

Clipping Severe Functional Mitral Regurgitation in a Failing Heart under Extracorporeal Membrane Oxygenation Support

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INTRODUCTION

The transcatheter edge-to-edge mitral valve repair (TMVR), using MitraClip (Abbott Vascular, Santa Clara, CA, USA), has been a safe and effective treatment for severe mitral regurgitation (MR).¹ In patients with severe functional MR, the regurgitant comes from incompetent coaptation, which is the consequence of annulus dilatation or abnormalities in left ventricular function rather than valvular deformity itself. Since current guidelines disclose the uncertain survival benefit of isolated valvular surgery for functional MR,² there are also controversies in respect to applying TMVR to this group of patients. On the other hand, surgical correction of functional MR with poor left ventricular systolic function and even under hemodynamic support carries excessive risk for mortality and morbidities. TMVR can be safely performed in patients with left ventricular ejection fraction less than 20%.³ TMVR has also been used to rescue acute MR due to chordae rupture and cardiogenic shock under extracorporeal membrane oxygenation (ECMO) support.⁴ However, the clinical impact and procedural safety of TMVR has never been reported in respect to patient with failing heart under pre-existing ECMO support.

CASE REPORT

A 78-year-old gentleman was referred to our hospi-

tal for treating refractory decompensated heart failure and cardiogenic shock. He had a medical history of triple coronary artery diseases underwent bypass surgery in 12 years ago. The patient also suffered from ischemic cardiomyopathy with severely depressed left ventricular systolic dysfunction and severe functional MR. Coronary angiogram has been performed a year ago prior to this admission and showed total occlusion of native 3 vessels and venous grafts. The patency of left internal mammary artery into left anterior descending artery was also confirmed. There was no other known pre-existing liver or autoimmune diseases in the past. This time, he was put on continuous inotropic infusion (dopamine) for nearly 30 days prior to referral to our tertiary medical center. Deterioration of renal and liver function was noted at presentation. Serum creatinin reached 7.65 mg/dl and serum ammonia reached 337 ug/dl. The NT-proBNP level was 9881 pg/ml and serum lactate was 36.6 mg/dl. Due to respiratory distress and hemodynamic instability, intubation with mechanical ventilation, intra-aortic balloon pump (IABP) and venoarterial ECMO were applied. From transthoracic echocardiography (TTE) and transesophageal echocardiography (TEE), severe posterior-oriented functional MR (effective regurgitant orifice area of 61 mm² and regurgitate volume of 56 ml) was identified. By using orthogonal TEE images from bi-commissure view and QLAB 10.0 (Philips Healthcare) 3D color Doppler reconstruction, the coaptation depth was 10 mm and a small coaptation gap (less than 1 mm) in the medial site of A2-P2 was identified (Figure 1A and B). Both anterior and posterior mitral leaflets were tethered downward to the left ventricle. The reversed systolic flow was detected over left upper pulmonary vein (LUPV) (Figure 1C). The left ventricular ejection fraction (LVEF) was 15% and right ventricular systolic pressure was 65 mmHg. Given the prohibitive surgical risk with calculated logistic EuroScore of

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92% and EuroScore II of 62% for mortality, the heart team and patient's families decided to treat the patient with MitraClip.

The procedure was conducted with classic MitraClip device (first generation) via left femoral vein access. Both the transeptal procedure and advancing the 24 Fr. guide catheter were smooth in the presence of 21 Fr. ECMO tube within inferior vena cava and right atrium. Pulmonary artery catheter was placed through right internal jugular vein to monitor peri-operative hemodynamics. In this procedure, the transeptal height to annulus is 3.5 cm and 4.5 cm to the coaptation line. Since the gap was less than 1 mm, the grasping attempt was not difficult with classic MitraClip device. After placing a single clip overcentral A2-P2 (Figure 1D), the acute procedure result was fair with only mild MR left (Figure 1E) and trans-mitral pressure gradient of 2 mmHg. Decline of v-wave amplitude (from 15 mmHg to 10 mmHg) and the mean pulmonary artery pressure (30 mmHg to 26 mmHg) were observed immediately after placing the clip. TEE also demonstrated disappearance of systolic reversed flow over LUPV (Figure 1F). Since residual MR is mild and equally splitted by the clip, second clip was not

attempted. The procedure time was only 92 minutes. Vascular access was closed by "figure-of-eight" suture. Patient weaned from ECMO within 5 days, IABP within 7 days, and mechanical ventilation within 2 weeks after index procedure. The patient discharged and functioned smoothly afterward. TTE showed improvement of the left ventricular systolic function (LVEF = 30%) as well as mild MR left in the 2 years follow-up.

