Case Report

Immediate Closure of Iatrogenic ASD After MitraClip Procedure Prompted by Acute Right Ventricular Dysfunction

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IATROGENIC ATRIAL septal defects (iASD) are created during percutaneous procedures that require trans-septal puncture (TSP). Up to 50% of iASDs resulting from TSP for MitraClip (Abbott Vascular, Santa Clara, CA) procedures have been found to persist beyond 6 months. Persistence of an iASD after the MitraClip procedure is associated with worse outcomes.1 There are published reports of acute hemodynamic compromise attributed to iASD shunts treated with both immediate and delayed percutaneous iASD closure.2–4 Below, the authors present the case of a MitraClip procedure undertaken with 2- and 3-dimensional transesophageal echocardiographic (TEE) guidance that resulted in a moderate-sized iASD and in the setting of pre-existing severe tricuspid regurgitation and moderate RV dysfunction. The iASD was closed during the same procedure under 3D-TEE guidance.

Case Presentation

A 73-year-old woman was referred to the authors’ hospital for a MitraClip implantation for severe mitral regurgitation (MR) due to a flail leaflet. The patient had multiple recent hospital admissions due to decompensated congestive heart failure. She was deemed unsuitable for surgery due to her comorbidities, which included Parkinson’s disease, chronic kidney disease, paroxysmal atrial fibrillation, and metastatic endometrial cancer. Prior TEE examination from the referring hospital described severe MR with flail P2 and P3 scallops, normal ejection fraction, severe tricuspid regurgitation, and rightward bowing of the inter-atrial septum in systole with no evidence of intracardiac shunting. Cardiac catheterization did not demonstrate any significant coronary artery stenoses. Preoperatively, the patient’s hemodynamic status was optimized with aggressive diuresis and pharmacologic cardioversion with amiodarone, resulting in clinical improvement and conversion from atrial fibrillation to sinus rhythm.

The MitraClip procedure was performed under general anesthesia with real-time guidance with intraoperative TEE imaging. TEE examination demonstrated that the flail portions of the posterior leaflet were in fact located at P1-P2 scallops...
(not P2-3 as reported previously), with a resultant anteriorly directed MR jet of severe intensity (Video 1). Evaluation of the right heart revealed severe tricuspid regurgitation and moderate right ventricular systolic dysfunction and dilation. (Post-procedure analysis of 3D TEE data using the Tomtec 4D RV assessment module to quantify RV function showed a tricuspid annular plane systolic excursion [TAPSE] of 8.8 mm and fractional area change of 14%.)

After femoral venous cannulation, a TSP was attempted under TEE and fluoroscopic guidance. Needle positioning was unusually challenging and required 2 punctures of the interatrial septum. The MitraClip device then was navigated through the mitral valve and positioned to grasp the A2 and P2 scallops and deployed successfully (Fig 1). This single clip grasped enough valve tissue to resolve the flail and caused a significant improvement of the MR. The combined mitral valve orifice area of the 2 resulting orifices was 2.84 (1.52 and 1.32) cm².

After removal of the trans-septal sheath, an iASD was visualized (6 x 12 mm, area of 0.54 cm² measured by planimetry) demonstrating bidirectional, but predominantly left-to-right flow (Fig 2) (Video 2). Simultaneously, a decline in RV function was noticed compared with the pre-deployment stage. Post-procedure quantification showed a decrease in fractional area change from 14 to 11%, and a reduction in TAPSE from 8.8 to 4.2 mm. There was no evidence of systemic hypoxemia, and an arterial sample demonstrated a saturation of 100%. Left ventricular function remained preserved without evidence of global or regional dysfunction.

Due to the worsening RV function, a 25-mm Amplatz septal occluder (St. Jude Medical, St. Paul, MN) was placed to close the iASD. TEE showed adequate positioning of the device without residual flow across the iASD (Fig 3). RV function recovered to near baseline (TAPSE 7.4 mm) (Video 3), and no inotropic or continuous vasopressor support was required. Right-heart catheterization was performed following iASD closure showing an RV pressure of 47/10/16 (systolic/diastolic/mean) mmHg, pulmonary artery pressures of 35/15/24 mmHg, and pulmonary capillary wedge pressure of 16 mmHg. The patient was transferred to the intensive care unit for monitoring overnight, was transferred to the floor the following day and was discharged to a rehabilitation facility 20 days later. The prolonged stay was largely due to recurrent atrial fibrillation and orthostatic hypotension, which gradually improved.

Discussion

The authors present a case of acute-on-chronic worsening of RV dysfunction associated with a predominantly left-to-right shunt through an iASD, within minutes of a successful MitraClip placement. While an intra-cardiac shunt of some degree is always created after TSP, this case demonstrated that

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Fig 1. (A) 3D TEE en-face view of the mitral valve and (B) 2D 4-chamber view showing the MitraClip device in place prior to detachment. AV, aortic valve; AML, anterior mitral leaflet; PML, posterior mitral leaflet; LAA, left atrial appendage; LA, left atrium; LV, left ventricle; RA, right atrium; RV, right ventricle.

