

Case Report

Percutaneous Mitral Valvuloplasty Refined: Use of a Novel Modified Antegrade Approach

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Key words:

Mitral valve stenosis, balloon valvuloplasty, transcatheter.

Mitral stenosis usually occurs many years after an episode of rheumatic fever and it has an indolent course until its later stages, when it acutely worsens. The rates of mitral stenosis keep declining; nonetheless, the need for advanced and sophisticated treatment modalities still remains. Our group has been applying a novel modified antegrade approach for treating mitral valve stenosis and, although we have limited experience, the results thus far are favorable. We present the preliminary data of three patients who suffered from symptomatic mitral valve stenosis and underwent successful percutaneous mitral valvuloplasty with this novel modified antegrade approach. This method increases the safety and the efficacy of the procedure and has the same clinical results as other available percutaneous techniques.

Manuscript received:

February 10, 2015;

Accepted:

April 30, 2015.

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Percutaneous mitral valvuloplasty (PMV) is considered the standard therapy in patients with symptomatic severe mitral stenosis who have favorable clinical and anatomical characteristics¹ and who are not surgical candidates. Compared to surgical mitral commissurotomy, PMV has been shown to have equal or better success rates^{2,3} and comparable restenosis rates.² The approaches that are most commonly used are the transvenous/antegrade approach (the Inoue balloon technique,⁴ the double balloon technique,⁵ the Multitrack technique,⁶ the Cribier technique⁷) and the transarterial/retrograde approach (Stefanadis technique⁸). The Inoue technique has proved to have equivalent efficacy compared with the other techniques, as well as lower procedural risks, so it is considered the most widely accepted method for PMV.⁹

Despite their comparable efficacy, all the techniques share similar technical difficulties, which include interatrial septum puncture, manipulation of the catheter in the left atrium and the crossing of the mitral valve by the Inoue balloon catheter. Potential complications include penetration of the needle into the ascending aorta or the pericardial space posteriorly to the atrium, hemopericardium, and unintended perforation by the tips of the catheters or the guidewires while they are being manipulated in the cardiac chambers, in the left atrial appendage, the pulmonary veins, or the left ventricular apex.

These challenges have led to the investigation of other novel techniques that aim to increase the safety and the efficacy of the procedure. One such procedure is the antegrade transseptal modified technique; our group has already treated 3 patients with this technique and the prelimi-

nary data are favorable. In this report, we present in detail how this procedure is performed and we discuss its advantages over the other techniques.

Case presentation

Three patients aged 20, 23, and 26 years old were admitted to our department for shortness of breath (New York Heart Association class III) and paroxysmal nocturnal dyspnea. The transthoracic echocardiogram showed severe mitral stenosis. The first patient had a mitral valve area (MVA) $0.3 \text{ cm}^2/\text{m}^2$ of body surface area (BSA), mean gradient of 15 mmHg, and mild mitral regurgitation. The second patient had an MVA of $0.4 \text{ cm}^2/\text{m}^2$ of BSA, and a mean gradient of 13 mmHg, while the third patient had an MVA of $0.5 \text{ cm}^2/\text{m}^2$ of BSA, and mean gradient of 15 mmHg. All three had a left ventricular ejection fraction $>55\%$. Transesophageal echocardiography (TEE) was performed in order to exclude left atrial thrombus. The Wilkins scores were 5, 6, and 7 respectively. Percutaneous mitral valvuloplasty was scheduled.

The procedure was performed via a femoral approach using an antegrade transseptal modified technique. Three access sites were used: the right femoral vein for the introduction of a vascular introducer sheath with hemostatic valve 16 F (Check-Flo sheath[®], Cook Medical, Indiana, USA), the left femoral artery for the introduction of a pigtail catheter (Cordis, Johnson and Johnson, Miami, FL, USA) into the non-coronary cusp with a 5 F sheath, and the left femoral vein for the pacing electrode of a temporary transvenous pacemaker system placed at the right ventricular apex through a 6F sheath. After a bolus administration of 1000 U heparin, right heart catheterization was performed. Transseptal puncture was performed according to the standard technique. Transesophageal echocardiographic guidance was used to facilitate the anatomic location of the *fossa ovalis*, the proper positioning of the balloon into the mitral valve, and the early detection of serious complications (i.e. hemopericardium). In addition, after the transseptal dilator had tented the *fossa ovalis*, a 0.014 inch J-tipped guidewire (SafeSept[®] Transseptal Guidewire, Pressure Products Medical Supplies, Inc., San Pedro, CA, USA) was used to penetrate the septum.

In all three cases, we administered 9000 U of heparin to reduce the risk of a thromboembolic event during the manipulation of catheters and wires in the left atrium, and anticoagulation time was monitored

during the procedure to maintain appropriate levels of anticoagulation.

The system of the needle, dilator and introducer was advanced over the 0.014 inch guidewire into the left atrium. After the SafeSept[®] guidewire, needle and dilator had been retracted, a stiff guidewire (Amplatz Super Stiff Guidewire, Boston Scientific, Natick, MA, USA) was advanced through the introducer into a left pulmonary vein. Then, the introducer was replaced with the 12 F FlexCath steerable sheath (Medtronic, Fridley, MN, USA). The use of this steerable catheter allowed us to deflect its tip to face towards the mitral valve orifice. The guidewire crossed the stenotic mitral valve and entered the left ventricle. In the right anterior oblique view, which helps to identify the proper line between the base and the apex, we advanced over the Super Stiff guidewire and through the stenotic mitral valve orifice a high-pressure and semi-compliant Cristal balloon (BALT, Montmorency, France) (Figure 1).

