Case Reports

MitraClip to Treat Severe Ischemic Mitral Regurgitation During Impella CP Support

in a 70-Year-Old Woman

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Acute mitral regurgitation is a life-threatening complication of acute myocardial infarction. We present the case of a 70-year-old woman who had acute myocardial infarction complicated by severe mitral regurgitation and cardiogenic shock. Although current guidelines recommend mitral valve surgery for such patients, surgery often carries prohibitive risk of morbidity and mortality. Thus, in certain patients, percutaneous repair may be the only viable treatment option. In this case, we used a 3-step percutaneous approach involving coronary artery revascularization with a drug-eluting stent in the left circumflex coronary artery, mechanical circulatory support with an Impella CP pump for cardiogenic shock, and mitral valve repair with the MitraClip system for severe mitral regurgitation. After successful intervention, our patient regained hemodynamic stability and showed clinical improvement at one-month follow-up. ***(Tex Heart Inst J 2020;47(4):306-10)***

Key words: *Heart-assist devices; heart valve prosthesis implantation/methods; mitral valve insufficiency/therapy; myocardial infarction; shock, cardiogenic*

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Acute mitral regurgitation (MR) is a life-threatening mechanical complication that can develop after an acute myocardial infarction (AMI). It can lead to cardiogenic shock and is associated with high rates of morbidity and mortality.[1] Mitral regurgitation can result from papillary muscle rupture or dyskinesia of the lateral or posterior left ventricular (LV) wall.[2,3] Current American Heart Association and American College of Cardiology guidelines recommend mitral valve surgery for patients with severe MR who remain severely symptomatic. European guidelines recommend using the MitraClip system (Abbott) in such patients who remain symptomatic despite medical therapy and who cannot undergo surgery (Class IIB; level of evidence C).[4] The United States Food and Drug Administration has approved the MitraClip for limited use in patients with asymptomatic degenerative MR in whom surgical mitral valve repair poses a prohibitive risk.[5] Using the MitraClip in patients with severe ischemic MR is considered to be off-label, but it may be the only treatment option in certain cases.

Case Report

A 70-year-old woman with a history of hypertension and hyperlipidemia presented at another facility with chest pain of 5 hours' duration. She was hypotensive (91/53 mmHg), and an electrocardiogram revealed inferolateral ST-segment-elevation AMI. She underwent urgent left-sided heart catheterization and was diagnosed with acute occlusion of the dominant left circumflex coronary artery (LCx). During the procedure, her blood pressure decreased to 50/30 mmHg, resulting in ventricular tachycardia that necessitated electrical defibrillation and intubation. An Impella CP (Abiomed Inc.) pump was inserted through the left femoral artery for hemodynamic support and LV unloading, enabling revascularization with a drug-eluting stent placed in the mid LCx. The angiographic results of revascularization were excellent.

On the same day, the patient was transferred to our center to manage cardiogenic shock and to monitor her progress on mechanical circulatory support. Upon arrival, she underwent right-sided heart catheterization while still on pump support (Table I). She was admitted to the coronary care unit, where she received optimal medical therapy; she was extubated the next day. A transthoracic echocardiogram (TTE) obtained

TABLE I. Hemodynamic Data During Right-Sided Heart Catheterization on Day 1 of Admission

Variable	Value
Pressure (mmHg)	
Aortic, S/D/M	124/96/106
Pulmonary artery, S/D/M	42/26/35
Pulmonary capillary wedge, a/v/M	23/22/21
Right atrial, a/v/M	14/13/12
Right ventricular, s/EDP	36/14
PAPi	1.7
Cardiac index (Fick) (L/min/m^2)	2.20
Cardiac power output (W)	1.05
Cardiac output (Fick) (L/min)	4.20

a = a-wave; D = diastolic; EDP = end-diastolic pressure; M = mean; PAPi = pulmonary artery pulsatility index; S = systolic; v = v-wave

at bedside showed an LV ejection fraction of 25% and severe inferior and lateral hypokinesis. Moderate mitral annular calcification and severe MR were also noted.

On day 3, an attempt to wean the patient from pump support at bedside failed when she became hypotensive. Her mean arterial pressure (in mmHg) rose from the mid-20s to the 50s, and her cardiac output decreased from 4.48 to 3.4 L/min. Full pump support was resumed.

