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Case Reports

Iatrogenic Atrial Septal Defect After MitraClip Transcatheter Edge-to-Edge Repair: To Close or Not to Close?

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Abstract

The evolution of percutaneous procedures that use transseptal puncture to treat left-sided structural heart disease has led to the emergence of iatrogenic atrial septal defects as a potential complication. These defects can result in hemodynamic decompensation and worsening clinical outcomes. Some iatrogenic atrial septal defects require immediate closure, others do not. This case report presents 2 patients who underwent transcatheter edge-to-edge mitral valve repair with transseptal puncture and required iatrogenic atrial septal defect closure (1 immediate and 1 delayed). The goal of this report is to highlight iatrogenic atrial septal defect assessment and the possible need for closure after transseptal puncture.

Keywords: Mitral valve insufficiency; heart septal defects, atrial; mitral valve; heart failure

Case Report 1

Presentation and Physical Examination

A 73-year-old man presented with symptomatic severe mitral valve regurgitation and congestive heart failure (HF). The patient was alert, awake, and oriented; he was short of breath at rest; his blood pressure was 94/62 mm Hg; his oxygen saturation was 94%; and his pulse rate was 91/min. He had a pansystolic murmur in the mitral area, with S3 gallop along with grade +2 bilateral pedal edema.

Medical History

The patient's medical history included myocardial infarction, congestive HF with an ejection fraction of 25%, an automated implantable cardioverter-defibrillator, New York Heart Association functional class III to IV, and hyperlipidemia. He was receiving optimized guideline-directed medical therapy (GDMT) for secondary mitral valve regurgitation, and he was taking apixaban 5 mg twice daily for atrial fibrillation to prevent stroke.

Technique

The consensus of the multidisciplinary heart team was that the patient was an appropriate candidate for mitral valve transcatheter edge-to-edge repair (TEER). Under transesophageal echocardiography (TEE) guidance,[1] an XTW MitraClip device (Abbott Laboratories) was inserted at A2/P2 (Fig. 1A). Subsequent assessment revealed disappearance of the pulmonary vein reversal flow and a mean atrial gradient of 3 mm Hg with mild mitral valve

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regurgitation. After the MitraClip device was withdrawn to the right atrium, definite bidirectional flow between the left and right atria was observed (Fig. 1B), and the patient's oxygen saturation dropped to 76%. A 16-mm Amplatzer septal occluder (Abbott Laboratories) was used to close the iatrogenic atrial septal defect (iASD) successfully (Fig. 1C and Fig. 1D). Postoperatively, the patient resumed taking apixaban 5 mg twice daily for stroke prevention.

Outcome

The patient was discharged home with stable oxygen saturation on room air at 99% the day after the TEER procedure.

Key Points

- Although iASD is a common sequela of left-sided transcatheter intervention, it rarely requires closure.
- The decision to close an iASD should be individualized and based on clinical and hemodynamic factors.
- Closing an iASD typically resolves hemodynamic decompensation and associated symptoms.

Abbreviations and Acronyms

GDMT	guideline-directed medical therapy
HF	heart failure
iASD	iatrogenic atrial septal defect
TEE	transesophageal echocardiography
TEER	transcatheter edge-to-edge repair

