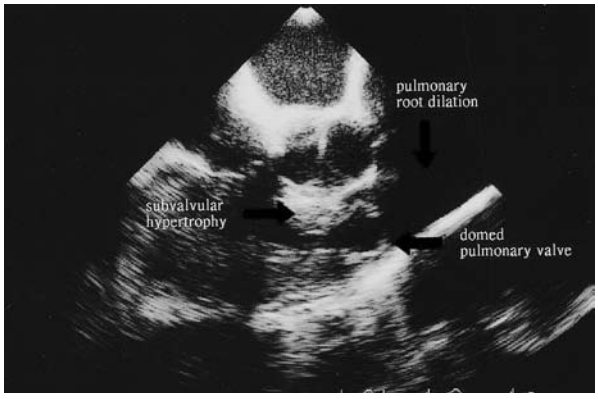


Fig.1. Transesophageal echocardiography revealed a domed pulmonary valve with slight subvalvular hypertrophy and pulmonary root dilation.

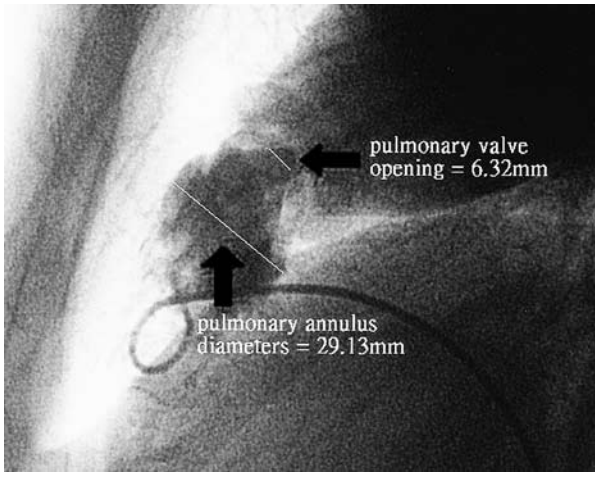


Fig.2-a. 6 Fr. Pig-tail catheter placed at RVOT with contrast injected into PA for pulmonary valve opening and pulmonary annulus diameters measurement.

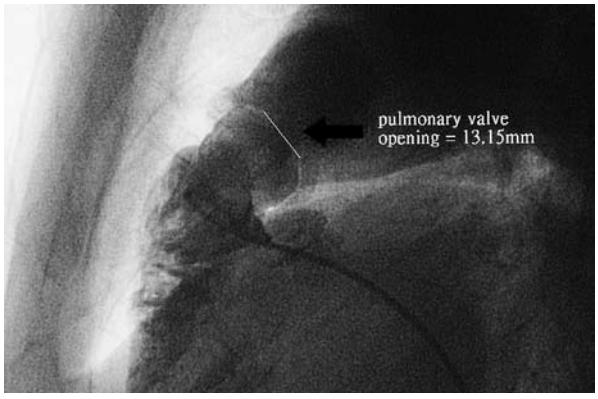


Fig.2-b. Right ventriculography post valvuloplasty of pulmonary valve.

and simultaneously inflated(up to 14 ATM in 10 seconds)six times, but only after we documented the precise location of the valve on the balloons by contrast testing. Next, we inflated two oversized XXL balloons(Boston Scientific, USA; size :18 x 2 x 75mm)23% larger than the pulmonary valve annulus diameter and repeated this four times (up to 10 ATM).

Then, we repeated the right side pressure measurements and ventriculography (Figure 2-b); transpulmonary PG decreased to 47 from 126 mmHg and PV diameter increased from 6.32 to 13.15mm. There were no significant pulmonary regurgitation.

We also repeated the transthoracic echoc ardiography; PG significantly decreased from 111 to 40 mmHg. One year later, transthoracic echocardiography showed a PG of 39 mmHg with mild pulmonary regurgitation. There was no further chest discomfort.

## Discussion

Since Kan et al., first introduced pulmonary balloon valvuloplasty (PBV) in 1982, it has become the treatment of choice for pulmonary valvular stenosis in newborns and children.[4] It has almost completely replaced surgical valvotomy, except in patients with truly dysplastic valves. Although numerous reports have demonstrated the immediate and long-term efficacy of this procedure in infants and children, limited information is available for adult patients.

In this case, a young adult with pulmonary stenosis, double-balloon valvuloplasty was used. This technique was introduced to overcome some of the technical limitations of the single-balloon technique, such as large introducer sheath sizes, difficult percutaneous insertion/removal, femoral vessel damage or obstruction, difficult maintenance of catheter position, and balloon material redundancy with the associated risk of clot formation.[5] Another technique using Inoue balloon, which was first reported by Lau et al. in 1993,[6] also has advantages over the fixed-sized balloon technique because it's size adjustable, marking stepwise dilation possible, and due to its short and self-positioning characters, minimizing the possible injury to RV infundibulum or main PA. But Inoue balloon has disadvantages including necessity of a large sheath, rigid property and costly expense. So present research propose double balloon technique to replace the Inoue balloon.[7]

The double-balloon procedure is not technically difficult but it does depend on high quality angiography for valve location and definition. It also differs from aortic valvuloplasty in that the use of an oversized balloon, approximately 25 to 30% larger than the valve annulus diameter. Balloon oversizing clearly improves valvuloplasty effectiveness. Pulmonary valve annulus injury is unlikely when balloons are smaller than 140%. The initial safety and efficacy of this technique have been confirmed by numerous studies summarized by McCrindle and Kan.[8] Even follow-up in three years after procedure, only 11% of these patients had restenosis; repeated balloon dilation yielded excellent obstruction relief. At later follow-up(3-10 years), only minimal restenosis occur.[8] Furthermore, follow-ups of up to 17 years have demonstrated continued beneficial effects. Peak pulmonary gradients during long-term follow-up have shown no significant differences with those taken one year after PBV, indicating the absence of restenosis. New onset of mild pulmonary regurgitation was noted in only 28% of cases.[9]

Long-term comparisons of balloon valvuloplasty versus surgery for pulmonary valve stenosis have also shown excellent outcomes.[10] Although surgery generally yielded lower long-term gradients and results in longer freedom from re-intervention initially, patients who underwent balloon dilation with a balloon 25-30% larger than

the valve annulus, the recurrences were not found. As the result, balloon valvuloplasty seems the better choice of treatment, because they take the less risk from surgery and even have equal effect, especially when patients have adequate balloon dilation. However, surgery should remain the exclusive therapy when concomitant intra-cardiac defects are present.

## Conclusion

As its technique has been refined, percutaneous pulmonary balloon valvuloplasty has become viable for adults. This is a report on a successful double balloon valvular dilation in a young adult with pulmonary stenosis. The literature review indicates that success rates, long-term prognoses and complication rates for this technique are excellent, even when compared with surgery. Pulmonary balloon valvuloplasty is in fact a safe and effective treatment for adults with congenital pulmonary stenosis. Percutaneous pulmonary balloon valvuloplasty should be considered the treatment of choice for adults with pulmonary valve stenosis.

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# 肺動脈瓣氣球擴張術應用於一肺動脈狹窄之年輕成人 — 一病例報告

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## 摘　要

經皮肺動脈瓣擴張術是目前對於肺動脈狹窄的病人，所推薦使用的治療方式。不過這項技術對於施行在成年的病人身上依然充滿了挑戰。在此我們報告了一位因疑似心絞痛而住院的年輕男性病人，經超音波檢測爲先天性肺動脈狹窄，安全且成功的接受肺動脈瓣氣球擴張術。我們並且參考多篇文獻報告來證實這項技術對於成年病人的安全性和成功性。