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From Tamponade to Triumph: LA Rupture Resulting in Cardiac Tamponade during BMV Successfully Managed with Device Closure, Followed by Successful BMV

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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Case Report

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ABSTRACT

The main objective of Balloon Mitral Valvuloplasty (BMV) is to relieve the symptoms of Mitral stenosis (MS) by percutaneous approach and avoiding valve replacement surgery. However, complications like rupture of the Aortic root or heart chamber can lead to hemopericardium and

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eventually increase morbidity and mortality associated with emergency surgery. In this case report, we discussed a case in which the rupture of the left atrium was managed by device closure, BMV was done successfully by percutaneous route, and valve replacement surgery was avoided.

Keywords: Hemopericardium represents; BMV; heart disease.

ABBREVIATIONS

AF : Atrial Fibrillation;
BMV : Balloon mitral valvuloplasty;
CVTS : Cardiovascular Thoracic Surgery;
CWD : Continuous Wave Doppler;
LA : left atrium;
MR : Mitral Regurgitation;
MS : Mitral stenosis;
MV : Mitral Valve;
MVA : Mitral valve area;
NYHA : New-york heart association;
OMT : Optimum Medical Therapy;
OPD : Outpatient department;
P/M TMG : peak/mean Transmitral Gradient;
PAH : pulmonary artery Hypertension;
PASP : Pulmonary artery systolic pressure;
PHT : pressure half time;
PSAX : Parasternal Short Axis;
PTMC : Percutaneous transcatheter mitral commissurotomy;
RA : right atrium;
RHD : Rheumatic Heart Disease;
TR : Tricuspid regurgitation;
TSP : Transseptal puncture;
TTE : transthoracic echocardiography;
VSD : ventricular septal defect.

1. INTRODUCTION

Hemopericardium represents a significant complication associated with BMV. This complication stems from chamber perforation during transseptal puncture or manipulation of the balloon and wire during the procedure [1]. The incidence of hemopericardium during BMV varies from 0.6% to 4% and is one of the most common indications for emergency surgery. The manifestation (effusion/tamponade) is influenced by the device responsible for the perforation (needle/sheath/dilator), the perforated structure, hemodynamic status, and coagulation status. These factors play a crucial role in determining the outcome of the procedure [1]. In cases of cardiac tamponade complicating BMV, emergency surgery is strongly recommended, as percutaneous pericardial drainage alone is unlikely to effectively resolve the issue [2].

In this case report, we have discussed a case of Left atrium (LA) rupture during BMV by Accura Balloon leading to hemopericardium and cardiac tamponade which was managed by percutaneous device closure followed by successful BMV.

2. CASE REPORT

A 52-year-old female, with a known case of rheumatic heart disease came to cardiology OPD with chief complaints of dyspnea which increased from NYHA class II to NYHA class III over one year despite optimum medical therapy (OMT) with beta-blockers and diuretics. The patient was also having a history of intermittent episodes of palpitations. The patient had undergone successful BMV three times in the past in 1998,2011 and 2019. She had no other comorbidities or addictions. The general examination was normal. On auscultation, there was a loud S1 with an Opening snap followed by a mid-diastolic rumble. Routine lab investigations were within normal limits.

An electrocardiogram (ECG) was suggestive of Atrial Fibrillation (AF) with a controlled ventricular rate and trans-thoracic echo (TTE) was suggestive of RHD with severe MS (Mitral valve area (MVA) by pressure half time (PHT) and planimetry=0.75 cm^2, P/M Transmitral Gradient (TMG) = 50/30 mm Hg). Medial and lateral mitral commissures were fused with Trivial mitral regurgitation (MR) with Moderate tricuspid regurgitation (TR) and severe Pulmonary Artery Hypertension (PAH) (Pulmonary artery systolic pressure (PASP)= 90 mm Hg). Wilkin's score was 7. The patient was planned for elective BMV with Cardiovascular Thoracic Surgery (CVTS) standby.

