Case series: Difficult PTMC using novel technique of veno-arterial looping

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1. Introduction

PTMC using Inoue or Accura balloon has long been considered an effective treatment modality especially in cases with favorable valve morphology, providing sustained hemodynamic improvement. In cases of unfavorable morphology (Wilkins score > 8), it postpones the need for surgical mitral valve replacement. Presence of left atrial clot, left atrial appendage clot and redo-PTMC may be associated with increased complications or result in incomplete success. Difficult anatomy as in small left atrium, interatrial septal bulge to the right, giant left atrium, calcific valve and involvement of submitral apparatus make left ventricular entry during PTMC difficult. Patients with severe kyphoscoliosis, venous anomalies, dextrocardia, pregnancy afford challenges during PTMC. We hereby describe case series of four patients where PTMC was successfully accomplished using a novel technique of veno-arterial looping.

2. Procedural details

All four patients were women with severe mitral stenosis in sinus rhythm with no evidence of left atrial and left atrial appendage clot. PTMC was planned via transfemoral route; venous access was obtained and 8F sheath was inserted; 6F arterial access was obtained and 6F pig tail catheter was positioned in the non-coronary sinus. Pre-procedure right ventricular (RV) and pulmonary artery (PA) pressures were obtained with multi-purpose catheter. 0.032" exchange length wire was positioned in the left innominate vein; 8F Mullin’s sheath with dilator was inserted. The Teflon guide wire was removed and Brockenbrough septal puncture needle was advanced in the Mullin’s dilator. We prefer to use right anterior oblique (RAO) and left anterior oblique (LAO) views assisted by transthoracic echo for septal puncture. Left atrial entry was confirmed by pressure tracing and injection of small amount of contrast in some cases. 70 cm 14F septal dilator was used to dilate the puncture site and the septum. 180 cm 0.025" stainless steel guide wire with coiled floppy tip was inserted into the left atrium (Figs. 1–3 and Table 1).

3. Case 1

The first case was of a 32-year old lady with echocardiographic evidence of severe mitral stenosis (MVOA – 0.9 cm²) with bicommissural fusion, Wilkins score > 8, dilated left atrium (LA) of 4.5 cm size and thick interatrial septum on. Transseptal puncture and puncture site dilatation was done using standard technique. Slenderized Accura balloon was then advanced on 0.025" stainless steel floppy wire. Left ventricular entry was attempted using standard techniques which failed. We then attempted over the wire technique. We withdrew the balloon and took Mullin’s sheath to direct an exchange length 0.035” wire into the left ventricle and across the aortic valve into the descending
aorta; however the wire was not supporting the Accura balloon entry into the left ventricle. The terumo wire was snared in the descending aorta with a peripheral gooseneck supported by JR diagnostic catheter. We could then advance the Accura balloon system into the left ventricle (LV) across the veno-arterial rail which provided more support and directed it toward the apex of the left ventricle. PTMC was then completed with serial step up dilatations of Accura balloon from 24 mm to 26 mm. Patient had split anterolateral commissure with grade II mitral regurgitation and stable hemodynamics at the end of procedure with MVOA – 1.5 cm²; she continues to be under follow up with regression of MR to grade I and with improved exercise tolerance.

4. Case 2

A 35-year old lady with 10 years history of RHD with MVOA – 1.3 cm² in sinus rhythm with Wilkins > 8 with bicommissural fusion and a bulging interatrial septum (to the right) was taken up for PTMC. The first transseptal puncture was posterior and was making it difficult to align the balloon system in the valvular plane. We revised the puncture under fluoroscopic and TTE guidance but it did not allow LV entry of the balloon despite multiple attempts and using classical steps. We then decided to use a veno-arterial rail system through which we could negotiate the Accura balloon to the left ventricular apex and subsequently completed the PTMC with serial step up dilatations from 26 mm to 28 mm with final achieved MVOA – 2 cm² with no procedural complications.

