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STRUCTURAL HEART DISEASE

CASE REPORT: CLINICAL CASE

Acute Device-Related Thrombus Elimination During Transcatheter Edge-to-Edge Repair Via Vacuum Catheter Aspiration

Marc Sandhaus, MD,[a] Emily Hiltner, MD,[a] Manabu Takebe, MD,[b] Partho Sengupta, MD,[a] Mark Russo, MD,[b] Ankur Sethi, MBBS[a]

ABSTRACT

We describe a rare complication of intraprocedural spontaneous thrombus formation on a transcatheter edge-to-edge repair (MitraClip; Abbott Laboratories) device in a hypercoagulable yet adequately anticoagulated patient. We also outline the novel use of a vacuum (Penumbra) aspiration system, which resulted in rapid and effective thrombus elimination. (J Am Coll Cardiol Case Rep 2024;29:102162) © 2024 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

A 64-year-old man with severe secondary mitral regurgitation (MR) was admitted to our facility for elective transcatheter edge-to-edge repair (TEER). During a recent hospitalization for heart failure exacerbation, he was diagnosed with heparin-induced thrombocytopenia (HIT) when he developed a deep venous thrombosis while on therapeutic heparin for atrial fibrillation; his platelet count fell to 56,000/μL from a baseline of 200,000/μL, and serology was positive for heparin-associated antibody. Once stabilized, he was discharged on therapeutic warfarin. On this admission, he was transitioned from warfarin to bivalirudin preprocedure.

LEARNING OBJECTIVES

- To identify patients at greatest risk for acute device-related thrombus and implement any necessary precautions.
- To recognize the utility of thrombectomy catheters in clot retrieval for intracardiac devices.

On the day of the procedure, his vital signs showed blood pressure of 104/65 mm Hg, pulse rate of 80 beats/min, respiratory rate of 19 breaths/min, and oxygen saturation of 99% on room air. A soft systolic murmur was heard at the apex, but there was no pedal edema or jugular venous distention. Access was obtained in the right femoral vein using ultrasound, and a Perclose (Abbott) device was used to preclose. Transseptal puncture was achieved with a preformed catheter and radiofrequency wire assisted by transesophageal echocardiography (TEE). After confirmation of an activated clotting time (ACT) >300 seconds, a TEER guide catheter followed by an XTW clip (Abbott Laboratories) was advanced into the left

From the [a]Department of Cardiology, Robert Wood Johnson University Hospital, New Brunswick, New Jersey, USA; and the [b]Department of Cardiothoracic Surgery, Rutgers-Robert Wood Johnson University Hospital, New Brunswick, New Jersey, USA.
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ABBREVIATIONS AND ACRONYMS

ACT = activated clotting time

HIT = heparin-induced thrombocytopenia

MR = mitral regurgitation

TEE = transesophageal echocardiography

TEER = transcatheter edge-to-edge repair

atrium under TEE guidance. Mitral leaflets were grasped at A2/P2 scallops. With TEE confirmation of significant reduction in MR and a good tissue bridge, the clip was released. Within a few minutes of clip implantation, a mobile, linear, 2.3-cm echodensity was noted on TEE (**Figure 1**, Video 1).

PAST MEDICAL HISTORY

He had a history of coronary artery disease and coronary artery bypass grafting, heart failure with reduced ejection fraction, severe MR, atrial fibrillation, deep venous thrombosis, and HIT.

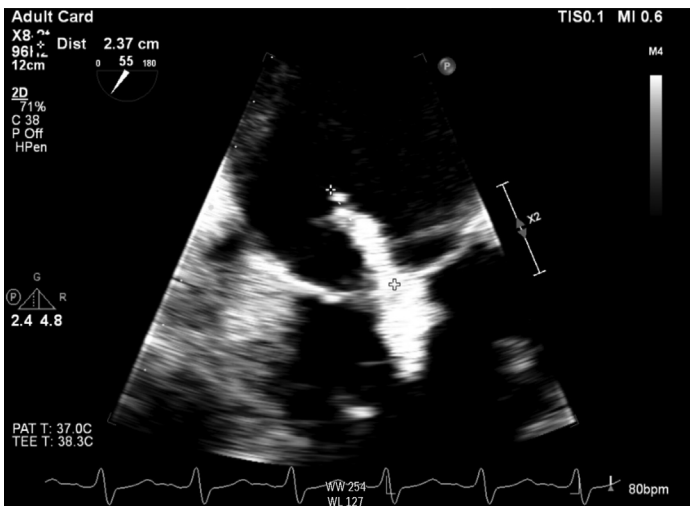
DIFFERENTIAL DIAGNOSIS

The differential diagnoses included device-related thrombus, ruptured mitral valve chordae/tissue, device malfunction, and defective device materials.

INVESTIGATIONS

Baseline TEE demonstrated severe MR caused by tethered leaflets. Evaluation by a multidisciplinary heart team deemed him a suitable candidate for TEER. HIT was recently diagnosed based on a positive heparin-associated antibody. The ACT values during the procedure are shown in **Table 1**.