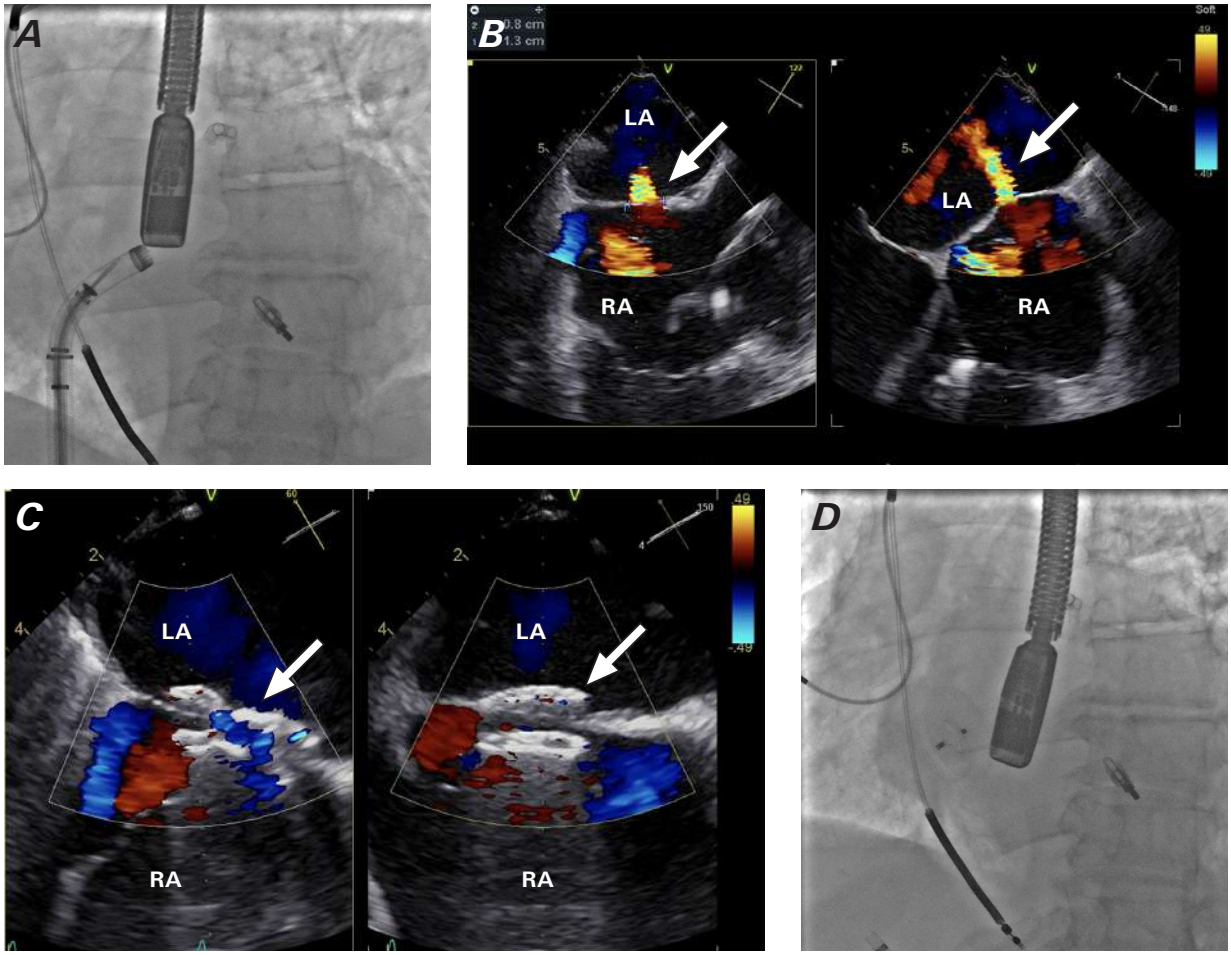

Fig. 1 Mitral valve TEER and immediate closure of the resulting iASD in a 73-year-old man with severe mitral valve regurgitation and congestive heart failure. (**A**) Fluoroscopy shows the TEER procedure, with a MitraClip device inserted at the A2/P2 position. (**B**) Color Doppler transesophageal echocardiogram (bicaval Xplane view) shows a large iASD with right-to-left shunting (arrow). (**C**) Doppler transesophageal echocardiogram (bicaval Xplane view) shows resolution of the shunting after iASD closure (arrow). (**D**) Fluoroscopy shows successful closure of the iASD.

iASD, iatrogenic atrial septal defect; LA, left atrium; RA, right atrium; TEER, transcatheter edge-to-edge repair.

Latest Follow-Up

At the 1-month follow-up visit, the patient indicated that his symptoms had improved and that he was feeling better.

