

Percutaneous closure of iatrogenic anterior mitral leaflet perforation: a case report

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Received 15 November 2019; first decision 16 January 2020; accepted 5 May 2020; online publish-ahead-of-print 20 July 2020

Background

Severe mitral regurgitation (MR) through the body of the anterior mitral leaflet (AML) is rare. The cause either iatrogenic during open-heart surgery or due to infective endocarditis. We present a case where a successful percutaneous closure of the AML perforation was an alternative to surgery.

Case summary

A 60-year-old male presented with shortness of breath (SOB) class III of 12 months duration. He underwent coronary artery bypass surgery with four grafts plus mitral valve (MV) repair 20 months ago. Transthoracic echocardiogram (TTE) and transoesophageal echocardiogram (TOE) revealed severe MR through the body of AML at A3. The percutaneous closure plan was to cross the AML perforation from the left ventricular side. The venocontracta of the perforation was 6 mm, an amplatzer septal occluder device 6 mm considered appropriate for closure of this hole. A snare catheter snared the wire and exteriorized creating arteriovenous loop. Amplatzer septal occluder 6 mm loaded to the delivery system till larger disc (left-sided) opened safely and freely below the MV apparatus. Once the left ventricular side disc opposed the ventricular surface of AML, the waist and left atrial disc gently released. The patient discharged in the next day. After 6 months, the patient had no more SOB, he returned to his daily activity. Follow-up TTE showed no MR, the closure device was stable in place.

Discussion

We added a successful case of transcatheter AML perforation to the literature. The role of TOE is crucial in diagnosis and procedure guidance.

Keywords

Mitral valve • Anterior mitral leaflet • Perforation • Percutaneous • Case report

Learning points

- Percutaneous closure of anterior mitral leaflet (AML) perforation is feasible in selected patients at centres with experience in structural heart disease intervention.
- Understand the technique of AML perforation closure and the transoesophageal echocardiogram 3D guidance of the procedure.
- Understand how to select the type and size of the closure device.
- Further research is needed to establish long-term follow-up of this approach and its use in lower-risk patients.

Introduction

Anterior mitral leaflet (AML) perforation leading to severe mitral regurgitation (MR) post-open-heart surgery may be iatrogenic.¹ Anterior mitral leaflet perforation may be the result of infective endocarditis at the aortic valve.² The usual treatment of severe MR due to AML perforation is surgical repair of the mitral valve (MV).³ Very few cases have been reported for percutaneous repair of perforated AML.^{1,4–7} Percutaneous closure of AML perforation is not guideline based and there is insufficient evidence of success, it should

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Handling Editor: Soren Skott-Schiegelow

Peer-reviewers: Cemil Izgi, Christoph Sinning, and Livia Gheorghe

Compliance Editor: Amir Aziz

Supplementary Material Editor: Deepti Ranganathan

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be reserved for high-risk surgical patients. However, patient preference and local experience in structural heart disease intervention are factors that may contribute in selecting this procedure. We add to the literature a case of successful percutaneous closure of an AML perforation in a patient who underwent coronary bypass surgery plus MV repair. We described the role of 3D echocardiography in guiding the procedure and selecting the device for closure. This patient was a moderate surgical risk for reoperation for MV repair.

MV repair band and perforation at the base of AML at A3 ([Figure 1C](#) and [Supplementary material online, Video S3](#)). Surgical view 3D full volume with and without colour confirmed that the MR jet was only through this perforation ([Figure 1D, E](#) and [Supplementary material online, Video S4](#)). In the Bicommisural view, there was no MR from either commissure ([Supplementary material online, Video S5](#)). There was an apparent systolic reversal in the left upper pulmonary vein indicating the MR severity ([Figure 1F](#)). There was no evidence of current or previous infective endocarditis. Further investigations revealed a normal white blood cell count, no fever, normal erythrocyte sedimentation rate, and negative blood cultures.