At this stage we inflated the Cristal balloon using simultaneous short bursts of rapid ventricular pacing (RVP) for temporary arrest of left ventricular ejection, which stabilized the position of the balloon. By progressive sequential inflations of a Cristal balloon catheter, transvalvular mitral gradient decreased for the first patient from 15 mmHg to 6 mmHg, while the MVA improved; it was calculated to be 1.5 cm^2 (as measured invasively) or 1.6 cm^2 (as measured by echo), with mild regurgitation. The second patient had a decrease in the mean transvalvular mitral gra-

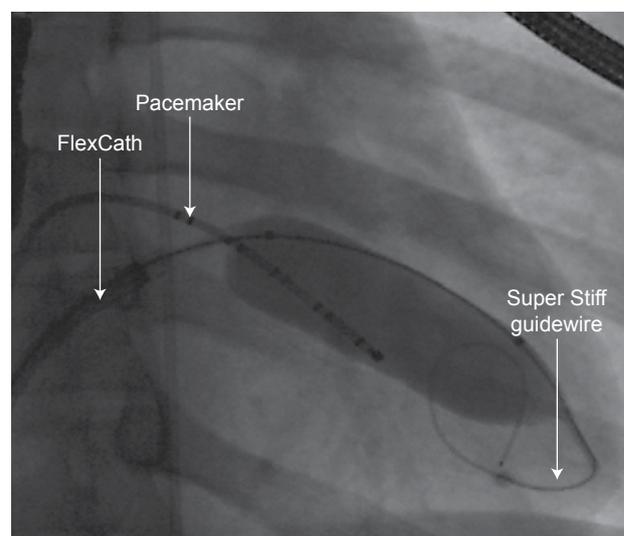


Figure 1. Antero-posterior fluoroscopic view, depicting the dilation of a high-pressure and semi-compliant Cristal balloon at the level of the mitral valve.

dient from 13 mmHg to 5mmHg, with an MVA of 1.5 cm², and the third patient had a decrease in the mean transvalvular mitral gradient from 15 mmHg to 6 mmHg, with an MVA of 1.4 cm².

The patients were successfully extubated and safely transported to the intensive care unit, where they remained for 24 hours. On the day after the procedure, a new echocardiogram was performed and the MVA was measured to be 1.6 cm² with mild regurgitation for the first patient, 1.5 cm² for the second patient, and 1.5 cm² for the third patient.

Discussion

Although the Inoue technique is the most widely used approach for PMV, it has important limitations and potential complications. The new modified technique we describe has certain advantages that can help the operator overcome these challenges.

One of the major advantages of this new technique is the size of the persistent iatrogenic atrial septal defect (iASD) after transseptal puncture compared with the Inoue technique. The latter requires the regular use of the 14F Inoue dilator after the puncture through the atrial septum, whereas the use of the Cristal balloon instead of the Inoue balloon allows us to employ catheters with a lower profile in our modified technique. Moreover, in our technique the balloon is removed through the steerable sheath that protects the septum, while the Inoue balloon requires somewhat complex manipulations and is pulled out directly through the puncture of the septum. This results in a smaller iASD and therefore minimizes its relevant clinical implications.

Another major advantage of the modified technique arises from the use of the SafeSept guidewire. SafeSept is a 135 cm long, 0.014 inch diameter nitinol guidewire specifically designed for transseptal puncture. Unsupported by the needle and dilator, the tip of the wire assumes a “J” shape, rendering it incapable of further tissue penetration. A radiopaque coil along the shaft allows for fluoroscopic visualization of the wire within the left atrium, while proximal marker bands help determine the approximate location of the SafeSept tip in relation to the tip of the needle. This guidewire provides some stability to the needle, which aids the passage of the sheath into the left atrium. We thus suggest that the use of the guidewire adds to the safety profile of the technique, as its soft tip and smaller size (compared to the 0.028 inch Inoue PMV guidewire) exclude severe perforation and ensure the safety of the procedure.

In order to overcome the challenge of optimal stabilization of the balloon through the stenotic mitral valve orifice during inflations, we used RVP. RVP is a technique where the ventricle is paced rapidly between 180 bpm and 220 bpm, arresting the ventricle temporarily to enable the balloon to be inflated more quickly and less often, as well as preventing the dislodgement of the balloon from the orifice of the valve. RVP is an established technique for temporarily minimizing cardiac motion and reducing left ventricular output and left ventricular systolic pressure during balloon aortic valvuloplasty¹⁰ and transcatheter aortic valve implantation.¹¹ We used the same technique to reduce the transvalvular flow and to optimize the Cristal balloon positioning, thus minimizing the displacement during inflations and increasing the safety and efficacy of the technique.

Lastly, the use of the FlexCath Steerable Sheath allows the operator to deflect the tip of the catheter, directing it towards the mitral valve. This facilitates the crossing of the guidewire through the stenotic orifice, which is a technical challenge in the Inoue approach. With this modified technique we attempted to overcome this challenge and subsequently increase the success rates of the intervention.

Despite the advantages of this new technique, its long term efficacy and safety need to be studied in a larger number of patients.

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