The transseptal puncture was done using standard landmarks under fluoroscopic guidance during BMV. The position of the Transseptal puncture (TSP) needle in LA was confirmed with bright red blood, LA pressure waveform, and Contrast injection under fluoroscopy. The looped LA wire was positioned in LA. There was no evidence of pericardial effusion at this point. Septal puncture dilated with Transseptal dilator over looped LA wire.

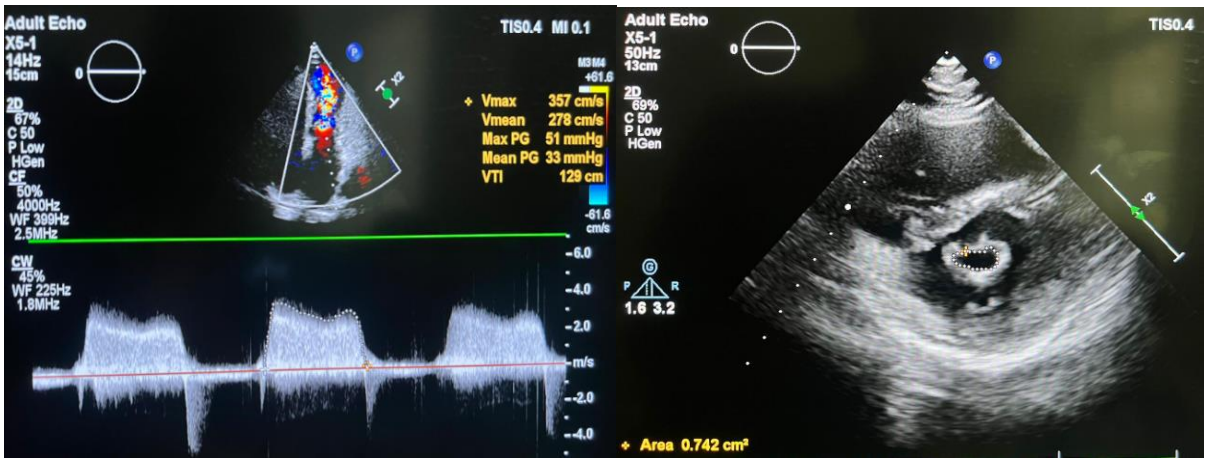

Fig. 1. (A) Colour Doppler across Mitral Valve showing turbulent jet due to MS and CWD showing P/M TMG of 51/33 mm Hg suggestive of severe MS. (B) PSAX view showing Fish mouth appearance of MV in open state in diastole with MV area of 0.74 cm^2 by Planimetry

