

CASE REPORT

INTERMEDIATE

CLINICAL CASE

Paradoxical Left-to-Right Device Embolization Complicating Transcatheter Mitral Valve Edge-to-Edge Repair



Kayla Chiew, MBBS, BSc, Mohammed Akhtar, MBBS, PhD, Michael McGarvey, MBBS, Suzy Browne, BSc, MSc, Ali Vazir, MBBS, PhD, Ee Ling Heng, MBBS, PhD, Robert Smith, MBBS, MD

ABSTRACT

We describe an unusual presentation of transcatheter mitral valve edge-to-edge repair device embolization into the left common femoral vein in a patient with primary degenerative mitral regurgitation. We hypothesize a possible mechanism for this phenomenon, factors that may increase the risk of this complication, and outline the patient's clinical course. **(Level of Difficulty: Intermediate.)** (J Am Coll Cardiol Case Rep 2023;5:101692) © 2022 The Authors. Published by Elsevier on behalf of the American College of Cardiology Foundation. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

HISTORY OF PRESENTATION

An 86-year-old man was referred to our tertiary center for discussion at the mitral multidisciplinary meeting because of worsening primary degenerative mitral regurgitation (MR). He was in New York Heart

Association functional class III with symptoms of lethargy, breathlessness, and an exercise tolerance of 30 m. He underwent a transesophageal echocardiogram (TOE), which demonstrated a broad P2 prolapse of the mitral valve, with a flail width of 28 mm and flail gap of 7 mm (Video 1). This resulted in torrential MR, a severely dilated left atrium, and a hyperdynamic left ventricle (Figure 1, Video 2). He underwent an uncomplicated transcatheter mitral valve edge-to-edge repair (TEER) the following month, with 3 MitraClip XTr devices (Abbott) inserted from the medial to lateral aspect of A2/P2 (Video 3). Left atrium pressure V-wave on invasive monitoring fell from 30 to 13 mm Hg. Postprocedure TOE demonstrated mild-moderate residual MR (Figure 2, Video 4) and a mean gradient across the mitral valve of 4 mm Hg. There was a small unidirectional left-to-right residual interatrial shunt defect. Six months later, he was admitted to his local hospital with decompensated heart failure.

LEARNING OBJECTIVES

- To acknowledge device embolization as a rare but possible complication of transcatheter edge-to-edge repair.
- To recognize features of mitral valve anatomy that may pose technical challenges and increase the risk of device embolization.
- To consider iatrogenic atrial septal defects as a conduit for the paradoxical migration of TEER devices into the venous system, in addition to facilitating right-to-left movement of venous thromboemboli.

From the Royal Brompton and Harefield Hospitals, London, United Kingdom.

The authors attest they are in compliance with human studies committees and animal welfare regulations of the authors' institutions and Food and Drug Administration guidelines, including patient consent where appropriate. For more information, visit the [Author Center](#).

Manuscript received August 14, 2022; revised manuscript received October 18, 2022, accepted October 31, 2022.

**ABBREVIATIONS
AND ACRONYMS****ASD** = atrial septal defect**CT** = computed tomography**ECG** = electrocardiogram**MR** = mitral regurgitation**TEER** = transcatheter edge-to-edge repair**TOE** = transesophageal echocardiogram**PAST MEDICAL HISTORY**

Prior history included stage 3 chronic kidney disease, chronic pleural effusions, hypertension, mild coronary atheroma, hypothyroidism, pleural plaques with a restrictive pattern on spirometry (forced expiratory volume in the first second 79%, forced vital capacity 69%, diffusion capacity for carbon monoxide 66%), and moderate tricuspid regurgitation.

DIFFERENTIAL DIAGNOSIS

General differentials for acute decompensation include new-onset arrhythmia, ischemia, or medication noncompliance. Differentials specific to TEER include leaflet injury or chordal rupture with new severe MR, clip-associated mitral stenosis, single leaflet detachment, or device embolization.