FIGURE 1 Intraprocedural Transesophageal Echocardiogram



A 2.3-cm linear mass noted on a recently placed transcatheter edge-to-edge repair device concerning for acute device-related thrombus.

MANAGEMENT

The ACT was rechecked and resulted at 296 seconds, but despite an additional bolus of bivalirudin, there was no reduction in the thrombus size over several minutes. Therefore, anticoagulation was switched to argatroban. The guide sheath was then removed and exchanged for a 10-cm 18-F sheath; a deflectable catheter was then advanced through the interatrial septum and carefully maneuvered just proximal to the clip under TEE and fluoroscopic guidance (**Figure 2**, Video 2). An Indigo System CAT 6 aspiration catheter (Penumbra Inc) was advanced through the guide catheter to aspirate the clot (**Figure 2**, Videos 2 and 3). Within a few minutes, clot debris was visualized in the aspiration filter (**Figure 3**), and resolution of the clot was also demonstrated by TEE (**Figure 4**, Video 4). There was minimal blood loss with no other immediate major complications related to this technique.

DISCUSSION

Anticoagulation, typically with intravenous unfractionated heparin, is routinely administered during left-sided structural heart interventions via transseptal access to prevent intraprocedural thromboembolic complications.[1] A large registry of more than 30,000 TEERs performed between 2014 and 2022 reported a 30-day device thrombosis rate of 0.0%.[2] However, there have been a few reports of intracardiac thrombi during TEER, with 1 small study reporting an incidence as high as 9.0%.[3] Notably, our patient had several risk factors that may be associated with thrombus formation, including severe left atrial dilatation and right ventricular dysfunction.

TABLE 1 Anticoagulation Management: Direct Thrombin Inhibitors Bivalirudin and Argatroban Used to Achieve Adequate Anticoagulation Measured Incrementally Via the ACT

Stage of Procedure	Anticoagulant	ACT Value (s)
Guide sheath introduced	Bivalirudin infusion	304
TEER introduced and released	Bivalirudin infusion	296
Thrombus detected	Bivalirudin infusion + argatroban bolus	Out of range

ACT = activated clotting time; TEER = transcatheter edge-to-edge repair.

Inadequate anticoagulation is arguably an apparent cause, but like our case, there are reports of TEER-associated thrombi despite appropriate anticoagulation. Although not systematically studied, bivalirudin is substituted in heparin-intolerant patients based on data derived from coronary and aortic valve interventions.[4]

There are a few reports of thrombus formation during TEER procedures, both during heparin and bivalirudin use, and sometimes even with ACT >250 seconds.[5,6] Predeployment device thrombus in the sheath or around the clip is typically treated with aspiration and removal of the catheter. However, management of device-related thrombus post-deployment is challenging. There have been reports of continued use of the current anticoagulant, supplementation with additional anticoagulation, or low-dose thrombolysis in this setting.[6-8] There are also reports of planned use of the AngioVac (Angiodynamics) for aspiration of a left atrial thrombus.[9,10] However, to our knowledge, this is the first reported use of this specific catheter for aspiration of a thrombus adherent to a TEER device. In comparison, this device can be used rapidly without much preparation, is easily delivered transseptally, and is maneuvered using a deflectable sheath albeit with limited suction ability. Furthermore, the size, location, and morphology of the thrombus in our case possibly allowed for successful aspiration with this specific aspiration system. We have previously reported aspiration of a thrombus adherent to the Watchman FLX (Boston Scientific) device using a similar technique.[11]

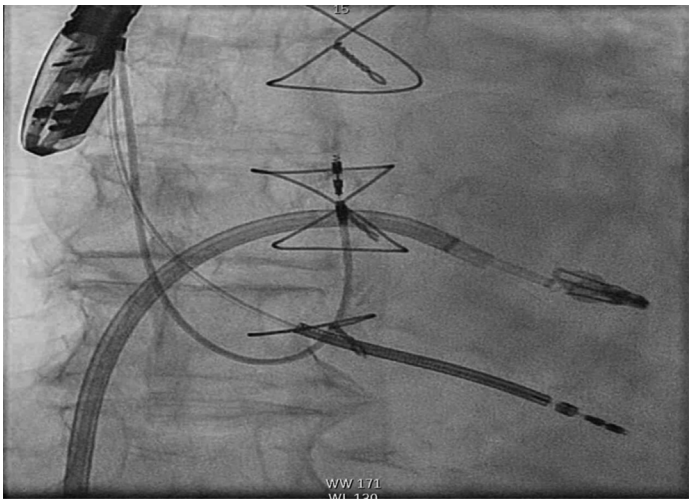
FOLLOW-UP

A collaborative team-based decision was made to conclude the procedure after successful placement of 1 clip to avoid further complications in this hypercoagulable patient. The patient had no discernable long-term consequences related to this complication. He was discharged home on warfarin, and at his most recent outpatient follow-up appointment reported an improvement in exercise tolerance and dyspnea. A repeat transthoracic echocardiogram at 2 months demonstrated mild MR and intact TEER with no evidence of thrombus.

