Re-intervention percutaneous balloon mitral valvuloplasty in a patient with left atrial appendage thrombus: a case report

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Background
Percutaneous balloon mitral valvuloplasty (PBMV) using an Accura balloon is an effective method for management of rheumatic mitral stenosis.

Case summary
Herein, we present a case of a 43-year-old female, who had undergone a previous PBMV, who presented with very severe mitral re-stenosis with Type Ia left atrial (LA) clot, in atrial fibrillation and New York Heart Association functional Class III. We used the modified septal puncture and over-the-wire technique, avoiding inadvertent manipulation of the LA clot for PBMV. The mitral valve was successfully dilated from 0.9 to 1.5 cm², and the patient had an uneventful post-procedure recovery.

Discussion
The presence of LA clot and mitral re-stenosis in a previously intervened valve are considered unfavourable characteristics for a PBMV procedure, and patients are usually advised surgical intervention. These patients are also high-risk candidates for surgery due to late presentation with advanced disease and poor functional capacity. Our patient underwent successful re-intervention with PBMV despite having suboptimal characteristics.

Keywords
Balloon angioplasty • Case report • Left atrial thrombus • Mitral valve disease percutaneous intervention

ESC Curriculum
4.4 Mitral stenosis • 5.3 Atrial fibrillation • 2.2 Echocardiography

Introduction
The technique of percutaneous balloon mitral valvuloplasty (PBMV) introduced by Kanji Inoue in 1982 revolutionized the management of symptomatic mitral stenosis (MS). The 2021 European Society of Cardiology guidelines consider old age, previous history of commissurotomy, New York Heart Association (NYHA) Class IV symptoms, permanent atrial fibrillation (AF), severe pulmonary arterial hypertension (PAH), Wilkin’s score >8, severe tricuspid regurgitation (TR), and presence of left atrial (LA) thrombus as unfavourable characteristics for PBMV. However, in resource limited countries with high prevalence of rheumatic heart disease, patients often present with debilitating symptoms in later stages of the disease and are often poor candidates for surgery. Here, we report a case of 43-year-old female who underwent successful re-intervention with PBMV for mitral re-stenosis with AF with LA thrombus Type Ia.
Timeline

| Date | Event |
|------|-------|
| 2015 | Patient first presented with progressive New York Heart Association (NYHA) Class III dyspnoea over a period of 4 years. She was diagnosed as having rheumatic affection of mitral valve and severe mitral stenosis in atrial fibrillation (AF). She was stabilized medically with rate control, diuretics and underwent a balloon mitral valvotomy. |
| 2015–20 | Patient was irregular in follow-up, being in NYHA Class I. She was advised Benzathine Penicillin prophylaxis, oral anticoagulation and rate control medications for AF. |
| Day 1 | Presentation to the emergency for dyspnoea and palpitations. Clinical examination, baseline investigations and a diagnosis of mitral re-stenosis with AF with LAA clot in a case of rheumatic heart disease with previous percutaneous balloon mitral valvoplasty (PBMV) is established. |
| Day 3 | After initial medical stabilization, patient taken for re-intervention PBMV |
| Day 5 | After observation for 48 h and having an uneventful post-procedure recovery, patient was discharged. |