INVESTIGATIONS

Electrocardiogram (ECG) showed sinus rhythm with monomorphic ventricular ectopic beats and no ischemic changes. Transthoracic echocardiogram (TTE) demonstrated recurrence of severe eccentric MR, with a newly dilated right ventricle and evidence of raised pulmonary arterial pressure. Without the expertise to facilitate a redo-TEER at his local

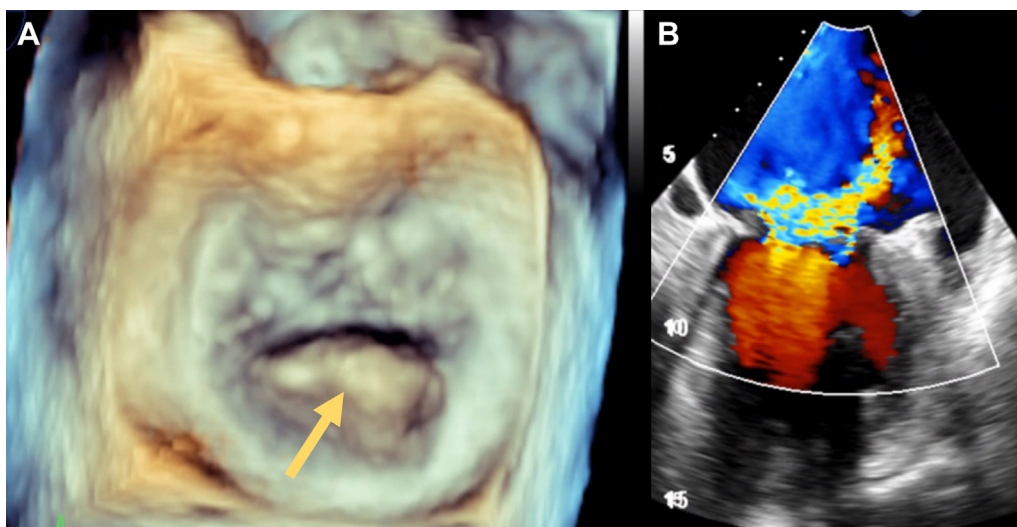
hospital, he was diuresed and stabilized for discharge. He was subsequently urgently reviewed at our center, where a chest radiograph demonstrated the presence of only 2 TEER clips. To investigate the embolized clip, a noncontrast computed tomography (CT) scan of the chest, abdomen, and pelvis was arranged in view of his renal impairment, which localized the clip to the left groin. The position of this embolized clip was confirmed on Doppler ultrasound to be in the left common femoral vein (**Figure 3**). Without disturbed flow, it was felt that anti-coagulation at this stage was not warranted.

Our working hypothesis is paradoxical retrograde movement of the detached third clip from the left to right atrium through an iatrogenic atrial-septal defect (ASD), and subsequent migration to the left common femoral vein.

With progressive symptoms and now in New York Heart Association functional class ambulatory IV, he had a repeat TOE, which confirmed severe MR (**Video 5**). There was recurrence of the flail of the lateral portion of the P2 scallop, resulting in a large coaptation defect where the third clip had previously been attached (**Video 6**). A large slit-like iatrogenic ASD was seen, with left-to-right flow (**Figure 4**).

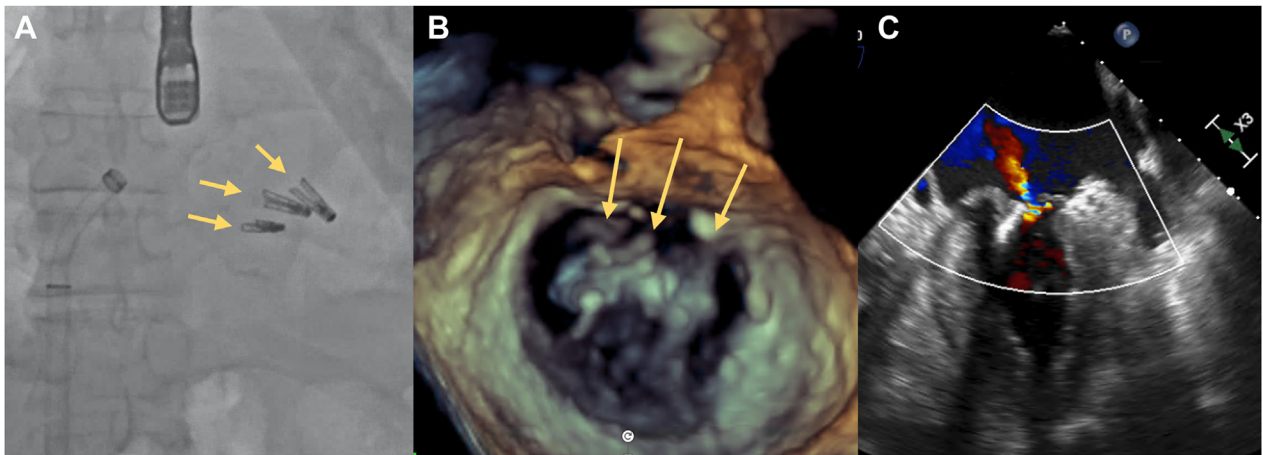
MANAGEMENT

The patient underwent a second TEER procedure 1 month later. On presentation he was in new atrial

FIGURE 1 Pre-Transcatheter Mitral Valve Edge-to-Edge Repair Transesophageal Echocardiogram

(A) 3-dimensional image of the mitral valve demonstrating a broad P2 prolapse (arrow). (B) 2-dimensional color image demonstrating torrential mitral regurgitation.

