Case Series

Mitral Valve Surgery in 6 Patients after Failed MitraClip Therapy

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The MitraClip percutaneous mitral valve repair system, developed as an option for percutaneous mitral repair, was clinically introduced in 2007. From 2010 through 2012, 6 of our patients underwent mitral valve surgery after MitraClip failure. Their mean age was 75 ± 7.7 years (range, 62–87 yr). Three had undergone cardiac surgery previously. In 5 of the 6 patients, mitral regurgitation recurred after initially successful MitraClip deployment and was the indication for surgery. The mean interval between MitraClip implantation and surgery was 106 ± 86 days (range, 0–238 d).

Mitral valve repair was feasible in 3 patients; the others underwent valve replacement. All the patients underwent additional cardiac procedures, because the MitraClip worsened existing conditions. Echocardiograms revealed sufficient valvular repairs. Two patients died during hospitalization, one of cerebral infarction and the other of bowel ischemia.

Mitral valve repair after failed MitraClip therapy can be complex and a surgical challenge. Careful consideration should be given to appropriate patient selection for MitraClip therapy, because the MitraClip can cause existing pathologic valvular conditions to deteriorate substantially. The interval between MitraClip failure and corrective surgery should be as short as possible. The primary indication is an issue of ongoing discussion. ***(Tex Heart Inst J 2014;41(6):609-12)***

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The current gold standard for the repair of mitral valve regurgitation (MR) is surgery through a partial or complete sternotomy or an anterolateral minithoracotomy. For high-risk surgical patients, one percutaneous alternative is repair with use of the MitraClip® Percutaneous Mitral Valve Repair System (Abbott Vascular, part of Abbott Laboratories; Redwood City, Calif). This procedure—clinically available since 2007—involves the transcatheter placement of 1 or 2 MitraClip devices under echocardiographic and fluoroscopic guidance, with the purpose of restoring leaflet coaptation in functional or structural degenerative valvular disease.[1,2] The stated advantage of this technique is to preserve the option of surgical repair after a failed attempt at device placement or when MR recurs after MitraClip implantation.[3] However, it is unclear what side effects clipping might have on the mitral tissues.[4] As MitraClip usage increases, so does the frequency of clip failure and the consequent need for surgical treatment. We present a dual-institution report of operative treatment after failed MitraClip interventions in 6 patients, and we discuss the indications for MitraClip usage.

Case Summaries

From 2010 through 2012, 6 patients (mean age, 75 ± 7.7 yr; 4 women) underwent MitraClip implantation at our hospitals. Three had undergone previous cardiac surgery. The mean EuroSCORE of the patients was 12.2 ± 7 (range, 1.3–21.4). The chief indication for MitraClip use was frailty, including advanced age, and the resultant high risk of surgery (n=5) or refusal of surgery (n=1). Patient 5's age (87 yr), and previous cardiac surgery in Patients 1, 2, and 3 in combination with renal insufficiency and severe pulmonary hypertension, were documented preoperatively. Patient 6 was on dialysis and had additional respiratory insufficiency preoperatively because of pulmonary fibrosis. She also had a history of stroke with lingering hemiparesis. Patient 4 was clinically stable with dyspnea on exertion.

The pathologic valvular conditions of the patients before MitraClip therapy were as follows: Patients 1 and 2 had annular dilation with severe MR, and Patient 2 also had moderate tricuspid valve insufficiency caused by annular dilation; Patients 3

and 4 had severe MR caused by annular dilation and leaflet calcification; Patient 5 had severe MR caused by annular dilation, with additional calcification of the posterior mitral annulus and moderate tricuspid valve insufficiency; and Patient 6 had mitral annular dilation, calcification of the posterior mitral leaflet, and moderate tricuspid insufficiency.

Table I shows the data concerning the 6 patients. Patients 3 and 4 were given 2 MitraClips, and the others were given one. In 5 of the 6 patients, MitraClip implantation was initially successful, and MR was reduced from grade 3+ to grade 2 in 4 patients and from grade 3 to grade 1–2 in one patient. These 5 patients presented later at our hospitals with recurrent MR of at least grade 3; the indication for surgical mitral valve repair was ongoing or recurrent MR of grade 2+. During MitraClip deployment in Patient 5, severe intracardiac thrombus formation and perforation of the left atrial roof resulted in hemopericardium and the need for mechanical resuscitation; therefore, emergent mitral valve repair was performed. The mean interval between MitraClip implantation and subsequent operative repair was 106 ± 86 days (range, 0–238 d).