CONCLUSIONS

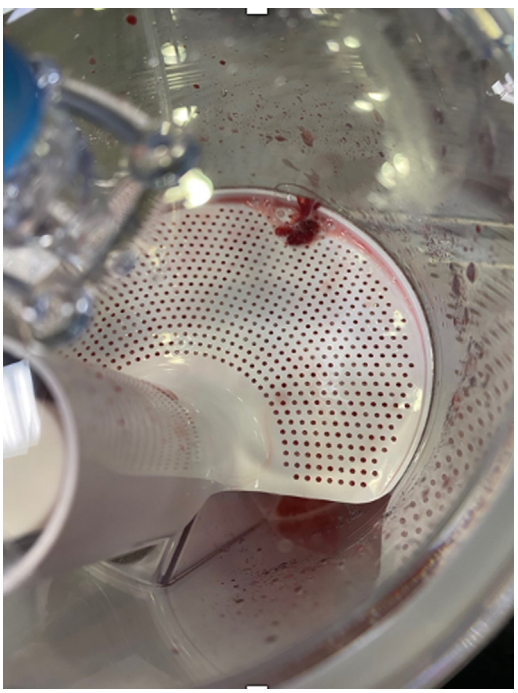
Acute device-related thrombus formation is a rare and potentially devastating phenomenon. Prevention, early recognition, and prompt intervention are essential in minimizing potential harm. In this case, a vacuum aspiration system was successfully used to

FIGURE 2 Fluoroscopic Guidance



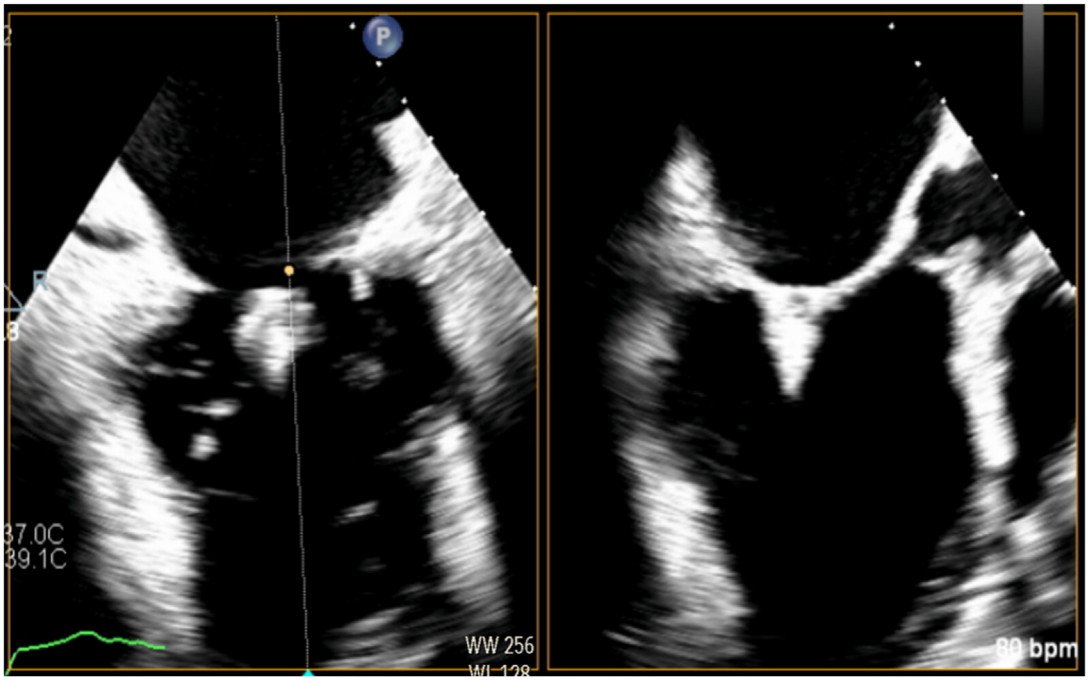
An aspiration catheter advanced through a guide catheter to aid with thrombus aspiration.

FIGURE 3 Clot Debris



Several cycles of aspiration resulted in visualization of clot debris in the device filter.

FIGURE 4 Clot Resolution



Multiplanar transesophageal echocardiography imaging demonstrating resolution of a device-associated clot post-thrombectomy.

remove the thrombus, allowing for safe TEER placement.

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ADDRESS FOR CORRESPONDENCE: Dr Ankur Sethi, Robert Wood Johnson University Hospital, 901 West Main Street, Building B, Suite 205, Freehold, New Jersey 07728, USA. E-mail: drankursethi@gmail.com. @AnkurSethi2021.

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KEY WORDS anticoagulation, echocardiography, imaging, mitral valve, thrombus, valve repair

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