Timeline

Twenty months ago	A 60-year-old male, diabetic and hypertensive, presented with inferior ST-elevation myocardial infarction.
Investigations at that time	His coronary angiography revealed multivessel disease. His transthoracic echocardiogram (TTE) showed inferior and inferolateral akinesia with an ejection fraction (EF) 45% and moderately severe ischaemic mitral regurgitation (MR).
Procedure done	He underwent coronary artery bypass surgery with four grafts plus mitral valve repair with a radiolucent band.
Presentation	Presented to our centre with shortness of breath New York Heart Association (NYHA) class III of 12 months duration and progressive course.
TTE and transoesophageal echocardiogram (TOE)	Transthoracic echocardiogram revealed akinetic inferior and inferolateral walls with EF 45% and severe MR through the body of anterior mitral leaflet (AML). Transoesophageal echocardiogram confirmed that severe MR jet was originating at the anteromedial commissure and 3D zoom surgical view showed the perforation at the base of AML at A3.
Heart team meeting	The surgeon accepted the patient for surgical MV repair with a patch or suture of the AML perforation. The patient refused reoperation. The team decided to do transcatheter closure of AML perforation.
Day of the procedure	Under general anaesthesia and TOE guidance a successful deployment of an atrial septal occluder 6 mm done with complete closure of the perforation.
Next day	The patient discharged in a good condition.
After 6 months	The patient had no more SOB, he returned to his daily activity. Follow-up TTE showed no MR, the closure device was stable in place.

Case presentation

A 60-year-old male, diabetic and hypertensive, presented to our centre with shortness of breath (SOB) New York Heart Association (NYHA) class III of 12 months duration, with a progressive course.

Twenty months ago, the patient presented with inferior ST-elevation myocardial infarction. His coronary angiography revealed multivessel disease. His transthoracic echocardiogram (TTE) showed inferior and inferolateral akinesia with a left ventricular ejection fraction (LVEF) 45% and moderately severe ischaemic mitral regurgitation (MR). He underwent coronary artery bypass surgery with four grafts plus MV repair with a radiolucent band.

There was pansystolic murmur grade IV/IV with maximum intensity at the apex propagating to the axilla. He had fine bilateral crepitations up to the mid chest.

A case of decompensated heart failure due to severe MR mostly as a result of failed surgical MV repair. There was no clinical evidence to suggest AML perforation.

Transthoracic echocardiogram (TTE) revealed akinetic inferior and inferolateral walls with LVEF 45% and severe MR through the body of AML ([Supplementary material online, Video S1](#)). Transoesophageal echocardiogram (TOE) confirmed that severe MR jet was originating at the anteromedial commissure ([Figure 1A, B](#) and [Supplementary material online, Video S2](#)). Three-dimensional zoom surgical view showed

The case was discussed in the heart team meeting, the calculated Society of Thoracic Surgery (STS) score was 2.3% for mortality and 16.5% for both morbidity and mortality. The surgeon accepted the patient for surgical MV repair with a patch or suture of the AML perforation. The patient refused reoperation. Percutaneous closure of AML perforation was performed successfully in our centre before.¹ After explaining the surgical and percutaneous options to the patient, highlighting that there is no evidence for long-term outcome for transcatheter option, he again selected not to have surgery. The team decided to do transcatheter closure of AML perforation.

The percutaneous closure plan was to cross the AML perforation from the left ventricular side. The wire from the aorta had easier crossing and more precise localization of the defect. The catheter in the ventricular side of the MV always faces the mitral leaflets and does not lose continuous navigation if compared with crossing from the left atrial side. The systolic flow of MR to the left atrium makes the wire crossing easier with the direction of blood flow. Device selection was based on a double disc device with larger disc towards the LV side to give both better closure and stability. The distance between the two discs is better to match the leaflet thickness (1–3 mm), so, an amplatzer septal occluder (ASO) device was selected. The venacontracta of the perforation was 6 mm, an ASO device 6 mm was considered appropriate for closure of this hole. TOE confirmed there is enough