Causes of MitraClip Failure. The causes of failed MitraClip therapy in the 5 nonemergent patients were analyzed intraoperatively. In Patient 2, we found MitraClip dislocation with anterior leaflet 2 (A2) and posterior leaflet 2 (P2) perforation (Fig. 1A) and chordal rupture in the A2 segment (Fig. 1B). Patients 3 and 4 had leaflet degeneration with fusion of both leaflets by the MitraClip. In Patient 1, we found MitraClip dislocation with P2 perforation, prolapse, and chordal rupture in the P2 segment. Patient 6 had perforation of the anterior mitral leaflet, which was covered with vegetations from *Staphylococcus aureus* endocarditis.

Surgical Procedures. Patients 1, 2, and 5 underwent mitral valve ring annuloplasty. Two were given a Cosgrove-Edwards® ring (Edwards Lifesciences Corporation; Irvine, Calif), and the other was given a Profile 3D® (Medtronic, Inc.; Minneapolis, Minn). Leaflet repair (in 2 of these 3 patients) was achieved with use of 4-0 Cardionyl® sutures (Péters Surgical; Bobigny, France), and implantation of neochordae (2 patients) was with use of 4-0 GORE-TEX® sutures (W.L. Gore & Associates, Inc.; Tempe, Ariz). One patient underwent quadrangular resection of P2 with leaflet plication.

In Patients 3, 4, and 6, we performed mitral valve replacement, using biological valves from St. Jude Medical, Inc. (St. Paul, Minn) in 2 patients and an Edwards PERIMOUNT® valve (Edwards Lifesciences) in the third.

Five of the 6 patients underwent tricuspid valve repair, 4 via annuloplasty with Cosgrove-Edwards rings and one by means of De Vega plasty. Four of the 6 underwent occlusion of the left atrial appendage. In all 6 patients, intra- and postoperative echocardiograms revealed sufficient valvular repairs, with no regurgitation or paravalvular leak.

Outcomes. Patients 1, 2, 3, and 4 had uneventful postoperative courses. Patient 5, who had needed mechanical resuscitation during MitraClip implantation, had a

TABLE I. Characteristics and Outcomes of the 6 Patients Who Underwent MitraClip Therapy

Variable	Patient 1	Patient 2	Patient 3	Patient 4	Patient 5	Patient 6
Age (yr), sex	67, M	77, F	62, F	77, F	87, M	76, F
Previous cardiac surgery	CABG	ASD closure	CABG	None	None	None
MitraClip initially successful	Yes	Yes	Yes	Yes	No; LA rupture and CPR	Yes
Cause of MitraClip failure	MC dislocation, P2 perforation, and chordal rupture at P2	MC dislocation, A2/P2 perforation, and chordal rupture at A2	Leaflet calcification	Leaflet calcification	LA perforation	Leaflet perforation and vegetations
Time to mitral surgery (d)	91	29	155	120	0	238
Surgical procedures	MVR, TVR, and LAA occlusion	MVR, TVR, and LAA occlusion	Bio MV replacement and TVR	Bio MV replacement	MVR, TVR, LAA occlusion, and LA repair	Bio MV replacement, TVR, and LAA occlusion
Postoperative course	Uneventful	Uneventful	Uneventful	Uneventful	Severe cerebral infarction; died on POD 12	Bowel ischemia; died on POD 4

A2 = anterior leaflet 2; ASD = atrial septal defect; Bio MV = biological mitral valve; CABG = coronary artery bypass grafting; CPR = cardiopulmonary resuscitation; F = female; LA = left atrial; LAA = left atrial appendage; M = male; MC = MitraClip; MVR = mitral valve repair; P2 = posterior leaflet 2; POD = postoperative day; TVR = tricuspid valve repair