Case Report 2

Presentation and Physical Examination

A 68-year-old woman presented at the emergency department 1 week after undergoing successful TEER. She reported having multiple episodes of hypoxemia and worsening shortness of breath. On examination, the patient was alert but dyspneic, with a respiratory rate of 30/min and a pulse rate of 100/min; her oxygen saturation was 77%, and her blood pressure was 110/71 mm Hg.

Medical History

The patient's medical history included hypertension, atrial fibrillation with subsequent pacemaker implantation, and multiple bleeding episodes. Because she could not tolerate anticoagulation, she had been treated with an Amplatzer Amulet left atrial appendage occluder device (Abbott Laboratories) 1 year earlier.

More recently, the patient had presented with severe symptomatic mitral valve regurgitation, severe tricuspid valve regurgitation, and congestive HF; her ejection fraction at that time was 30%. She was treated with GDMT and referred to the structural heart team, who deemed her to be at high risk for surgery; she was therefore admitted for elective mitral valve TEER. The TEER was accomplished by inserting 2 adjacent MitraClip devices (XTW and NTW) at A2/P2 under TEE guidance (Fig. 2A). The patient's severe mitral valve regurgitation decreased to trace regurgitation, with a mean mitral valve gradient of 2.5 mm Hg. A small iASD with left-to-right shunting was noted at this time. Her tricuspid valve regurgitation was treated by deploying a MitraClip XTW clip at the anterior and septal leaflets under 4-dimensional intracardiac echocardiogram and transgastric TEE guidance. This procedure decreased her tricuspid valve regurgitation from torrential to moderate. The patient was extubated and monitored overnight, and she was discharged without incident. She was discharged home, taking aspirin 81 mg and clopidogrel 75 mg daily.

Technique

The patient underwent cardiac workup and imaging to exclude pulmonary edema and embolism. Supplemental oxygen up to 15 L/min was given before she was taken to the catheter lab with suspected iASD; this finding was confirmed with an intracardiac echocardiogram, which showed evidence of significant right-to-left shunting (Fig. 2B). After right-to-left shunting was confirmed, the patient underwent delayed iASD closure in which a Gore 30-mm Cardioform septal occluder (W. L. Gore & Associates) was inserted under intracardiac echocardiogram guidance (Fig. 2C and Fig. 2D).

Outcome

Cessation of flow through the iASD was confirmed by intracardiac echocardiography. Oxygen saturation improved substantially to 98% upon iASD closure, and supplemental oxygen decreased from 15 L/min to 2 L/min on the table. The patient was observed in the critical care unit, then moved to the ward, with a further decrease in supplemental oxygen. By the next day, the patient had stable oxygen saturation (98%) on room air.

Latest Follow-Up

At the 1-month postoperative follow-up office visit, the patient's symptoms had improved, and she reported feeling better, with no need for supplemental oxygen at home. Her resting oxygen saturation was stable at 95%.

Discussion

Mitral valve regurgitation is thought to affect approximately 2 million people in the United States.[2] Mitral valve repair is advised when clinical symptoms and moderate to severe mitral valve regurgitation persist despite GDMT.[3] Over the past 10 years, TEER has evolved as an alternative for replacing mitral valves in patients for whom open heart surgery would be high risk. The evolution of percutaneous procedures that use transseptal puncture to treat left-sided structural heart disease, however, has led to the emergence of iASD, a potential complication that can induce hemodynamic decompensation that worsens clinical outcomes. Although 35% to 50% of patients develop iASD after TEER, closure is rarely required.[4] Moreover, patients with iASDs were found to have no hemodynamic compromise (despite higher right ventricular pressures) and