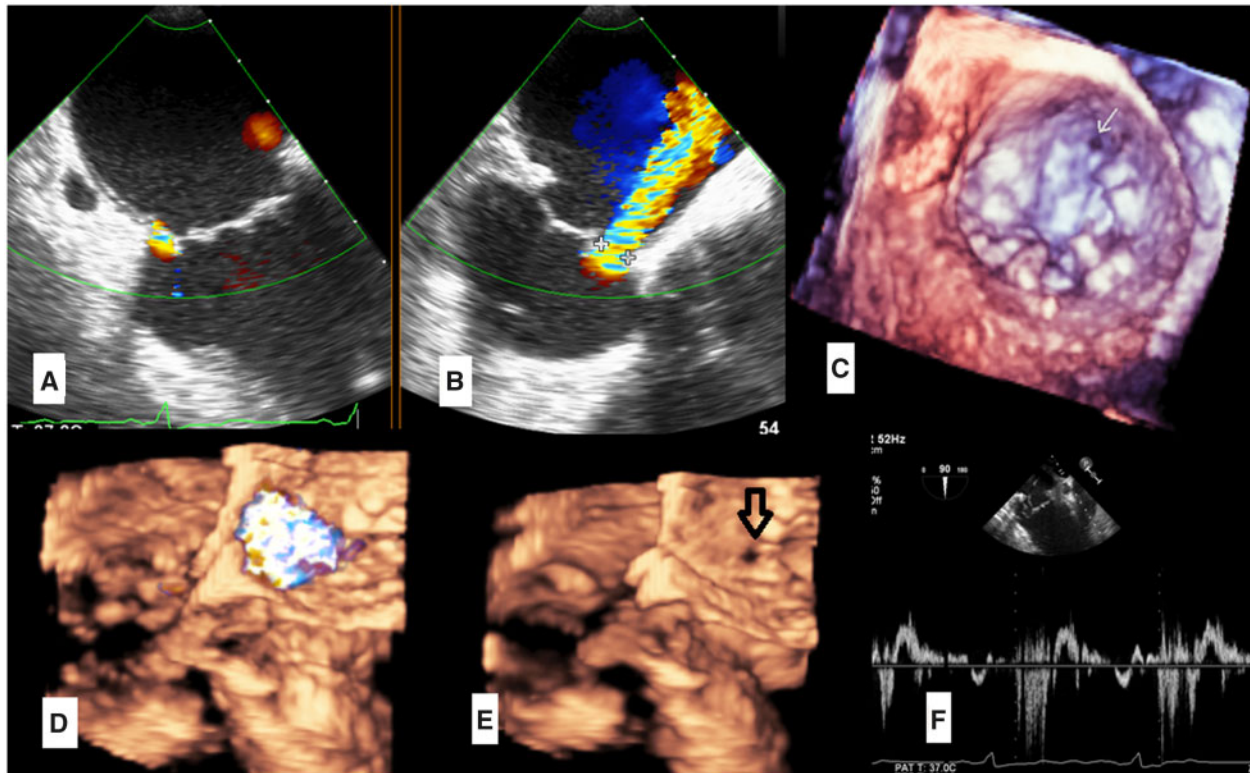


Figure 1 (A) Colour flow at the medial commissure. (B) Severe mitral regurgitation at a perforation of anterior mitral leaflet at A3. (C) Three-dimensional zoom, the arrow pointed to the perforation at the base of A3. (D and E) Full volume with and without colour, showed the colour flow and the hole (arrow). (F) Pulsed Doppler at left upper pulmonary vein showed systolic reversal indicating severe mitral regurgitation.

distance between the perforation and the edge of AML to support the device.

Under general anaesthesia and TOE guidance arterial 6 and 10 F venous femoral access obtained. Transseptal access using 8.5 F SLO sheath and BRK 0 needle targeted posterior–inferior puncture site to avoid angulation or traction to the leaflet.