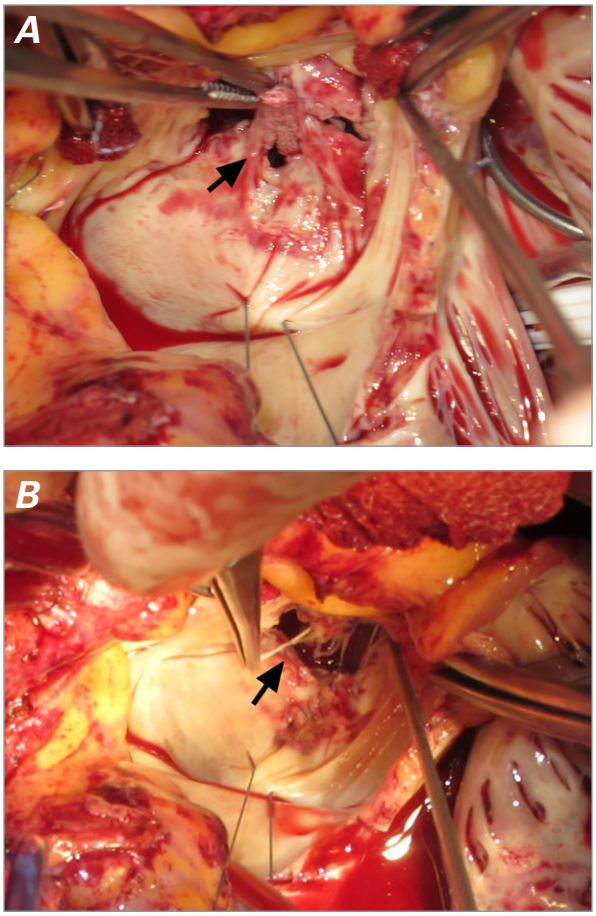

Fig. 1 *Patient 2. Intraoperative photographs show* ***A****) the MitraClip beside the leaflet perforation of the P2 segment and* ***B****) rupture of the anterior mitral chordae.*

severe cerebral infarction with extensive hypoxic brain damage and died on the 12th postoperative day. Patient 6, diagnosed preoperatively with endocarditis and sepsis, died in the intensive care unit on the 4th postoperative day, of extensive bowel ischemia with persistent lactic acidemia.

Discussion

MitraClip implantation, a relatively new transcatheter therapy for MR, is applied with increasing frequency in patients for whom mitral valve surgery poses a high risk.[3] However, the indications for MitraClip implantation should be discussed carefully beforehand, because when MitraClip therapy fails, the patient's pathologic valvular condition can worsen so substantially that valve replacement becomes necessary. Patients with degenerated leaflets are poor candidates for MitraClip therapy. In 2 of our 3 patients who underwent mitral valve replacement after failed MitraClip therapy, the native leaflets exhibited fibrosis and were fused with the MitraClip, making repair impossible. Whether the fibrosis was induced by the MitraClip is unclear.[4]

In general, patients with severe mitral leaflet or annular calcification are not good candidates for MitraClip therapy and should instead be scheduled for valve replacement.[5] Reported rates of surgery for mitral valve dysfunction after MitraClip therapy are 20% at 1 year and 24% at 4 years—significantly higher than the reoperation rates after standard surgical treatment (2% at 1 yr and 5% at 4 yr).[5] The efficacy of the MitraClip procedure, seemingly lower than that of standard surgical procedures, might improve after future technological refinement.[6] Until then, selecting patients appropriately is crucial. Young and comparatively healthy patients, for whom the risks of surgery are minimal, normally should not undergo MitraClip therapy, because the success and durability of the repair are fundamental.[6] Patients with concomitant tricuspid insufficiency should undergo standard operative treatment that includes tricuspid valve reconstruction.[7]

Mitral valve surgery after failed MitraClip therapy can be complex. The feasibility of mitral repair depends on the patient's underlying pathologic valvular conditions and the time between MitraClip implantation and surgery. For example, MitraClip therapy caused substantial deterioration of the valve conditions in 2 of our patients, leading to chordal rupture and leaflet perforation possibly caused by increased tension.

Patients diagnosed with endocarditis after failed MitraClip therapy should undergo surgery early, because their health might deteriorate if surgery is delayed. Our Patient 6, with endocarditis, was already in poor general condition with severe sepsis. Valve repair was impossible because of leaflet perforations and heavy vegetations, so valve replacement was the only alternative.

In summary, surgical mitral valve repair after failed MitraClip therapy in patients with valvular deterioration can be challenging and complex. The interval between MitraClip implantation and surgery should be as short as possible, to enable mitral valve repair and prevent deterioration in health that would worsen the outcome.

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