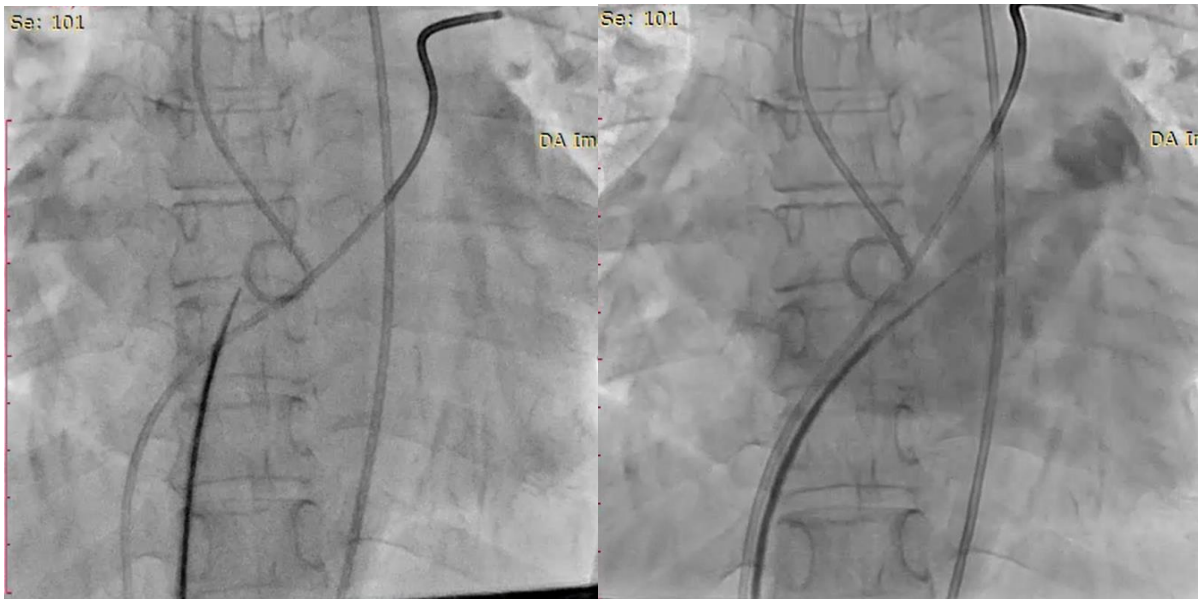

Fig. 2. (A) Transseptal puncture taken under standard fluoroscopic markers (B) Contrast injection showing Mullins sheath positioned in LA after TSP

Accura balloon number 25 was passed over the looped LA wire into LA through the transeptal puncture. Accura balloon was then passed into LV and first inflation was given, giving suboptimal results with respect to TMG and MVA. Hence, a second inflation was attempted. While we were handling the balloon inside the LA to pass it into LV, the patient developed sudden onset hypotension and bradycardia. The patient had asystole which led to syncope following which the patient became unresponsive. Cardiopulmonary resuscitation (CPR) was started immediately and the patient was intubated and put on ventilatory and ionotropic support. On TTE, there was pericardial effusion with tamponade physiology. Immediately pericardiocentesis was done and auto-transfusion was initiated. The patient was revived with CPR and pericardiocentesis. However, there was rapid recollection of blood and hence tapping with auto-transfusion continued.

During the fluoroscopy, the balloon was observed within the cardiac shadow at the left ventricle level. As it was not outside cardiac shadow we ruled out pulmonary vein rupture. Also, no ventricular premature contractions were detected on ECG, indicating that the balloon had

ruptured LA and was likely positioned in the pericardial cavity. Subsequently, a diagnostic fluoroscopic image obtained by injecting contrast through the Accura Balloon revealed evidence of active contrast leak into the pericardial space, resulting in staining of the pericardium. Therefore, it was established that the balloon caused a rupture in the left atrium free wall and moved into the pericardial space. The CVTS team was immediately informed about the urgent need for surgery. Unfortunately, the patient couldn't be relocated because an emergency procedure was underway in the CVTS operating room, which was unavailable. Consequently, we decided to promptly close the left atrium defect using a device. The patient's family members were thoroughly informed about the experimental nature of the procedure, as it offered a potential alternative to an otherwise inevitable surgery.

Amplatzer super-stiff wire was introduced through the Accura balloon into pericardial space which was crossing the defect in LA. Lifetech Konar MF Ventricular Septal Defect (VSD) device 12/10 mm was loaded in 7F Lifetech delivery sheath and was passed over Amplatzer super stiff wire. One rim of the device was opened into pericardial space and gradually pulled inside LA. As the outer rim of the device got stuck at the LA defect on the pericardial side,