Judkin's Rt 5 F 3.5 (Terumo) and glide wire 0.035/260 (Terumo) in the RAO projection crossed from the LV to the LA through the perforated AML (Figure 2A and Supplementary material online, Video S6). Surgical view 3D zoom from left atrial side showed the catheter from AML hole to LA (Figure 2B) and from LV side showed enough distance between the hole at A3 and the edge of AML (Figure 2C). A snare catheter size 25 mm through the SL sheath snared the wire and exteriorized creating arteriovenous loop (Supplementary material online, Video S7).

Torque Vue sheath 7 F quickly crossed from the venous side across the IAS and LA to the perforated A3 segment of the MV to the ascending aorta.

An ASO device 6 mm was loaded to the delivery system till larger disc (left-sided) opened safely and freely below the MV apparatus (Figure 2D and Supplementary material online, Video S8). The disc was not interfering with the closure mechanism of the MV and away from the aortic valve. Once the left ventricular side disc opposed the ventricular surface of AML, the waist and left

atrial disc were gently released (Figures 2E, F and 3A and Supplementary material online, Video S9).

After a meticulous and extensive assessment of the MV closure mechanism, left ventricular outflow tract (LVOT) gradient, leaflets movements, MV diastolic function and absence of any residual mitral incompetence (Figure 3B and Supplementary material online, Video S10), the device was released in a stable position (Figure 3C and Supplementary material online, Video S11). Pulsed Doppler at left upper pulmonary vein showed normalization of S/D ratio after perforation closure (Figure 3D). The patient was discharged the next day.

After 6 months, the patient had no more SOB, he returned to his daily activity. Follow-up TTE showed no MR, the closure device was stable in place (Figure 3E and Supplementary material online, Videos S12–S15).

Discussion

Sareyyupoglu et al.³ reported 26 patients with AML perforation who underwent MV repair. Twenty-four (92%) patients had endocarditis. For anterior leaflet repair, a patch was used in 11 (42%) patients and primary suture closure in 15 (58%). Patient survival was 95% at 1 year and 90% at 5 years. In a review of 475 cases after repair of aortic valve insufficiency,