On day 7, in the catheterization laboratory, another attempt to discontinue pump support failed. Hemodynamic and clinical findings after the pump was turned off showed a sudden increase in mean pulmonary artery pressure (mPAP) from 17 to 38 mmHg, a decrease in LV systolic pressure (in mmHg) from the 100s to the mid-80s, and an increase in LV end-diastolic pressure to 44 mmHg (Fig. 1). The patient's clinical and hemodynamic deterioration necessitated full resumption of Impella support, which restored her to hemodynamic stability within minutes (Fig. 2).

On day 8, a transesophageal echocardiogram (TEE) was obtained to evaluate MR severity. Pump flow was decreased from P8 (maximal flow) to P3 and then briefly to between P0 and P1. The TEE showed severe MR with tethering of both mitral leaflets (Fig. 3). A 3-dimensional Doppler color-flow image showed a severe regurgitant jet (Fig. 4). The patient's Mitral Regurgitation Severity Index was 1.8 (≥1.8 is considered diagnostic of severe MR).[6] Her cardiogenic shock was attributed to severe ischemic MR. Our heart team deemed the patient to be at high risk of in-hospital death after surgery (indicated by a EuroSCORE II of 14.84%).

On day 14, the MitraClip procedure was performed. The patient was receiving anticoagulant therapy as required during pump support. Access was obtained by inserting a large-bore 23F sheath into the right femoral

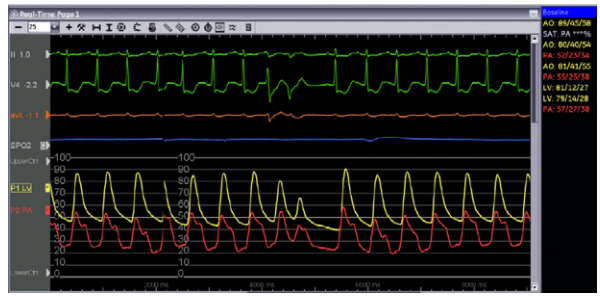


Fig. 1 *Hemodynamic pressure tracings recorded during a failed attempt at Impella CP pump weaning show decreasing left ventricular pressure (yellow) and elevated pulmonary artery pressure (red), suggesting cardiogenic shock.*

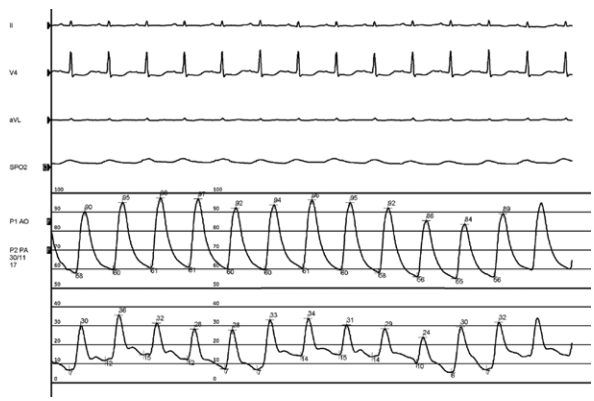


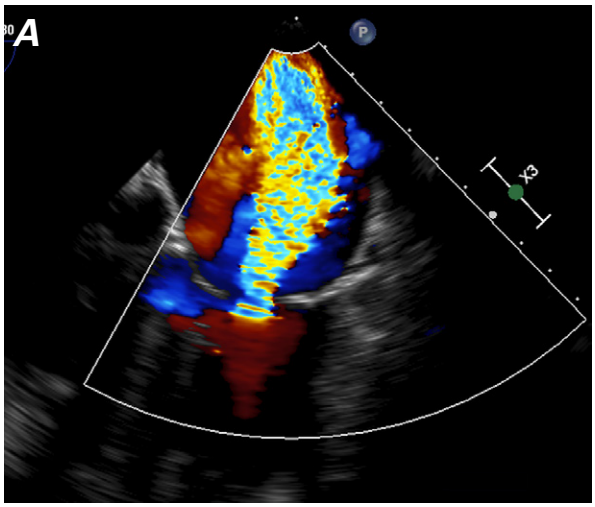
Fig. 2 *Hemodynamic pressure tracings from the left ventricle and pulmonary artery show a return to normal after full Impella CP pump support was resumed.*

vein and then performing a transatrial septal puncture. While the pump remained in the LV outflow tract, close to the anteromedial papillary muscle, the MitraClip was successfully deployed to the second anterior and second posterior scallops of the mitral leaflets (Fig. 5).