FIGURE 2 Post-Transcatheter Mitral Valve Edge-to-Edge Repair Fluoroscopy and Transesophageal Echocardiogram

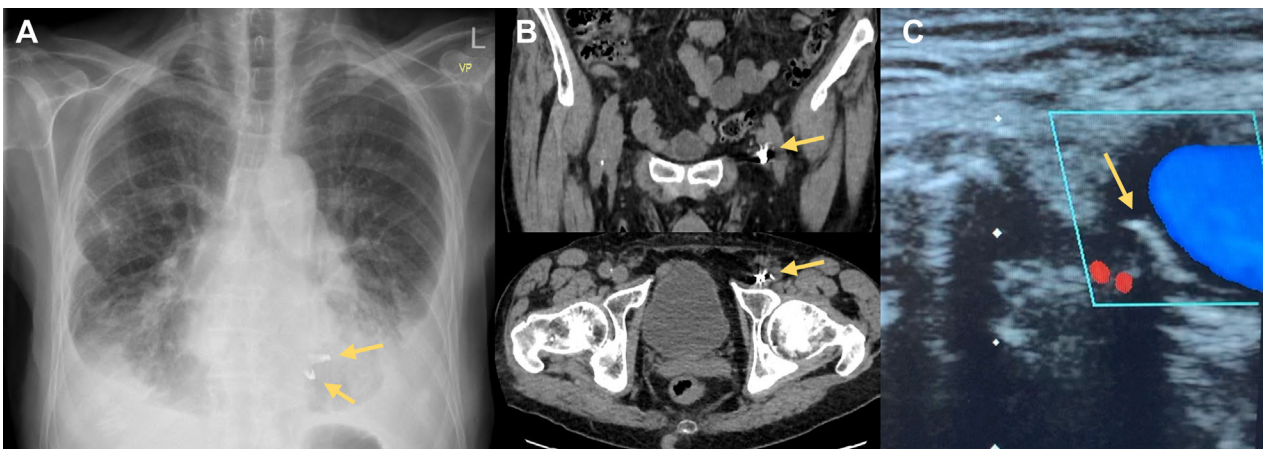


(A) Fluoroscopy demonstrating 3 deployed mitral transcatheter edge-to-edge repair clips (**arrows**). **(B)** 3-dimensional transesophageal echocardiogram demonstrating 3 deployed mitral transcatheter edge-to-edge repair clips (**arrows**). **(C)** Color Doppler transesophageal echocardiogram demonstrating mild-moderate residual mitral regurgitation.

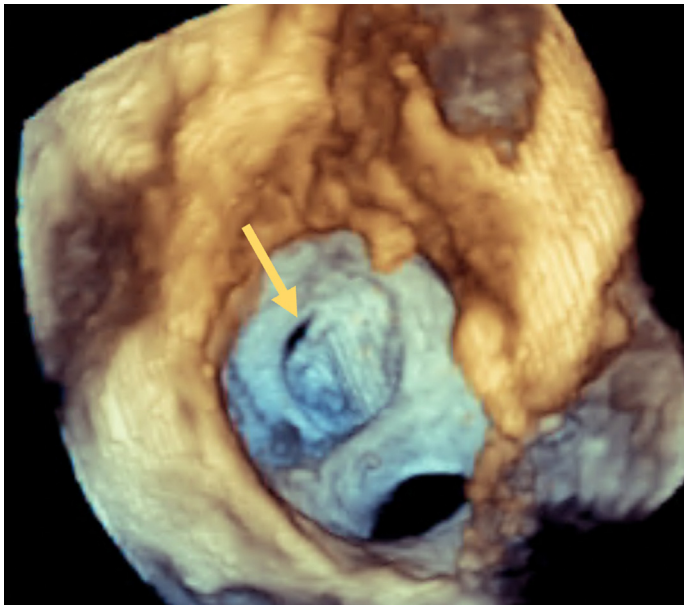
fibrillation and was successfully direct current cardioverted. A single mitral valve edge-to-edge repair system was placed at the site of the previously embolized clip. This resulted in a significant reduction in the degree of regurgitation to a moderate level (Video 7), with mean gradient across the mitral valve of 6.5 mm Hg. The embolized clip in the left femoral

vein was left in situ because of absence of symptoms, and anticoagulation was commenced in view of the atrial fibrillation. The small iatrogenic ASD seen was not closed because flow was seen to be unidirectional from left to right, which was felt to be beneficial in the context of residual MR in offloading the left atrium (Figure 5, Video 8).