5. Case 3

This technique was successfully used in 45-year old lady with severe calcific mitral stenosis when standard techniques failed.
6. Case 4

The fourth case was a 47-year old lady with severe MS (MVOA – 0.7 cm²) with severe subvalvular disease and Accura balloon was not crossing the valve despite typical bobbing movement of the balloon at the valve due to critically stenosed valve and severe subvalvular disease. Veno-arterial loop was created. A peripheral angioplasty balloon of 8 mm × 20 mm was then taken and inflated to 4 atm across the valve to dilate the subvalvular apparatus. The Accura balloon was then slid into left ventricle after double looping in the left atrium. PTMC was then completed with serial dilatations up till 24 cc. Patient had sudden bradycardia and hypotension during her sheath removal; she was then found to have left sided evolving hemiparesis; she was immediately taken up for cerebral angiogram. Branch of (paired) anterior cerebral artery had thrombotic occlusion which improved with intra arterial thrombolysis. She showed dramatic improvement in her neurological weakness and was subsequently stabilized and discharged (Fig. 2).

7. Discussion

PTMC is recommended as first line therapy with high success and low complication rate in clinical and anatomically appropriate cases. A fraction of our symptomatic patients present with unfavorable anatomy and are not willing for surgical valve...
replacements. Inoue balloons are preferred for their profile for doing PTMC but have the financial disadvantage of reusability. Most of our rheumatic heart disease patients are from poor socio-economic status and Accura balloon is used as a cost effective option. Trans septal puncture and crossing the valve is an important step in PTMC. Several maneuvers have been described to overcome difficult trans septal punctures including (Fig. 4):

- Double looping in the left atrium.
- Reverse looping in the left atrium.
- Over the wire technique – Left ventricle entry is achieved by crossing with Mullin’s sheath. JR, AR1, AL1 can also be tried. 0.025” stainless steel spring coil wire is directed into left ventricle and PTMC balloon dilatation is done or Terumo wire can be placed in the descending aorta and PTMC balloon is railed on the terumo wire and PTMC balloon dilatation is accomplished.
- Floating Swan Ganz catheter into left ventricle and directing the terumo wire so as to avoid inadvertent inter chordal tracking.
- Stefanadis technique of retrograde non-transseptal PTMC technique.

We used veno-arterial loop as a support rail to successfully advance our balloon into the left ventricle when standard techniques failed. A 0.035” exchange length terumo wire was manipulated into the left ventricle via a multipurpose 5F catheter through the Mullin’s sheath. Next, it was forwarded into the descending aorta and right common iliac artery from where it was snared by a peripheral goose neck snare introduced via a diagnostic 6F JR catheter through the arterial end. All manipulations need to be gentle. An arteriovenous loop can cut through the valve and aorta unless it is protected by a catheter especially when there is critical mitral stenosis situation needing sufficient pull and push. The other complications we foresee are cardiac perforation, ventricular arrhythmias, tear of mitral valve and stroke.

The reasons we encountered difficulty during PTMC were multifold-thick interatrial septum, bulging interatrial septum and severe underestimated sub valvular disease. However this single technique was used effectively in all four cases albeit with some technical modifications. The average procedural time taken was 80 min and fluoroscopy time of 34 min. This technique gives more support for balloon entry across LV compared to over the wire technique. A single case report of using this technique has been described in an elderly gentleman.10

One patient had cardio-embolic stroke from which she recovered though there was no documented pre-procedural LA clot. The cause could be embolized micro-thrombi or veno-arterial loop raising an aortic plaque or because of prolonged procedural duration. Whether a conventional PTMC would not have resulted in stroke is a matter of debate as PTMC is associated with a stroke risk of 0.5–5% and is reduced with use of Inoue balloon and pre-procedural TEE to 0.6%.

Ventricular premature beats were noted during procedure but none had hemodynamically significant ventricular tachycardia. There were no access site complications.

8. Conclusion

We advocate revision of septal puncture and use of new hardware when the first attempt at left ventricular entry fails. Secondy, standard advocated modified techniques can be used. If they still fail, then veno-arterial looping can be considered. Using this technique PTMC could be performed, even in difficult cases wherein conventional method of crossing the mitral valve has failed.

Conflicts of interest

The authors have none to declare.

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