Case

A 43-year-old female, presented with symptoms of dyspnoea and palpitations NYHA Class III for the last 2 months. Her past history was notable for having undergone PBMV 6 years ago following which she had remained in functional Class I for 5 years. She started having progressive worsening of dyspnoea which had progressed to NYHA Class III for the last 2 months. She was in AF, with controlled ventricular rate of 72 b.p.m. and resting room air saturations of 90%. On auscultation, she had a loud S1. A mid diastolic murmur with opening snap could be appreciated at the apex. Bilateral lower zone fine crepitations were present on examining the lungs. Her chest X-ray was suggestive of pulmonary congestion (see Supplementary material online, Figure S1). Her transthoracic echocardiography revealed rheumatic affection of mitral valve with mitral valve area (MVA) of 0.9 cm² (Figure 1A), mean gradient of 13 mmHg (Figure 1B), moderate TR, moderate PAH with Wilkins score of 8/16 [mobility: 2, thickness: 2, calcification: 3, subvalvar pathology: 1, Appendix]. Trans-esophageal echocardiogram (TEE) was done which showed Manjunath Type Ia LA clot (Figure 2). She was on oral anticoagulation, Nicoumalone 2 mg daily, with prothrombin time-international normalized ratio in therapeutic range with time in therapeutic range of 70%. She was on metoprolol extended release 50 mg once a day. She was stabilized first with intravenous furosemide, digoxin, and initial bi-level positive airway pressure support for 3 h. She was switched to intravenous heparin infusion. Routine investigations ruled out anaemia, thyroid disorder, or sepsis that might have aggravated her underlying heart disease. After explaining risks of thromboembolism and open mitral commissurotomy/mitral valve replacement (MVR) as alternative, in view of symptomatic very severe MS, she was taken for PBMV.

Femoral artery access was obtained with 5F sheath. A pigtail catheter was introduced and baseline left ventricular end-diastolic pressure of 6 mmHg was noted. Trans-mitral end-diastolic gradient was noted to be 15 mmHg. The pigtail was then positioned in aortic root in non-coronary cusp. A 0.032” wire was introduced into the Innominate vein. Mullins sheath was tracked over the 0.032” wire (see Supplementary material online, Figure S2). Brockenbrough needle was introduced and together with Mullins sheath, was descended into the right atrium with clockwise rotation from 12 to 5 o’clock position (see Supplementary material online, Figure S3). The interatrial septum was punctured at fossa ovalis after confirming the position in antero-posterior and lateral views (see Supplementary material online, Figure S4). The transseptal puncture technique used in this patient was unique in being more superior and lateral than the conventional technique to avoid inadvertent entry or manipulation of LA appendage during PBMV. The main axis of LA appendage is anteriorly oriented, hence a puncture at the supero-anterior quadrant of the fossa ovalis facilitates to keep the guidewire away from the LA appendage so as to prevent embolization of LA clot. Also, the coiled guide wire was introduced directly into the LV away from the appendage. Septal dilatation was done and 24 mm Accura balloon introduced over the wire. Accura balloon unlike Inoue balloon has single balloon and is easy to use. The balloon was inflated across the mitral valve (see Supplementary material online, Figure S5) and the mean gradient fell to 4 mmHg. Post-procedure MVA was found to be 1.5 cm² (Figure 3A) with mean mitral valve gradient of 5 mmHg (Figure 3B), and the patient had an uneventful post-procedure recovery.

Due to a hugely dilated LA, a supero-anterior puncture (see Supplementary material online, Figure S6) was done to allow a more vertical LV entry over the wire and this facilitated avoiding the LA appendage. Thus when compared with low inter atrial puncture as described by Manjunath, we differ in following:

1. Puncture technique.
2. Over-the-wire entry.
3. Re-intervention in mitral re-stenosis.

Such a technique would be feasible in LA clot Types Ia, Ib, and Ila. As the coiled guide wire is introduced at the fossa ovalis, it is directed vertically down towards the LV. It thus helps to avoid manipulation of structures superior to the plane of fossa ovalis, leaving thrombi of Types Ia, Ib, and Ila if any, untouched. Possible complications in this technique includes formation of atrio-aortic fistula, entanglement of coiled wire into mitral apparatus, clot embolization, and formation of interatrial septal haematoma.

On follow-up visit to the out-patient department, patient was better, in NYHA functional Class II. She had an MVA of 1.5 cm² and a mean gradient of 6 mmHg. She was continued on oral anticoagulation, metoprol, digoxin, and diuretics.