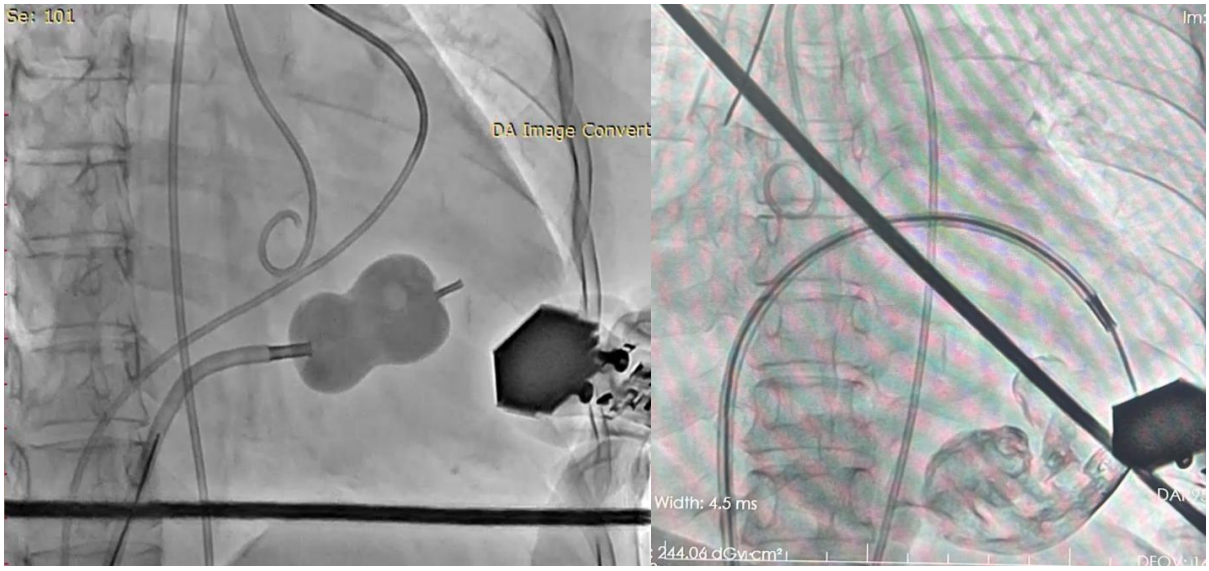

Fig. 3. (A) First inflation by Accura Balloon no 25 (B) Contrast injection through Accura balloon s/o contrast leak in pericardial space as the balloon is in the pericardial cavity due to LA free wall rupture

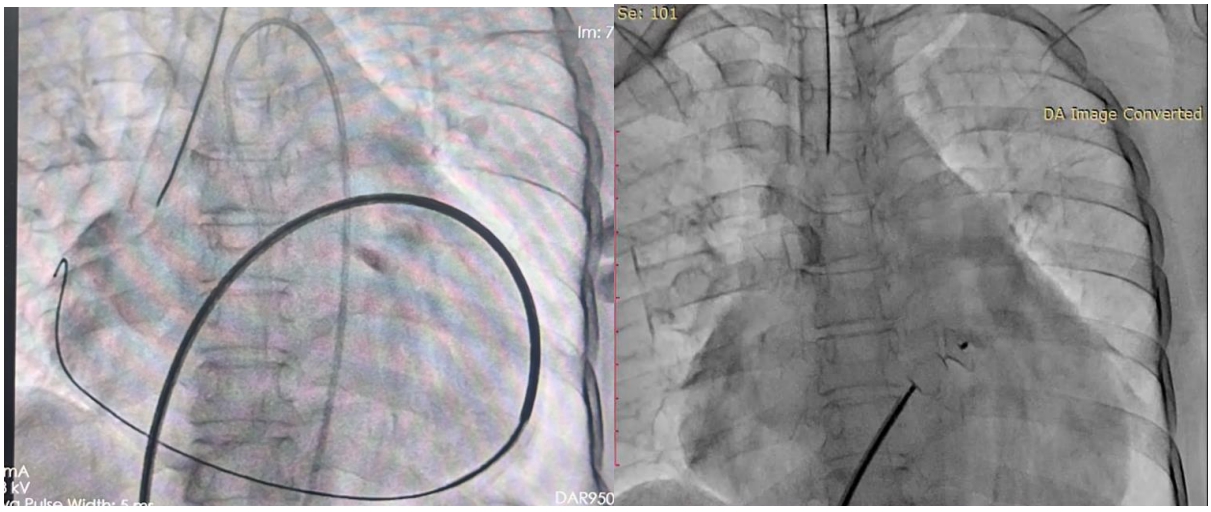

Fig. 4. (A) Amplatzer superstiff wire in pericardial space (B) Positioning of the Konar MF VSD 12/10 device across the defect in the LA free wall

the other rim was opened in LA. The device was placed perfectly across the LA defect and there was no contrast leak into the pericardial space on injecting contrast in LA.