FIGURE 3 Investigations to Locate the Embolized Transcatheter Mitral Valve Edge-to-Edge Repair Clip



(A) Chest radiograph with only 2 visible mitral valve edge-to-edge repair clips (**arrows**). **(B)** Computed tomography chest, abdomen, and pelvis in the coronal (**top**) and axial planes (**bottom**) localizing the embolized clip to the left groin (**arrows**). **(C)** Color Doppler ultrasound of the groin confirmed the position of the embolized clip in the left common femoral vein (**arrow**).

FIGURE 4 Repeat 3-Dimensional Transesophageal Echocardiogram of the Interatrial Septum

A large slit-like iatrogenic atrial septal defect is demonstrated (arrow).

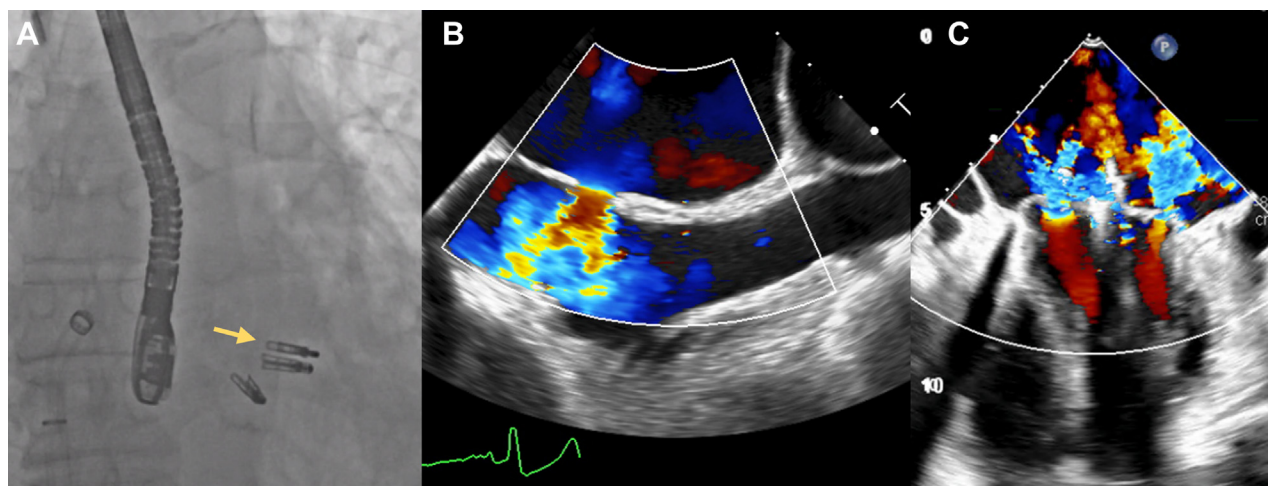
DISCUSSION

We report a case of paradoxical device embolization of a mitral TEER clip from the left to right atrium

through an iatrogenic ASD and distally to the left femoral vein.

Device embolization remains a very rare complication of TEER, with the TVT (Transcatheter Valve Therapy) registry of 12,334 mitral TEER procedures reporting a 0.1% rate of clip embolization.¹ Just a handful of case reports describing this complication exist, the majority of which occur during the index procedure. Delayed presentations, as in our case, have only been reported twice. One presented as an acute coronary syndrome 6 weeks after the initial TEER when a clip embolized into the right coronary ostium, requiring retrieval by snaring into the femoral artery and subsequent surgical cut-down.² The second case involved clip embolization into the patient's axilla, discovered 1 year later and not intervened. Partial clip detachment was, however, noted since 1-month postprocedure.³