Discussion

Rheumatic MS is associated with LA thrombus in 3–13% patients in sinus rhythm and 33% in patients with AF. The risk factors for LA thrombus formation in MS include AF, previous embolic episodes, age >40 years, LA dimension >45 mm, LA appendage emptying velocity <20 cm/s, infero-superior LA dimension >69 mm, mean mitral gradient >18 mmHg and spontaneous echo contrast Grade ≥3 on TEE. The LA thrombus is classified based on location and mobility as follows (see Supplementary material online, Figure S7):

Type Ia: LA clot confined to appendage.
Type Ib: LA appendage clot protruding into cavity.
Type Ila: LA roof clot limited to a plane above fossa ovars.
Type Ilib: LA roof clot extending below the plane of fossa ovars.
Type III: layered clot over the interatrial septum.
Type IV: mobile clot which is attached to LA free wall, roof or IAS.
Type V: ball valve thrombus.

Manjunath et al. performed PBMV in 108 patients with severe MS and LA clot Types Ia, Ib, or Ila. All patients in the study group underwent PBMV by modified over-the-wire technique. They found a significant improvement in MVA, mean mitral valve gradient, pulmonary artery systolic pressures and mean LA pressures without any increase in...
Figure 1 The morphologic and haemodynamic characteristics of the patient on presentation. (A) Pre-balloon mitral valvuloplasty thickened anterior and posterior mitral valve leaflets with fish mouth opening and mitral valve area of 0.9 cm². (B) Pre-balloon mitral valvuloplasty mean mitral valve gradient of 13.8 mmHg.

Figure 2 Trans-esophageal echocardiogram showing spontaneous echo contrast in left atrial and LAA clot Type IA.
thromboembolic episodes when compared with the control group of severe MS without LA thrombus.

Shaw et al.\(^6\) reported successful PBMV in 21 patients with clot localized entirely to LA appendage. Six patients with LA appendage clot protruding out of the appendage were anticoagulated for another 1 month. On repeat echocardiographic examination, three of them demonstrated partial resolution with clot being confined to LA appendage only, who underwent successful PBMV.

Mitrval re-stenosis after previous PBMV occurs at the rate of 7–21%. The incidence increases after 5 years of follow-up.\(^7\) Wilkins score >8, Post PBMV MVA <1.8 cm\(^2\), pre-existing AF, higher age and NYHA functional Class III or IV have been identified as risk factors for development of re-stenosis.\(^8\) The dominant pathophysiology of mitral valve re-stenosis includes thickening of leaflets due to fibrosis, calcifications, fusion of commissures and shortening of chordae tendineae resulting in narrow orifice.

Sharma et al.\(^9\) studied 70 patients with a history of prior intervention, either surgical or percutaneous, in a prospective, open-label, randomized study. Forty-four patients had undergone a prior PBMV and 26 patients had undergone a prior surgical commissurotomy. All of them underwent a repeat PBMV due to mitral re-stenosis. They reported a successful PBMV in 84.1% patients with prior PBMV and in 65.4% patients with prior surgical commissurotomy. They found comparable and significant increase in MVA, decrease in pulmonary artery systolic pressure, decrease in LA mean pressure, and decrease in trans-mitral gradient in both groups.

Pathan et al.\(^10\) reported repeat PBMV in 36 patients having undergone a previous PBMV and compared it with 33 patients who underwent MVR having undergone a previous PBMV as the control arm to compare both interventions in patients with mitral valve re-stenosis. They reported a successful procedural outcome with repeat PBMV in 75% of patients and at 3-year follow-up, good functional results without subsequent MVR or death were obtained in 47% of patients.

Our patient is a unique case in undergoing a successful PBMV after having undergone a previous PBMV and having an associated LA thrombus type Ia. Studies evaluating PBMV in mitral re-stenosis have not included patients with LA clots. Ansari et al.\(^11\) has shown that PBMV, in addition to giving symptomatic relief; improves LA appendage performance over a period of 3 months by structural remodelling, in the form of better LA appendage fractional area change and LA appendage tissue doppler velocity; thus conferring protection from thromboembolism.