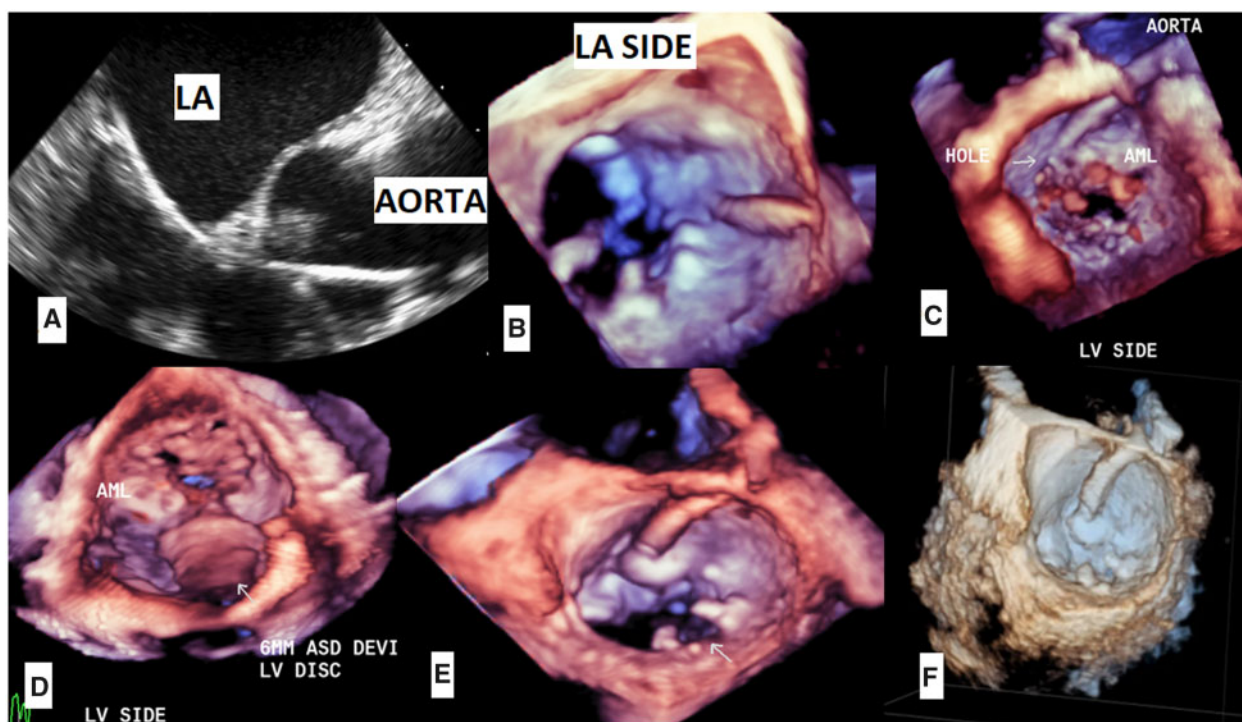


Figure 2 (A) The wire passed from aorta through the anterior mitral leaflet hole to the LA. (B) Three-dimensional zoom LA side showed the catheter from anterior mitral leaflet hole to LA. (C) Three-dimensional zoom LV side showed the catheter from LV to anterior mitral leaflet hole at A3. (D) Deployment of LV disc of 6 mm ASD device. (E and F) Deployment of LA disc of 6 mm ASD device during systole and diastole.

two cases of perforation of the base of the AML were reported.⁷ Transcatheter repair of AML is only reported in sporadic cases.^{1,4-7} Abuelatta *et al.*¹ reported a 2-year follow-up for a 20-year-old patient with iatrogenic AML perforation at A2 after a mechanical aortic valve replacement. The follow-up was good with no MR, and the AML tolerated the weight of an ASD 4-mm device nicely. Sengun *et al.*⁷ used an AMPLATZER™ Duct Occluder II 6 mm to close an iatrogenic AML perforation in a 19-year-old patient. Czerny *et al.*⁸ reported a similar case of percutaneous closure of MV leaflet perforation after surgical repair. In this case, we described a successful percutaneous closure of AML perforation in a moderate surgical risk patient. The decision for closure was based on patient preference and the availability of an expert team in structural heart disease intervention. Live 3D TOE during the procedure is mandatory to decide the type, size of the device as well as any complications. Further research is needed to establish mid- and long-term follow-up of this approach and its use in lower-risk patients.

Conclusion

Transcatheter closure of AML perforation is feasible in selected patients. More research is required for safety and long-term follow-

up. Transoesophageal echocardiogram 3D is essential for accurate diagnosis and procedure guidance.

Lead author biography



Dr Hesham Abdo Naeim, MD, FASE, graduated from Faculty of Medicine, Al-Azhar University in December 1997; was granted MSc degree in cardiovascular diseases in December 2002; MD degree in 2006. He was a Diplomate—Adult Comprehensive Echocardiography from National Board of Echocardiography, United States at June 2014. He was a resident and assistant lecturer of cardiology in Al-Azhar University hospitals from June 1997 to February