Immediately after the procedure, an intraoperative TEE showed less severe MR (Fig. 6). The Impella CP pump was removed, after which the patient remained clinically and hemodynamically stable. A repeat TTE showed mild residual MR with a mean gradient of 4.3, a mitral valve area of 2.4 cm^2, and an improved LV ejection fraction of 40% to 45%, with no evidence of systolic flow reversal in her pulmonic veins. The patient was discharged from the hospital in stable condition after one week. She was doing well one month after the procedure.

Discussion

Managing AMI complicated by severe ischemic MR necessitates aggressive afterload reduction, mechanical circulatory support, and, often, mechanical ventilation as a bridge to emergency surgical valve repair or replacement. Only a few case reports have described MitraClip implantation in patients for whom surgery posed a high



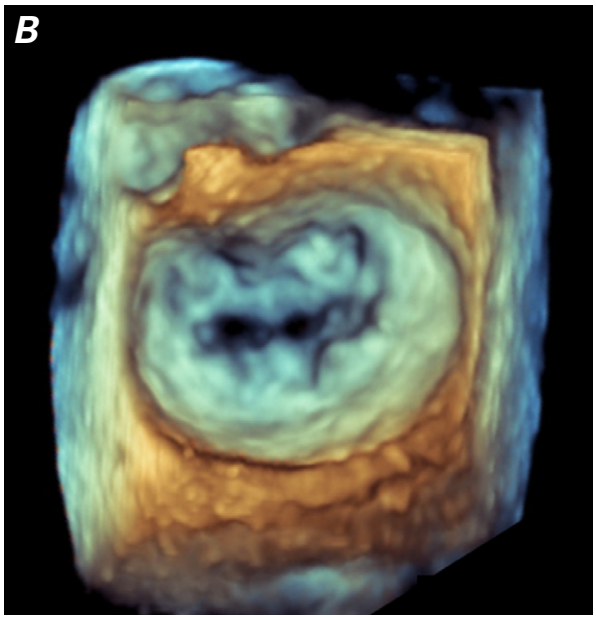


Fig. 3 *Transesophageal echocardiograms on day 8 show* ***A****) severe mitral regurgitation with an eccentric jet (midesophageal 4-chamber view) and* ***B****) malcoaptation of the mitral leaflets during systole (3-dimensional view).*

risk. In those cases, the clip was deployed with varying success in post-AMI patients receiving intra-aortic balloon pump (IABP), extracorporeal membrane oxygenation (ECMO), or HeartMate II (Thoratec) support.[7-10] Whereas IABP offers limited mechanical circulatory support, it also necessitates substantially less anticoagulation than do percutaneous ventricular assist devices (pVADs) such as Abiomed's Impella, the TandemHeart (LivaNova PLC), and ECMO systems. In comparison with other pVADs, the Impella pump offers some advantages for patients with severe ischemic MR. It can be rapidly deployed, with arterial access achieved through a smaller puncture, and it reduces LV pressure throughout the cardiac cycle, thus reducing MR.