Conclusions
Rheumatic MS is a pathology very much rampant in developing countries. Poor socio-economic conditions and limited health care accessibility often brings patients in late stages of the disease with significant morbidity. In patients with low-to-intermediate echo score, repeat PBMV should be the procedure of choice despite challenges such as re-stenosis and LA thrombus. PBMV was safely performed in this case with LA clot Type Ia. Modified septal puncture technique and over-the-wire technique can be used for PBMV to avoid entry into LA appendage or manipulation above the fossa ovalis.
Lead author biography

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Appendix

Wilkins score criteria

| Score | Leaflet mobility | Leaflet thickening | Leaflet calcification | Sub-valvar apparatus |
|-------|------------------|--------------------|-----------------------|----------------------|
| 1     | Highly mobile valves with restriction of leaflet tips only | Leaflets near normal (4–5 mm) | Calcification at a single spot | Minimal thickening of chordae just below the valve |
| 2     | Mid-portion and base of leaflets have restricted mobility | Mid-leaflet and margin thickening | Scattered areas of calcification confined to leaflet margins | Thickening of chordae up to one-third of chordal length |
| 3     | Valve leaflet move forward in diastole mainly at base | Thickening extends through entire leaflets (5–8 mm) | Calcification extending to mid-portion of leaflets | Thickening extending to distal third of chordal length |
| 4     | No, or minimal, forward movement of base in diastole. | Pronounced thickening of all leaflet tissue (>8–10 mm) | Extensive calcification through most of the leaflet tissue. | Extensive thickening and shortening of all chordae down to the papillary muscles |

References

1. Vahanian A, Beyersdorf F, Praz F, Milojevik M, Baldus S, Bauersachs J, Capodanno D, Conradi L, Bonis M, Paulis R, Delgado V, Freemantle N, Gaird M, Haukaa K, Jeppsson A, Juni P, Pierard L, Prendergast B, Sadaba J, Tribouilloy C, Wojakowski W. 2021 ESC/EACTS guidelines for the management of valvular heart disease: developed by the task force for the management of valvular heart disease of the European Society of Cardiology (ESC) and the European Association for Cardio-Thoracic Surgery (EACTS). Eur Heart J 2022;43:561–632.

2. Davison G, Greenland P. Predictors of left atrial thrombus in mitral valve disease. J Gen Intern Med 1991;6:108–112.

3. Srinanistrayana J, Varma RS, Satheesh S, Anikumar R, Balachander J. Prevalence of left atrial thrombus in rheumatic mitral stenosis with atrial fibrillation and its response to anticoagulation: a transesophageal echocardiographic study. Indian Heart J 2003;55:358–361.

4. Manjunath CN, Sinrivasu KH, Ravindranath KS, Manohar JS, Prabhavathi B, Dattatreya PV, Sridhar L, Dhanalakshmi C. Balloon mitral valvotomy in patients with mitral stenosis and left atrial thrombus. Catheter Cardiovasc Interv 2009;74:653–661.

5. Manjunath CN, Sinrivasu KH, Panneerselvam A, Prabhavathi B, Ravindranath KS, Rangan K, Dhanalakshmi C. Incidence and predictors of left atrial thrombus in patients with rheumatic mitral stenosis and sinus rhythm: a transesophageal echocardiographic study. Echocardiography 2011;28:457–460.

6. Shaw TR, Northridge DB, Sutaria N. Mitral balloon valvotomy and left atrial thrombus. Heart 2005;91:1088–1089.

7. Jung B, Corme B, Ducimetiere P, Porte JM, Nallet O, Michel PL, Acar J, Vahanian A. Functional results 5 years after successful percutaneous mitral commissurotomies in a series of 528 patients and analysis of predictive factors. J Am Coll Cardiol 1996;27:407–414.

8. Meneguz-Moreno RA, Costa JR, Gomes NL, Braga SL, Ramos AI, Meneghello Z, Maldonado M, Ferreira-Neto A, Franca J, Siqueira D, Esteves C, Sousa A, Sousa J, Abizaid A. Very long term follow-up after percutaneous balloon mitral valvuloplasty. JACC Cardiovasc Interv 2018;11:1945–1952.

9. Sharma KH, Jain S, Shukla A, Bohora S, Roy B, Gandhi GD, Ashwal A. Patient profile and late effects of successful PTMC on left atrial appendage function in patients with severe rheumatic mitral stenosis IN SINUS rhythm. Indian Heart J 2020;72:179–183.