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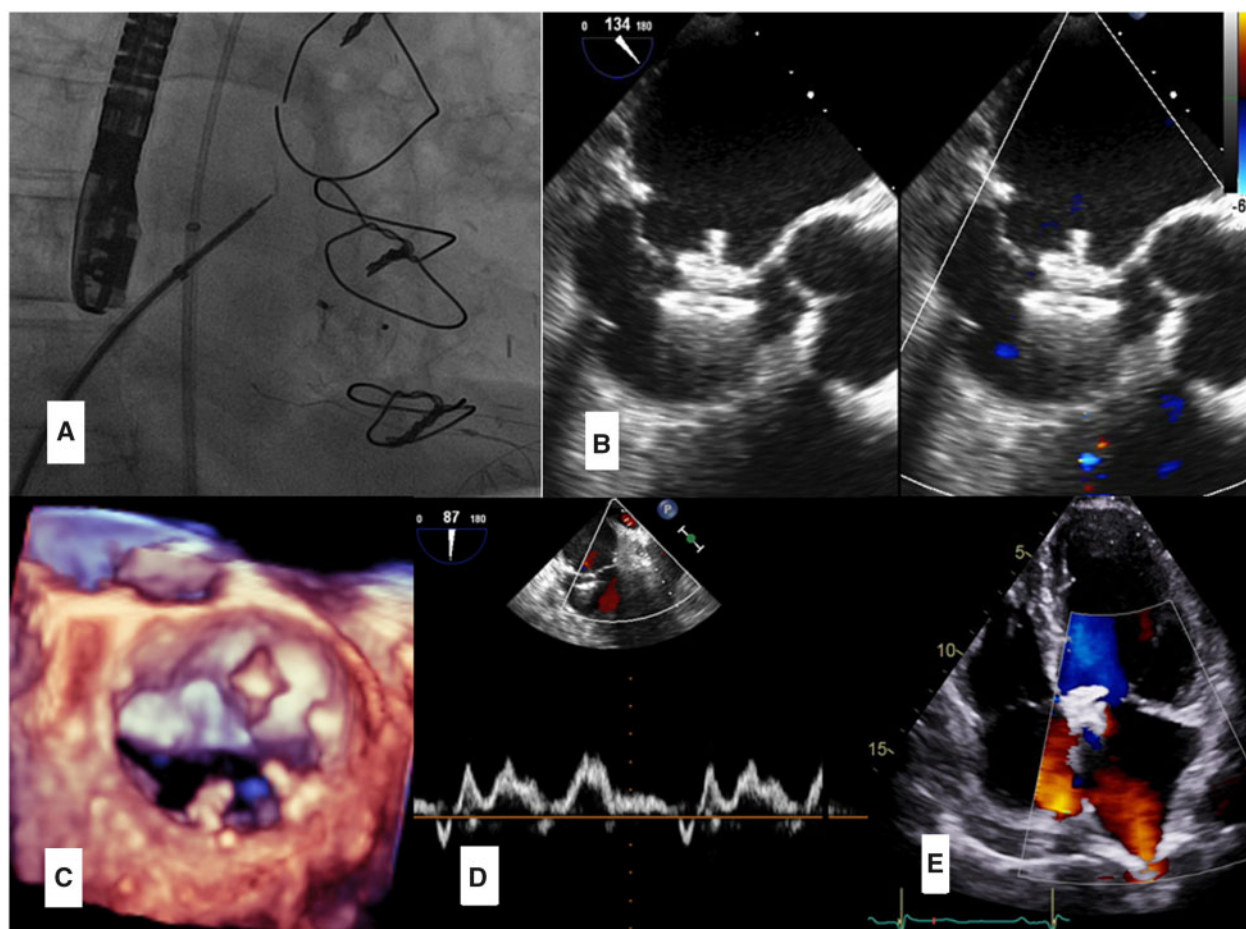


Figure 3 (A) Fluoroscopy showed the released 6 mm ASD device. (B) LVOT colour compare view showed no mitral regurgitation after the device release. (C) Three-dimensional zoom surgical view showed the released device at A3. (D) Pulsed Doppler at left upper pulmonary vein showed normalization of S/D ratio after perforation closure. (E) Follow-up apical four-chamber view systolic frame showed the ASD device at anterior mitral leaflet, no mitral regurgitation.

Supplementary material

Supplementary material is available at *European Heart Journal - Case Reports* online.

Acknowledgements

The authors want to acknowledge Dr Ibraheem Alharbi and Dr Hassan Sandogji for their support during the production of this article.

Slide sets: A fully edited slide set detailing this case and suitable for local presentation is available online as [Supplementary data](#).

Consent: The authors confirm that written consent for submission and publication of this case report including images, videos and associated text has been obtained from the patient in line with COPE guidance.

Conflict of interest: none declared.

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