Pericardial effusion was drained completely and the patient was observed for half an hour for any recollection of blood in the pericardium. As there was no recollection and the patient had improved hemodynamics, the device was released. Now, the looped LA wire was passed into LA and then the Accura balloon was passed over the wire. The second inflation of BMV was given and optimum results were obtained with the decrease in TMG and an increase in MVA. Left atrial pressure dropped from 58/25 mm Hg (mean 38) to 37/13 mm Hg (mean 24) and PA pressures dropped from 65/28 mm Hg (mean 47) to 50/22 mm Hg (mean 32).

The patient shifted to ICCU with low-dose inotropic support. Arterial line and pericardial sheath were kept in place for monitoring. There was no increase in pericardial effusion till 24 hours and ionotropes were tapered off. The patient was extubated and the Pericardial sheath was removed.

Post BMV TTE: MVA by planimetry = 1.80 cm^2 with P/M TMG = 18/10 mmHg with splitting of both commissures with mild MR and mild PH with PASP =40 mm Hg

The patient was discharged on Tablet Aspirin 150 mg OD and oral anticoagulation with low-dose diuretics and beta blockers.

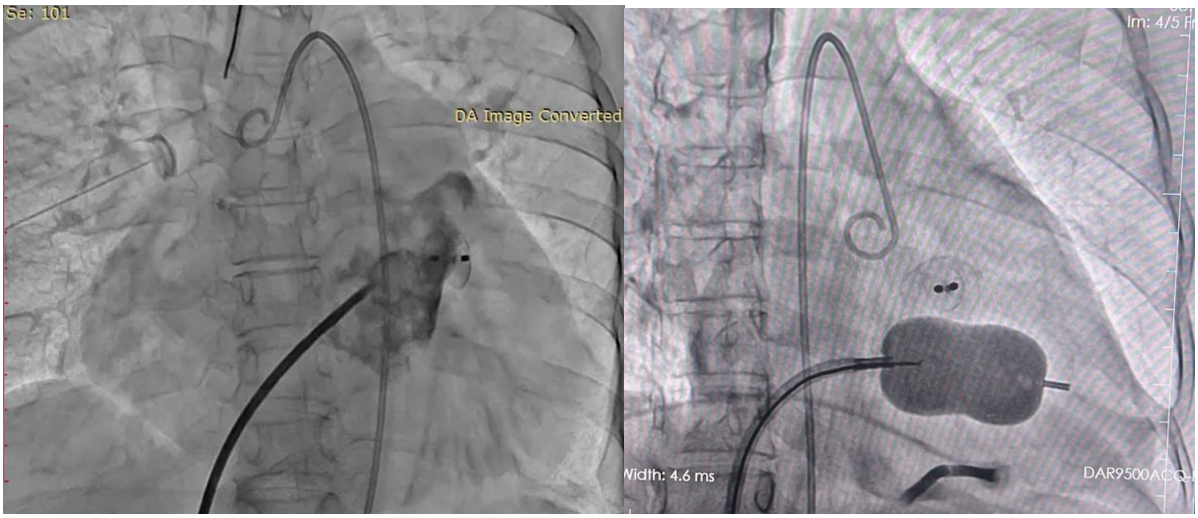

Fig. 5. (A) Contrast injection s/o device completely sealing the defect as there is no contrast leak in pericardium (B) Second inflation given by Accura balloon no. 25 after stabilizing the patient with pericardial sheath in situ