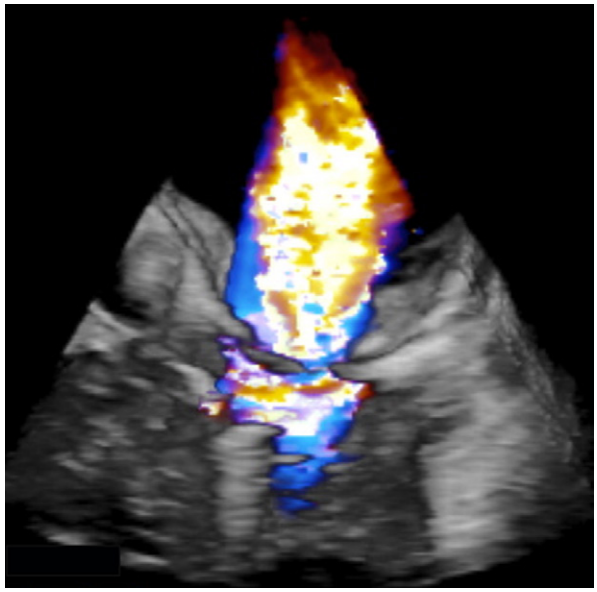
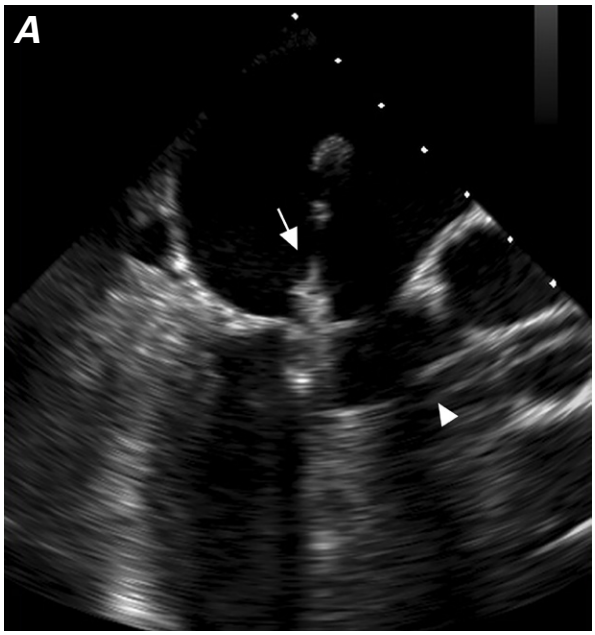


Fig. 4 *Three-dimensional transesophageal echocardiogram (color-flow Doppler mode) shows a severe mitral regurgitant jet.*

Acute MR as a mechanical complication after AMI is not an indication for MitraClip use. In the EVEREST II (Endovascular Valve Edge-to-Edge Repair Study)[11] and COAPT (Cardiovascular Outcomes Assessment of the MitraClip Percutaneous Therapy for Heart Failure Patients with Functional Mitral Regurgitation)[12] trials, recent AMI (within the preceding 12 weeks) was an exclusion criterion because ventricular remodeling in the first few days or weeks after an AMI can alter the mitral apparatus and regurgitation. Also, after revascularization, MR can become less severe as the myocardium recovers.[5,11,12] Emergency mitral valve surgery poses considerable risk, even when the patient has been hemodynamically stabilized with pVAD support. Risk arises from surgical intervention in a patient with a recent AMI and a delicate hemodynamic balance who is receiving dual antiplatelet and aggressive anticoagulation therapy.

The potential benefit of minimally invasive, percutaneous treatment for patients at high surgical risk is appealing. Inserting a large-bore sheath into the right common femoral vein and performing transatrial puncture is relatively safe, even for patients who are not taking anticoagulants. Much of the data on transcatheter mitral valve repair procedures is derived from hemodynamically and clinically stable patients with chronic MR. Standard therapy for acute MR remains surgical valve replacement, but surgical correction is not always advisable in high-risk cases. In our patient, deploying a MitraClip while an Impella CP pump was positioned in the LV outflow tract, close to the anteromedial papillary muscle, proved to be feasible and did not require special maneuvers for the pump or the clip. Using the MitraClip was justified because the patient had remained



