Two Cases of Surgical Correction of Recurrent Mitral Regurgitation due to Failed Catheter-Delivered Mitral Clip (MitraClip)

Masahide Komagamine,1 Kan Nawata,1 Shota Kita,1 Kiyoshi Chiba,1 Shingo Kuwata,2 Yoshihiro Akashi,2 and Takeshi Miyairi1

Introduction

The edge-to-edge surgical repair technique for patients with degenerative mitral regurgitation (MR) was first described in 1991 by Alfieri et al.1 Based on this concept, a catheter-delivered clip system was designed to allow percutaneous edge-to-edge mitral valve repair with the MitraClip system (Abbott, Chicago, IL, USA), which received the CE mark in 2008.2 In 2013, the U.S. Food and Drug Administration approved the MitraClip procedure for patients with primary MR determined to be a prohibitive risk for mitral valve surgery.

A clinical trial conducted in Japan using MitraClip in 2017 reported that no-elective cardiovascular surgery was required or no major adverse events occurred during the 30 days post-MitraClip implantation.3 The results of this clinical trial of the MitraClip led to insurance reimbursements in April 2018 in Japan.

Case Report

Case 1

An 85-year-old man with symptomatic severe MR was admitted to the cardiology department at our hospital. Preoperative electrocardiography showed atrial fibrillation, and echocardiography revealed significant prolapse of anterolateral (P1) area of posterior mitral leaflet due to torn chordae with a normal left ventricular (LV) ejection fraction (LV diastolic diameter: 54 mm, LV systolic diameter: 31 mm, ejection fraction: 73%). Additionally, there was...
moderate tricuspid regurgitation (TR) and mild aortic regurgitation with left atrial dilatation. Considering his age, MitraClip was selected, and two clips were placed at the A1/P1 segment and A2/P2 segment. The intraoperative transesophageal echocardiography (TEE) after two MitraClip implantations improved MR down to mild. However, 5 days after the procedure, TEE showed severe residual MR due to single leaflet device attachment (SLDA) with the A1/P1 segment (Fig. 1). Additional clipping was practically difficult; therefore, the patient was referred to our department, where he underwent mitral valve replacement using a 27-mm Perimount Magna Mitral Ease valve (Edwards Lifesciences Corp., Irvine, CA, USA), tricuspid annuloplasty using a 30-mm Physio Tricuspid ring (Edwards Lifesciences Corp.), and left atrial appendage closure, 13 days after the MitraClip procedure.

Intraoperative observation of the mitral valve revealed an SLDA at the anterolateral area of anterior leaflet (A1) (Fig. 2). Owing to strong adhesion of the leaflets to the clips and severe leaflet damage, mitral valve replacement was inevitable, which was performed with preservation of as much tissue of the anterior and posterior leaflets after resection of the two clips. Weaning from the heart–lung machine was uneventful. Postoperative TEE revealed the absence of MR. The patient was discharged on postoperative day 22 without significant trouble.

Case 2
An 84-year-old woman with symptomatic severe MR was referred to the cardiology department of our hospital. Preoperative echocardiography revealed significant prolapse at the P2 segment (middle scallop of posterior mitral leaflet) due to torn chordae with a normal LV ejection fraction (LV diastolic diameter: 47 mm, LV systolic diameter: 27 mm, ejection fraction: 75%). She also had mild TR with left atrial dilatation. Again, the MitraClip procedure was selected because of her age, and two clips were placed at the A2/P2 segment to treat large P2 prolapse. The intraoperative TEE after the procedure showed the decrease in MR down to trivial, whereas the postoperative transthoracic echocardiography (TTE), which was carried out on day 4, showed severe residual recurrent MR with SLDA due to anterior leaflet tear.

The patient developed fever due to catheter infection, and her blood culture revealed the presence of *Citrobacter koseri*, for which she received an appropriate course of antibiotic therapy. After confirming a negative blood culture following the antibiotic therapy, we performed surgical correction (55 days after the MitraClip procedure).

Intraoperative inspection of the mitral valve revealed SLDA at the P2 segment of posterior leaflet accompanied with anterior leaflet tear at the A2 segment (Fig. 3). We did not find any vegetation or significant inflammatory change of the mitral valve. The bacteriology examination of the removed MitraClip device was also negative. We performed the same corrective procedure as mentioned for Case 1. Her postoperative course after the mitral replacement was uneventful, and she was transferred to the cardiology department on the 14th postoperative day and discharged on the 30th postoperative day.