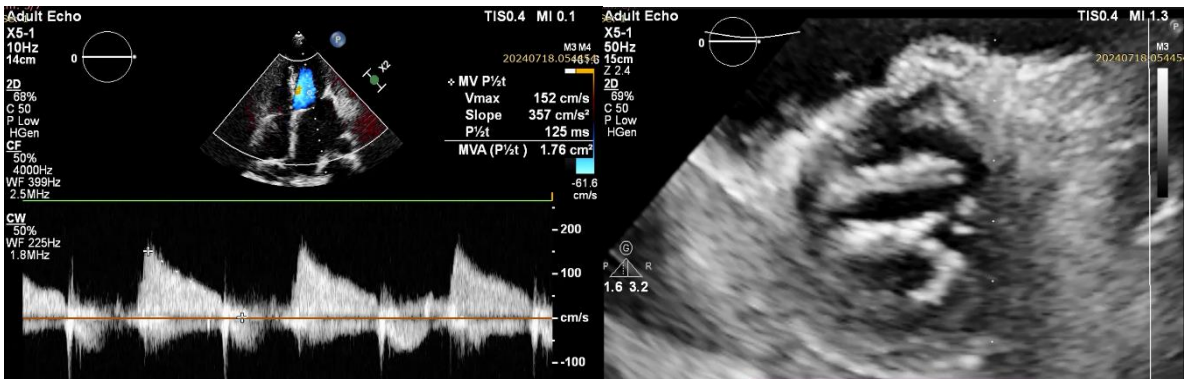

Fig. 6. (A) CWD across MV showing MVA of 1.76 cm^2 by PHT and decreased TMG (B) PSAX view of MV post-BMV showing bilateral split commissures with increased MVA up to 1.8 cm^2

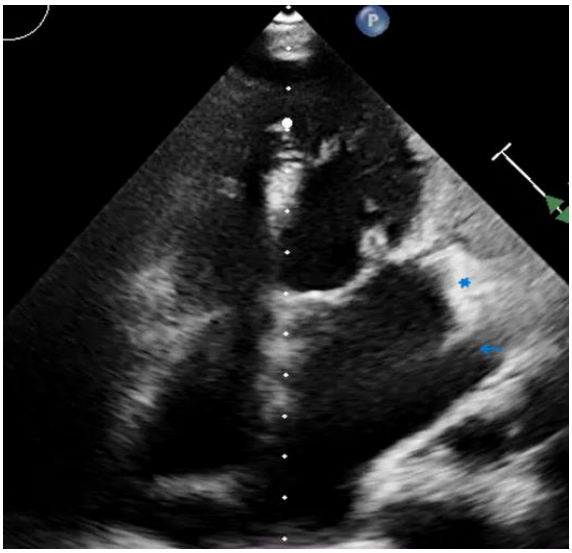

Fig. 7. The device (*) is seen towards the left ventricular side of the LA appendage (Blue Arrow)

3. DISCUSSION AND CONCLUSION

Cardiac tamponade secondary to cardiac perforation following percutaneous transvenous mitral commissurotomy (PTMC) with an incidence of 0 to 9% in several studies accounts for half of the procedure-related mortalities and is often managed by surgery if hemodynamically unstable [3]. The sites of perforation could be one of the cardiac chambers or the aortic root [4]. It has been suggested in previous research that emergency surgery is the recommended course of action for cases of cardiac tamponade complicating BMV, as percutaneous pericardial drainage alone is unlikely to successfully resolve the issue [5].

The preferred approach involves per-operatively sealing the perforation and performing a surgical mitral commissurotomy, with the specific technique (open or closed) depending on the chosen surgical approach for sealing the perforation. Additionally, there have been reports of using cyanoacrylate glue to seal the stitch injury perforation via a pericardial sheath [6].

Upon encountering this situation, we began to contemplate a different approach to closing the perforation. Subsequently, we opted to utilize a novel method involving a muscular VSD device to close the defect. We acknowledged the potential risks, including inadequate sealing of the defect and the possibility of ongoing hemopericardium. Additionally, we considered the risk of the device becoming dislodged into the LA/LV/pericardial cavity, which would have necessitated emergency surgical intervention.

Considering the diameter of the transseptal dilator (14F~5mm), it's clear that the defect created measures 5 mm in diameter. Hence, for adequate sealing of the defect devices with two rims (approximately 10 mm) and waist size of approximately 5-7 mm will be adequate. We emphasize keeping such devices in cathlab where BMV is routinely done. This approach needs an experienced interventional cardiologist with good experience in device closure procedures.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of this manuscript.

ETHICAL APPROVAL

As per international standards or university standards written ethical approval has been collected and preserved by the author(s).

CONSENT

As per international standards or university standards, patient(s) written consent has been collected and preserved by the author(s).

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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