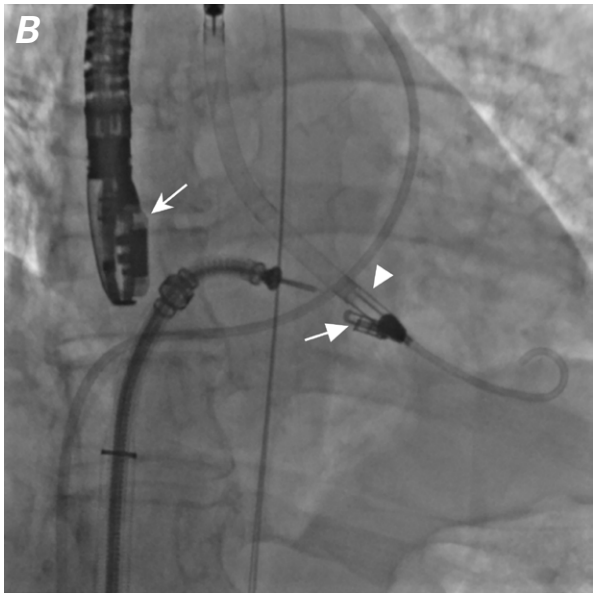
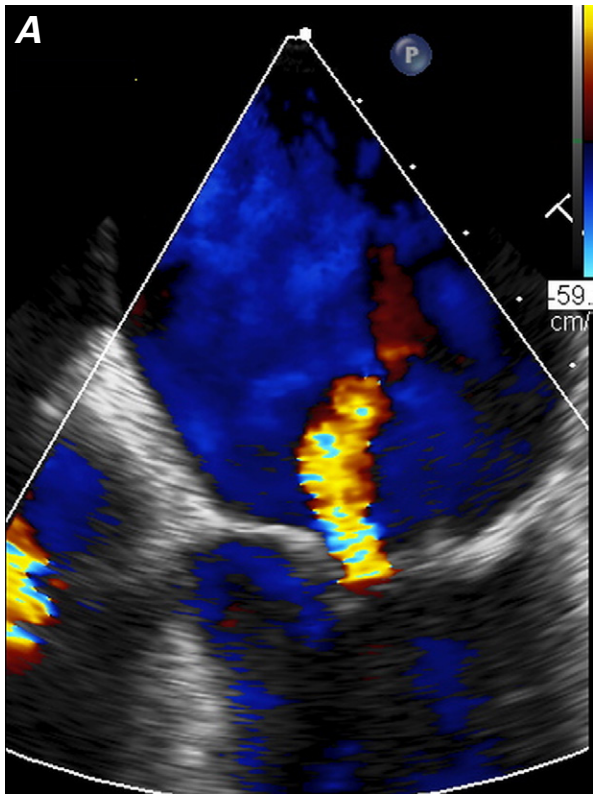


Fig. 5 *A) Intraoperative transesophageal echocardiogram (2-chamber long-axis view) shows the close proximity of the MitraClip system (arrow) and Impella CP pump (arrowhead) during simultaneous use.* ***B****) Intraoperative angiogram shows the transesophageal echocardiographic probe (notched arrow) guiding MitraClip deployment (arrow) and the Impella CP pump (arrowhead) positioned in the left ventricle.*



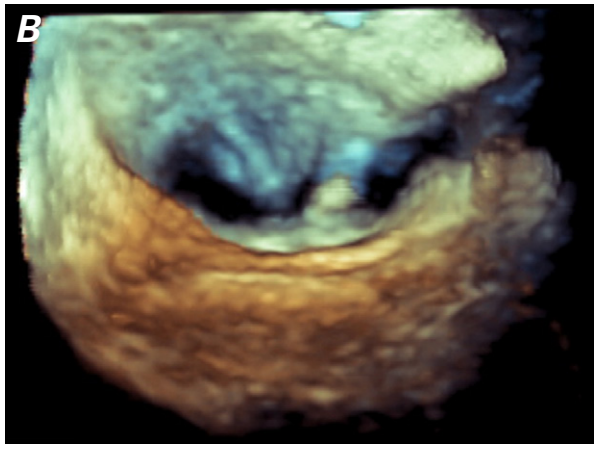


Fig. 6 *Postprocedural transesophageal echocardiograms show* ***A****) improvement in mitral regurgitation (2-dimensional, midesophageal 4-chamber view) and* ***B****) successful clipping of the second anterior scallop to the second posterior scallop of the mitral leaflets (3-dimensional view).*

dependent on Impella CP support for 2 weeks despite complete revascularization and optimal medical management. Consistent with findings from previous case series and reports, we observed rapid decreases in LV end-diastolic pressure, left atrial pressure, mPAP, and pulmonary capillary wedge pressure after successful correction of MR. We found only one other case report of Impella pump support during a MitraClip procedure,[13] involving a patient whose acute decompensation was reversed during mitral leaflet repair.

Conclusion

Our case highlights the feasibility, safety, and effectiveness of percutaneously treating cardiogenic shock and severe ischemic MR in a patient with AMI. The novel combination of Impella CP pump support and MitraClip repair was safe and effective and, during the

period of hemodynamic pump support, provided time to carefully plan definitive treatment. A decade ago, the outcome would have been different. Although this percutaneous approach may prove to be more beneficial than surgical intervention, investigation of its long-term safety is warranted in larger series with longer follow-up in appropriate patients.

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