Fig 2. (A) View of the iASD from the right atrium. The iASD measured 12 x 6 mm. (B) 3D color-flow Doppler image of the iASD from the right, showing bidirectional shunting. iASD, iatrogenic atrial septum defect; AV, aortic valve; TV, tricuspid valve; IAS, interatrial septum; RA, right atrium; RV, left ventricle.
in an already compromised RV, an acute decline in function due to volume overload can occur and can be successfully managed expeditiously. The authors’ patient underwent immediate percutaneous closure of the iASD after the completion of the procedure.

With the increasing use of percutaneous interventions for left-sided structural heart disease, TSP is likely to become increasingly common. Some evidence suggested that variations in catheter size, procedural complexity and patient populations impact the persistence and clinical significance of iASDs created during TSP.1,5,6

In a study by Hofmann et al involving 28 patients undergoing MitraClip placement under 3D TEE guidance, evidence of left-to-right shunting was found in all cases with shunt flows of 1,218 ± 567 mL/min.7 No right-to-left shunts were reported in this study. Another TEE study found a 50% persistence of iASDs 6 months after MitraClip placement, with a 5-fold increase in mortality associated with persistent iASDs.1 This was significantly higher than transthoracic echocardiography-based data from MitraClip patients that showed iASD persistence of 27% at 6 months, which was similar to that of other procedures requiring TSP.5 The difference in rates between these 2 reports likely was due to the increased sensitivity of TEE for detecting iASDs.

It has been suggested that iASDs after MitraClip procedures have a worse clinical outcome when compared to iASDs occurring after other procedures.1 This may be due to a combination of the larger device size, higher procedural complexity, and the increased incidence of elevated left-sided pressures in this population that can generate increased shunting and reduced rates of spontaneous closure. Therefore, in the authors’ opinion, all patients of this relatively vulnerable population should be observed closely for complications of the iASD. Most patients in the reported cases needing an emergency closure showed significant hemodynamic changes and clinical symptoms within hours after the procedure. However, longer observation may be needed as decompensation has been reported as late as 15 days after the procedure.8

The decision of whether and when to close an iASD can be challenging since no guidelines exist, and systematic data are limited. Cases of iASD with clinically significant shunts resulting in acute decompensation previously have been reported. These included both right-to-left shunting leading to hypoxemia as well as left-to-right shunting associated with acute right ventricular dysfunction.2,4 In the latter cases, however, the RV dysfunction presented several hours following the procedure, whereas in the authors’ case, in the context of poor baseline RV function, the deterioration was immediate and responded rapidly to closure of the iASD.

Previous cases of immediate iASD closure after a MitraClip procedure have been reported in the presence of large iASDs (larger than 8-mm diameter),7 significant shunting (presenting as significant drop in partial pressure of arterial oxygen/fraction of inspired oxygen ratio [PaO2/FIO2]),7 or major hemodynamic decline after withdrawal of the catheter in patients with severely impaired left and right ventricular dysfunction or pulmonary hypertension.8 The authors are aware of one previous report of immediate iASD closure after cardiac arrest associated with left-to-right shunting and RV failure.9 The case presented here represented a less severe form in the same clinical spectrum. Together these cases suggested that patients with significant pre-existing RV dysfunction may warrant a more aggressive approach to iASD management.

In this case, the decision to intervene immediately was motivated by echocardiographic evidence of acute deterioration of already compromised RV function; the possible worse clinical outcome of iASDs and high incidence of persistence associated with MitraClip procedures, and the patient’s multiple significant comorbidities, which increased the risk of a repeat anesthetic for delayed repair. The authors hypothesized that an immediate closure would be more favorable and less harmful than a wait-and-see approach, risking further decline of the clinical condition of the authors’ patient and an additional emergency procedure.

Larger studies are required to fully understand the complications related to iASD after MitraClip procedures and the effect of immediate iASD closure on clinical outcomes, especially in patients with significant pre-existing RV dysfunction. The combination of mitral repair and iASD can result in complex changes to right ventricular preload and afterload. Given the high incidence of right ventricular dysfunction in this population, a better understanding of the acute and long-term physiologic changes in this setting will be crucial to evidence-based management of these cases.

Conclusions

The MitraClip procedure increasingly is used to manage MR in patients with high surgical risk. However, some of the complications of this procedure have not been evaluated. The authors presented a case of a patient with poor baseline RV function who underwent a successful MitraClip procedure. In this patient, an iASD resulted in significant shunting and precipitated acute right ventricular failure. The iASD was treated with immediate closure with an Amplatzer device with significant clinical improvement.
Appendix A. Supplementary material

Supplementary data are available in the online version of this article at http://dx.doi.org/10.1053/j.jvca.2017.02.034

References