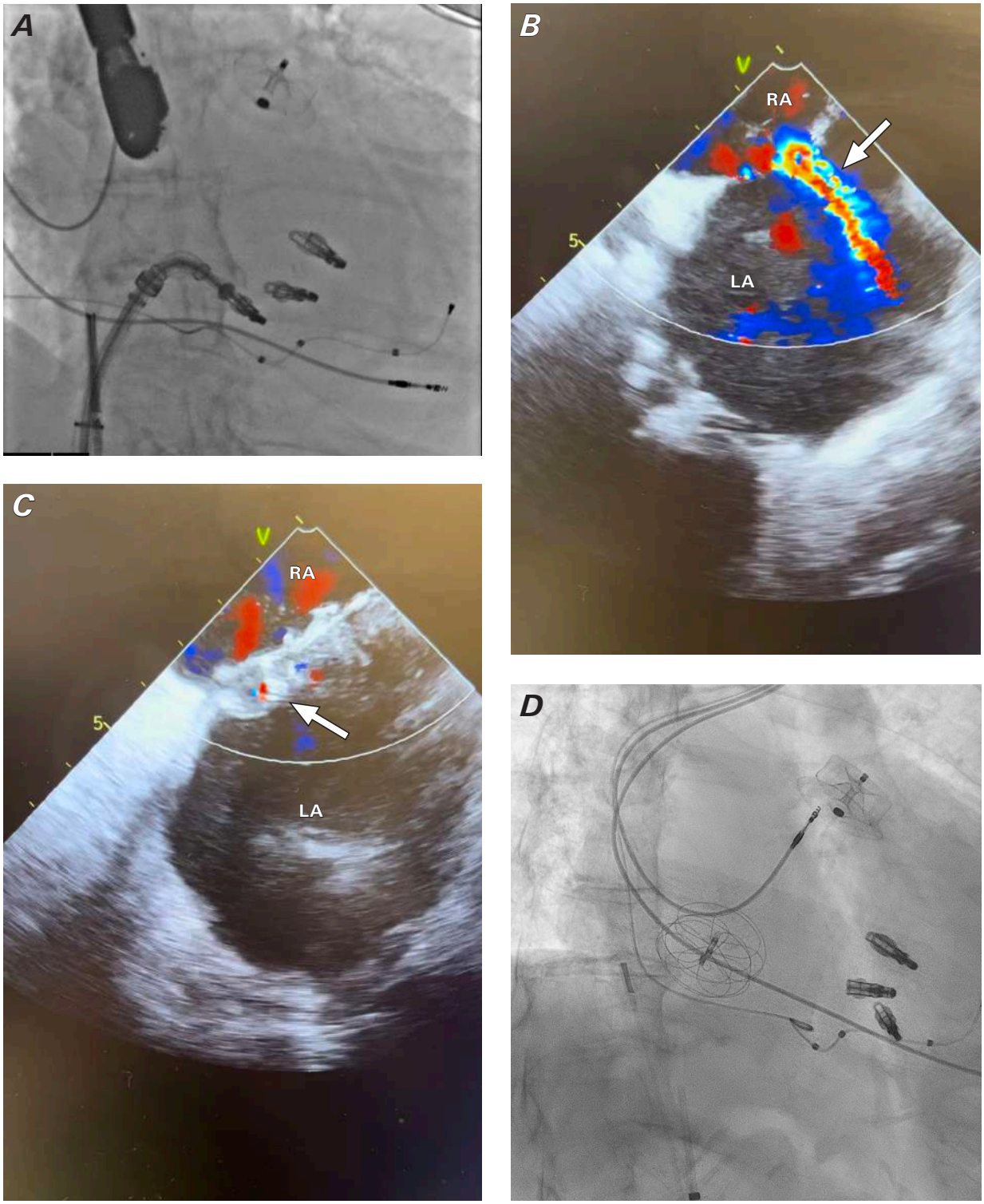

Fig. 2 Delayed closure of an iASD in a 68-year-old woman with hypoxemia and dyspnea 1 week after mitral and tricuspid valve TEER. (**A**) Fluoroscopy shows 2 MitraClip devices in the mitral position and 1 clip in the tricuspid position. (**B**) Color Doppler intracardiac echocardiogram (septal view) shows substantial right-to-left shunting after TEER (arrow). (**C**) Color Doppler intracardiac echocardiogram (septal view) shows successful iASD closure (arrow). (**D**) Fluoroscopy shows successful iASD closure under intracardiac echocardiographic guidance.