Discussion
Since the introduction into the Japanese market in April 2018, the number of MitraClip procedure has been
increasing year by year. Owing to its minimal invasiveness, a lot of frail or vulnerable patients with severe functional MR in whom open-heart surgery was contraindicated have enjoyed the benefit of this percutaneous treatment.

On the other hand, there have also been reports of complications after MitraClip implantation: 2.3%–6.3% of patients required surgical revision due to various complications within a year after the implantation. The common complications after MitraClip implantation include clip detachment, leaflet tears with clip and clip embolization in the acute phase, leaflet infections due to infective endocarditis, and degeneration of mitral valve in the chronic phase.

MitraClip implantation was performed in 150 patients from April 2018 to February 2021 at our hospital, of which only two patients experienced an SLDA requiring surgical correction in the acute phase. Rader et al. reported 25 cases (among 1204 cases) that required mitral valve surgery, with the mean interval from MitraClip to surgery of 5.1 months (interquartile range, 2.5–14 months). The common complications after MitraClip implantation include clip detachment, leaflet tears with clip and clip embolization in the acute phase, leaflet infections due to infective endocarditis, and degeneration of mitral valve in the chronic phase.

MitraClip implantation was performed in 150 patients from April 2018 to February 2021 at our hospital, of which only two patients experienced an SLDA requiring surgical correction in the acute phase. Rader et al. reported 25 cases (among 1204 cases) that required mitral valve surgery, with the mean interval from MitraClip to surgery of 5.1 months (interquartile range, 2.5–14 months). Alzoe et al. reported 13 patients (among 139 cases) who required surgical repair. 12 were performed within 1 year after MitraClip, with two cases of complete clip detachment, five cases of partial clip detachment, and one case of clip embolization.

Thickened mitral leaflets, shortened posterior leaflet, and mitral annulus calcification are the risk factors of the failed procedure. The incidence of the SLDA as an adverse event at our institute is not higher than that of those previous reports, and our patient selection criteria seem to be relevant. Detailed echocardiographic study during the MitraClip procedure as a heart team intervention leads to good patient outcomes.

From these two cases, we advocate two issues in regard to surgical correction of failed MitralClip.

One is the importance of careful mitral valve monitoring by auscultation and TTE, particularly within the first year after MitraClip implantation. The other is the timing of surgical intervention.

Generally, surgical revision after failed MitraClip implantation tends to be at high risk because of the patients’ primary profiles. A cohort study by Melillo et al. showed that surgical revision after failed MitraClip implantation was associated with poor in-hospital and post-discharge outcomes; the in-hospital mortality was at 15% and all-cause mortality reached 26.5% at the 1-year follow-up.

Predominantly, patients compromised with preoperative cardiogenic shock, septic shock, and liver failure are at increased risk of poor postoperative outcomes.

In case 1, the surgery was scheduled 8 days after the detection of SLDA, in fear of complete clip detachment causing some embolic event. To the contrary, in case 2 with bloodstream bacteremia, despite a risk of progression to complete clip detachment, our corrective surgery was performed only after confirming negative blood cultures with sufficient antibiotic therapy.

The lesson from the previous report was valuable. The indication and optimal timing of surgical intervention after failed MitraClip should be discussed carefully by the heart team to improve the surgical outcomes. Notably, intraoperative inspection of the clipped mitral valves revealed strong adhesion of the mitral leaflets to the clip and severe damage of the leaflets due to the clip procedure, which was evident in both 13 days and 55 days after the procedure.

Although instruction how to manually detach the clip is given by the manufacturer, it was practically impossible to remove the clip and try to repair the valve leaflets in both cases. Our decision was mitral valve replacement to shorten the cardiopulmonary bypass time. It might be useful to preserve as much of the anterior and posterior leaflets structure as possible in mitral valve replacement to maintain continuity with the papillary muscles to prevent LV perforation as well as to preserve LV function.

**Conclusion**

Development of residual severe MR due to SLDA after MitraClip is a rare but a serious complication of the procedure leading to poor patient outcomes. A dedicated follow-up study after this procedure is needed to note mitral valve in the echo findings, particularly within the first year.
Because of the high-risk baseline profile of the patients, surgical correction after failed MitraClip implantation needs careful consideration on optimal timing of the intervention.

Disclosure Statement

The authors do not have any conflicts of interest to declare.

References