Case Report

Percutaneous balloon pulmonary valvuloplasty: A modified over-the-wire Inoue balloon technique for difficult right ventricular anatomy

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**Abstract**

Percutaneous balloon pulmonary valvuloplasty (BPV) is the mainstay of treatment for significant pulmonary stenosis with doming leaflets. Various techniques have been described in the literature including the use of Inoue Percutaneous Transseptal Mitral Commissurotomy (PTMC) catheter with standard 0.025" guidewire. But if right ventricular anatomy is not suitable, 0.025" guidewire doesn’t provide enough support to track the Inoue PTMC catheter. Here, we report a case of successful BPV using a novel technique of slenderizing the Inoue PTMC catheter over an Amplatz superstiff 0.035" guidewire. This technique may be useful during BPV in difficult right ventricular inflow and outflow tract anatomy in patients with congenital pulmonary valve stenosis.

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1. Introduction

Congenital valvular pulmonary stenosis (PS) accounts for 5–10% of all congenital heart disease. In most of the cases, the stenosis is due to fusion of commissures leading to “doming” of the valve leaflets and rarely may be due to dysplastic leaflets. Balloon pulmonary valvuloplasty (BPV) is safe and effective in attaining both immediate and long term reduction of pulmonary valvular gradients and is currently the preferred therapeutic modality for “doming” valvar PS. Successful BPV has been reported with standard Inoue Percutaneous Transseptal Mitral Commissurotomy (PTMC) catheter but has limitation in difficult right ventricle anatomy due to inadequate support of the 0.025" guidewire and rigidity of the metal stylet. Here, we describe a case of successful BPV with modified over-the-wire technique in patient with congenital valvular PS with difficult RV anatomy.

2. Case report

A 23-year-old male patient presented with exertional dyspnea and fatigue for last 2 years. On clinical examination, patient was hemodynamically stable with Grade 4/6 ejection systolic murmur in 2nd and 3rd left intercostal space near the sternum. Two-dimensional cross-sectional echocardiographic and Doppler examination revealed thickened and doming pulmonary valve leaflets with severe stenosis and significant right ventricular (RV) dysfunction. Right atrium was significantly dilated with severe tricuspid regurgitation (TR). On cardiac catheterization, the mean right atrial (RA) pressure...
was 15 mmHg and RV systolic pressure was 150 mmHg. RV angiography revealed severe valvular PS with a pulmonary valve annulus of 19 mm and a distorted RV inflow (massively dilated right atrium and severe tricuspid regurgitation) and outflow anatomy (Fig. 1A, S Video 1). With informed consent, BPV was planned. The pulmonary valve was crossed with a 0.035" hydrophilic 260 cm long guidewire (Radifocus, Terumo Corp, Japan) over which a 6 Fr JR 4 diagnostic catheter (Cordis, Johnson & Johnson, USA) was tracked. Peak systolic pulmonary artery (PA) pressure was 20 mmHg, yielding a peak-to-peak gradient across the PV of 130 mmHg. A 0.035" Amplatz superstiff 260 cm long guidewire (Cordis, Johnson & Johnson, USA) was positioned in the distal right PA branch. A 12 Fr Sheath was inserted into the right femoral vein. An over-the-wire 20 × 40 mm Maxi LD balloon catheter (Cordis, Johnson & Johnson, USA) was introduced through this sheath and negotiated across the pulmonary valve. However, constant forward slippage of the balloon into the PA or back into the RV outflow tract prevented optimal balloon positioning at the pulmonary valve despite using RV pacing (Fig. 1B). Furthermore, balloon inflation was associated with prolonged bradycardia and severe hypotension. Thereafter, BPV was attempted with standard Inoue PTMC balloon catheter but due to inadequate support with 0.025" stainless steel guidewire the catheter couldn’t be tracked. Therefore, the 0.025" stainless steel guidewire was exchanged for the 0.035" Amplatz superstiff guidewire and positioned in the distal right PA. Subsequently, the Inoue PTMC catheter was slenderized without the metal stylet over the Amplatz superstiff guidewire (an off label use) and advanced across the pulmonary valve without difficulty. The stenotic pulmonary valve was dilated with the Inoue PTMC catheter at 22 mm with stable position (Fig. 2A and B). After dilatation, the RV systolic pressure was reduced to 65 mmHg and the PA systolic pressure increased to 35 mmHg. Catheter pull back revealed a residual gradient of 4 mmHg across the PV and an infundibular gradient of 25 mmHg. The mean RA pressure was reduced to 6 mmHg. Patient was discharged in hemodynamically stable condition.

Fig. 1 – Right ventricular angiogram in lateral view revealing trabeculated right ventricle, stenotic pulmonary valve (Arrow) and main pulmonary artery (Panel A). An over-the-wire inflated Maxi LD balloon catheter in main pulmonary artery (Panel B).

Supplementary video related to this article can be found online at http://dx.doi.org/10.1016/j.ihj.2013.12.010

3. Discussion

Since its first description in 1982 by Kan et al, percutaneous balloon valvuloplasty has revolutionized the treatment of congenital valvular PS.1,2 It is currently the preferred therapeutic modality for valvular PS in children and in adults.3–6 Current approaches of BPV utilize various fixed size balloon catheters using a single or a double balloon technique. Use of over-the-wire fixed size balloons with a 0.035" Amplatz superstiff guidewire is used for management of critical valvular PS, but balloon instability and long inflation–deflation time causes bradycardia and hypotension as in our case. These limitations were addressed using an Inoue PTMC catheter as it has relatively short and flexible balloon unlike the standard fixed size balloon catheter which has a longer balloon portion and a sharper tip. It also has a unique property of self positioning, enabling it to anchor at the pulmonary valve during inflation, thus preventing abrupt forward movement and damage to the PA.7,8 Another advantage is its rapid inflation and deflation cycle (approximately 4–5 s) allowing fast hemodynamic recovery and also allows graded dilations by increasing the size of the same balloon, thus preventing cumbersome exchanges of balloons. In the standard over-the-wire technique, the Inoue PTMC catheter after slenderizing over the metal stylet is usually advanced over its accompanying 0.025" floppy tipped stainless steel guidewire. It can also be advanced freely but in relatively simpler RV inflow and outflow anatomy.8 In patients with difficult RV anatomy as in our case the standard technique is limited by the rigidity of the metal stylet and also by inadequate support of the 0.025" guidewire for tracking the Inoue PTMC catheter across the pulmonary valve. This creates difficulty in optimal positioning of the balloon across the pulmonary valve. Slenderizing the Inoue PTMC catheter (without the metal stylet)
over a $0.035^\circ$ Amplatz superstiff guidewire provides an extra support for tracking the balloon with its optimal positioning across a critically stenosed pulmonary valve. This modified over-the-wire technique has advantage of both the Inoue balloon and $0.035^\circ$ Amplatz superstiff guidewire for adequate support thus increases the chances of successful BPV in difficult right ventricular inflow and outflow tract anatomy in patients with congenital pulmonary valve stenosis.

**4. Conclusion**

This case highlighted the advantage of slenderizing the Inoue PTMC catheter over a $0.035^\circ$ Amplatz superstiff guidewire. This modified over-the-wire technique can be reserved for patients with severe pulmonary stenosis and difficult RV anatomy during BPV.

**Conflicts of interest**

All authors have none to declare.

**REFERENCES**