iASD, iatrogenic atrial septal defect; LA, left atrium; RA, right atrium; TEER, transcatheter edge-to-edge repair.

no difference in prognosis compared with patients without iASDs.[4]

The decision to close an iASD depends on multiple clinical and procedural factors, such as a large iASD, the presence of pulmonary hypertension, significant left-to-right shunting, large right-to-left shunting, marked right ventricular failure, an aneurysmal septum, and mobile material on pacemaker leads.[5] Small defects with no right ventricular volume overload are not considered for closure unless right-to-left shunting is causing substantial hypoxemia or paradoxical embolism.[6] Moreover, some iASDs may require immediate closure, whereas others do not.[7] A decrease in saturation caused by right-to-left shunting is one of the strongest indications for closing an iASD during the TEER procedure.[8] More than 50% of iASDs that occur after transseptal puncture persist for more than 6 months without incident,[7] and 30% remain at 1 year.[1]

Mitral valve regurgitation is categorized as either primary (when caused by intrinsic valve or chordae tendineae abnormality) or secondary (when caused by left ventricular dysfunction). Doppler transthoracic echocardiography is considered the first-line method for diagnosing and classifying mitral valve regurgitation severity[2] and is useful for further visualizing mitral valve pathology. Transesophageal echocardiography is also helpful in further defining the patient's anatomy and suitability for transcatheter intervention; moreover, patients are sedated during TEE, which may reduce the severity of mitral valve regurgitation. Any incompatibility between clinical symptoms and the severity of mitral valve regurgitation should be assessed using stress-test echocardiography or cardiac magnetic resonance imaging.[3]

The COAPT randomized clinical trial[9] assessed patients with both HF and moderate to severe secondary mitral valve regurgitation who remained symptomatic despite GDMT. The trial found a marked decrease in both hospital admissions for HF and any-cause mortality within 24 months of follow-up for patients treated with TEER and GDMT vs GDMT alone.[9] Nonetheless, all novel interventions come with a cost, and TEER procedures have been associated with various complications, including femoral vein access complications; cardiac issues, such as pericardial effusion and iASDs; endocarditis; bleeding from anticoagulation for coexisting or de novo atrial fibrillation; device failure; gastrointestinal injury from TEE use; and acute kidney injury from the transient decrease in arterial blood pressure during general anesthesia or from systemic inflammatory response.[10]

In particular, iASDs arise as a complication of TEER as a result of transseptal puncture caused by a large-bore (24F) guiding catheter. Other risk factors for persistent iASD include a longer-duration procedure, extensive catheter movement, elevated left atrial pressure, and left ventricular hypertrophy.[3] Given that the ideal treatment for postprocedural iASD is still undetermined,[8] individualized risk assessment and treatment plans for each patient are suggested.

This case report presents 2 patients who required iASD closure, 1 immediate and 1 delayed. Both patients had undergone TEER with transseptal puncture to repair severe mitral valve regurgitation. The goal of this report is to highlight iASD assessment and the possible need for closure after transseptal puncture.

In the first case, the patient presented with severe symptomatic mitral valve regurgitation. During the TEER procedure, a bidirectional flow was noticed between the left and right atria that prompted immediate closure of the iASD. In the second case, the patient presented 1 week after her TEER procedure with hypoxemia and pulse oximetry of 77% that were not responsive to supplemental oxygen that was titrated up to 15 L. Echocardiography confirmed right-to-left shunting, which can occur when right atrial pressure increases. In this condition, oxygenated blood mixes with deoxygenated blood, leading to hypoxia. The patient was admitted to the hospital for delayed iASD closure, after which her oxygen saturation improved substantially.

In conclusion, whether an iASD should be closed depends on many factors. Closure should be considered after TEER when there is bidirectional flow between the right and left atria or right-to-left shunting.

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