DISCUSSION

Our special case has demonstrated the safety and efficacy of MitraClip to rescue patient in cardiogenic shock under ECMO support even in the extremely low LVEF. Unlike acute MR due to rupture chordae, the main concern of applying TMVR in pre-existing failing heart with functional MR is that the left ventricular function did not recover even unloaded the mitral insufficiency. Dobutamine stress echocardiography (DSE), positron emission tomography, or cardiac magnetic resonance image is suitable for the evaluation of myocardial viability but not feasible in acute deteriorated conditions. We

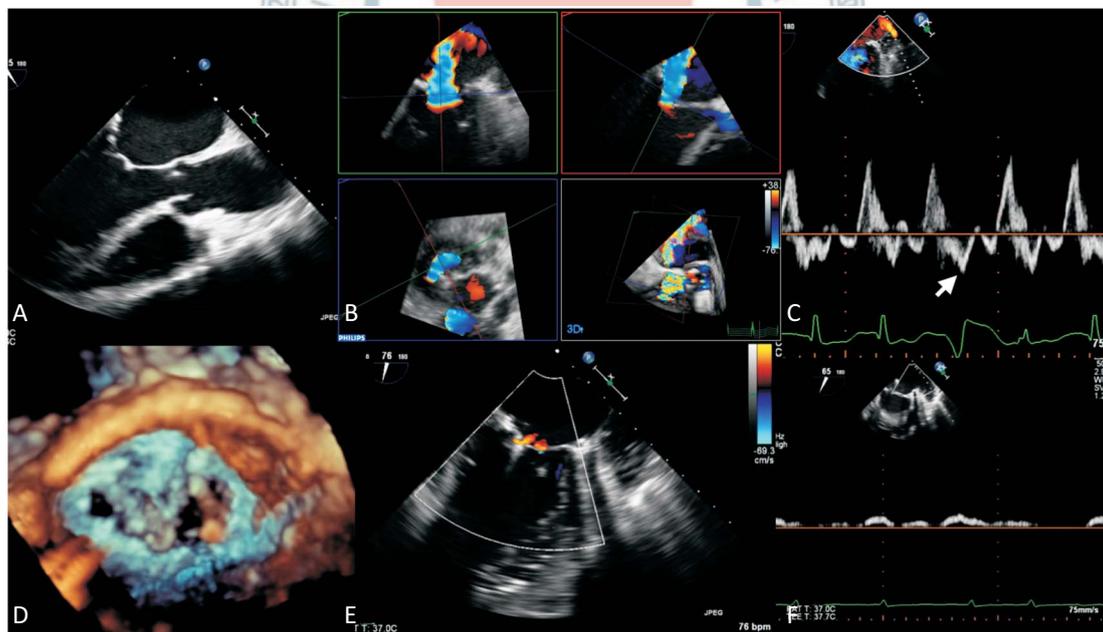


Figure 1. (A) TEE LVOT view demonstrated tethering of both mitral leaflets with a small gap between anterior and posterior leaflet. (B) QLAB 10.0 (Philips Healthcare) 3D color Doppler reconstruction demonstrated the significant MR jets coming from central A2-P2 site. (C) White arrow indicated the reversed systolic flow in left upper pulmonary vein. (D) 3D enface view from LV. It elucidated that the clip is located at central A2-P2 location. (E) TEE bi-commissure view with color Doppler demonstrated only mild MR left after a single clip. (F) TEE demonstrated disappearance of systolic reversed flow over left upper pulmonary vein. LV, left ventricular; LVOT, left ventricular outflow tract; MR, mitral regurgitation; TEE, transesophageal echocardiography.

did not perform DSE in this case since he was put on prolong inotropic agents infusion for nearly 30 days prior to this index procedure.

All of these modalities are not applicable in our patient. This was a medical dilemma to decide treating MR or not. Instead of DSE, we decided to observe the hemodynamic change and function of vital organs after putting ECMO. With cardiopulmonary support by ECMO, there was no further deterioration of the heart function. As a result, the MitraClip was performed 3 days after the ECMO implantation. Although heart transplantation could be the destination therapy, the lack of donors and age limitation to elderly recipient remained a major barrier. MitraClip is also taken into a bridge therapy to rescue patients with end-stage heart failure when they are on the waiting list for heart transplantation.⁵ Compare to surgical mitral intervention, the beauty of TMVR is consistent low risk among patients who carry high surgical risk⁶ or even on critical conditions.⁷

Many studies have shown significant improvement in myocardial remodeling and functional capacity after the TMVR.⁸ However, there were conflicting results in recent two randomized controlled studies. The long-term survival benefit of MitraClip was not shown to be superior to optimal medical treatment alone in the MITRA-FR study.⁹ On the other side, a remarkable reduction of all-cause mortality and heart failure admission events was observed in MitraClip and optimal medical treatment as compare to medical treatment alone in COAPT trial.¹⁰ Given that the MITRA-FR and COAPT trails enrolled the patients with chronic and relatively stable severe functional MR, the results of these two studies were not applicable in our critical patient.

This case demonstrated that with careful evaluation, MitraClip is still a viable alternative method to rescue patients with severe functional MR and failing heart under ECMO support. On the other side, it may not be applicable to every patient, especially without appropriate pre-procedural evaluation.

CONCLUSIONS

While surgical mitral repair carries too much risk for severe functional MR in patients with failing heart, MitraClip can be a viable alternative.

LEARNING POINT

MitraClip has been a safe and effective treatment in patients with severe functional MR. The role of treating MR is of uncertain benefit in patients with failing heart under mechanical support. This case has demonstrated that by careful selection, MitraClip could be an alternative treatment to rescue patients with critical illness.

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CONFLICT OF INTEREST

All the authors declare no conflict of interest.

A written informed consent approved by our institutional review board was obtained from the patient.

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