The phenomenon of retrograde device embolization through an ASD into the venous system has only been reported once. Caussin *et al*⁴ described a case of a mitral TEER device embolizing into the right ostial renal vein on day 2 post-procedure, which was successfully retrieved percutaneously. Our patient's mitral anatomy, with tissue fragility and a large flail width and gap requiring multiple clips, likely increased the risk of this complication through the technical challenges of clip alignment and adequate tissue grasp. We have demonstrated that iatrogenic ASDs, which may not appear significant in size initially, can in fact facilitate paradoxical movement

FIGURE 5 Post-Redo Transcatheter Mitral Valve Edge-to-Edge Repair Fluoroscopy and Transesophageal Echocardiogram

(A) Fluoroscopy demonstrating 1 mitral TEER clip replaced at the site of the previously embolized clip (arrow). (B) Color Doppler TOE demonstrating the unidirectional left-to-right residual atrial septal defect that was not intervened. (C) Color Doppler TOE demonstrating multiple jets of overall moderate residual mitral regurgitation.

of embolized devices under the right hemodynamic circumstances, such as with recurrence of MR and raised left atrial pressure. The presence of this ASD, and possibly MR after an initial single leaflet detachment, were likely beneficial in offloading the left atrium and may have even been somewhat protective in mitigating the risk of an arterial embolization. Distal migration of the clip may have been assisted by the patient's pre-existing tricuspid insufficiency and raised pulmonary pressure, with the paucity of valves in the inferior vena cava and pelvic veins facilitating movement to the femoral vein.

FOLLOW-UP

On day 3 postprocedure, the patient developed profound hypoxia and reported epigastric and left shoulder pain. ECG demonstrated bradycardia with intermittent complete heart block. He was intubated and ventilated, and a pacemaker was implanted. Note was made intraprocedurally of the development of thrombus in the left axillary vein following instrumentation, suggestive of a hypercoagulable state given that the patient received uninterrupted anticoagulation. Chest computed tomography showed a dilated pulmonary trunk with stable appearances of his pleural effusions, supporting the suspicion of a pulmonary embolism. In view of his recent interventions, anticoagulation, and comorbidities, thrombolysis was felt to be too high risk. Later that day he became hypotensive with new ST-segment elevation in leads III, V₂ and V₃ on ECG and a

troponin of 27,000. He underwent percutaneous coronary intervention to the distal right coronary artery as well as ASD closure on day 4. The working diagnosis is of coagulopathy and venous thromboses, with paradoxical embolus migration from the right atrium through the ASD, culminating in right coronary artery occlusion and an inferior myocardial infarction. Despite initial clinical improvement, he sadly passed away on day 19.

CONCLUSIONS

We describe a unique case of retrograde TEER device embolization into the left femoral vein, highlighting challenging mitral valve anatomies that may increase the risk of this complication as well as the possibility of iatrogenic ASDs in facilitating this. The hemodynamic shifts that occur periprocedurally were made apparent through the changing role of the ASD. Although initially felt to be protective in shunting the left atrium and reducing the risk of systemic embolization, the eventual reduction in MR severity conversely provided a low-resistance pathway for venous thromboemboli to traverse into the systemic circulation.

FUNDING SUPPORT AND AUTHOR DISCLOSURES

The authors have reported that they have no relationships relevant to the contents of this paper to disclose.

ADDRESS FOR CORRESPONDENCE: Dr Kayla Chiew, Royal Brompton Hospital, Sydney Street, SW3 6NP London, United Kingdom. E-mail: kayla.chiew2@nhs.net.

REFERENCES

1. Chhatriwalla AK, Vemulapalli S, Holmes DR Jr, et al. Institutional experience with transcatheter mitral valve repair and clinical outcomes: insights from the TVT registry. *J Am Coll Cardiol Intv*. 2019;12(14):1342-1352.
2. Chitsaz S, Jumean M, Dayah T, Rajagopal K, Kar B. Late MitraClip embolization: a new cause of ST-segment-elevation myocardial infarction. *Circ Cardiovasc Interv*. 2016;9(11):e004271.
3. Bilge M, Alsancak Y, Ali S, Duran M, Biçer H. An extremely rare but possible complication of MitraClip: embolization of clip during follow-up. *Anatol J Cardiol*. 2016;16(8):636-638.
4. Caussin C, Diakov C, Dervanian P, Amabile N. Backward migration of a MitraClip through a patent transseptal orifice: the salmon syndrome. *J Am Coll Cardiol Intv*. 2015;8(14):1907-1908.

KEY WORDS atrial septal defect, embolization, mitral regurgitation, transcatheter edge-to-edge repair

APPENDIX For supplemental videos, please see the online version of this paper.