ARCHIVES OF THE TURKISH SOCIETY OF CARDIOLOGY

Official journal of the TURKISH SOCIETY OF CARDIOLOGY

Percutaneous Treatment of Severe Acute Mitral Regurgitation Early After Myocardial Infarction and a Short Review of the Literature

Miyokart İnfarktüsü Sonrası Erken Dönemde Gelişen Akut Ciddi Mitral Yetersizliğinin Perkütan Tedavisi ve Kısa Literatür Özeti

ABSTRACT

Transcatheter edge-to-edge repair treatment is mainly used for patients with chronic heart failure concomitant severe mitral regurgitation. However, utilization of this system in the acute seting of myocardial infarction is still limited. In this case report authors aimed to show the effectiveness of the percutaneous treatment for severe acute mitral regurgitation early after myocardial infarction.

Keywords: Mitraclip, mitral regurgitation, myocardial infarction, percutaneous mitral valve intervention, transcatheter edge to edge repair

ÖZET

Transkateter uç uca onarım temel olarak ciddi mitral yetersizliğinin eşlik ettiği kronik kalp yetersizliği hastalarında kullanılmaktadır. Ancak bu sistemin miyokart infarktüsünün akut fazında kullanımı henüz sınırlıdır. Yazarlar bu olgu sunumunda miyokart infarktüsü sonrası erken dönemde gelişen akut ciddi mitral yetersizliğinde perkütan tedavinin etkinliğini göstermeyi amaçlamışlardır.

Anahtar Kelimeler: Mitraklip, mitral yetersizlik, miyokart infarktüsü, perkütan mitral kapak girişimi, transkateter uç uca onarım

CASE REPORT
OLGU SUNUMU

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Received: December 6, 2022
Accepted: December 12, 2022

Cite this article as: Hakgör A, Karaca O, Yazar A, Boztosun B, Ateş İ. Percutaneous treatment of severe acute mitral regurgitation early after myocardial infarction and a short review of the literature. *Turk Kardiyol Dern Ars.* 2023;51(4):290-293.

DOI:10.5543/tkd.2022.09434

Early onset acute severe functional mitral regurgitation (FMR) after acute coronary syndrome (ACS) is a serious disorder and is related to poor prognosis. While patients with FMR are extensively treated medically with close follow-up in the coronary intensive care unit during acute settings, interventional management is still controversial. In this case report, implementation of transcatheter edge-to-edge repair (TEER) with MitraClip system (Abbott, Menlo Park, Calif., USA) is presented to a young patient admitted with ACS, suffering from severe FMR after successful complete revascularization.

Case Report

A 45-year-old male, without any previous cardiovascular disease, was admitted to the emergency department with acute-onset, heavy compressive retrosternal chest pain. 12-derived electrocardiogram showed no ST-elevation but broad ST-segment depression on V1-6 derivations. Bedside transthoracic echocardiography (TTE) was rapidly performed and showed hypokinesia on the posterolateral left ventricle with mild mitral regurgitation. The patient was hemodynamically stable during admission while progressive chest pain persisted despite intravenous nitroglycerin; therefore, urgent coronary angiography (CAG) was performed from left transradial access with 6-French slender sheath, 2 hours after admission. Coronary angiography revealed hazy 80% occlusion starting from distal left-main coronary artery (LMCA) into the circumflex (CX) ostium which was considered as the culprit lesion and long-segment critical stenosis in proximal to mid-portion of the left anterior descending artery (LAD) (Figure 1A and B, Video 1 and 2). Right coronary artery was non-dominant and had a small diameter with

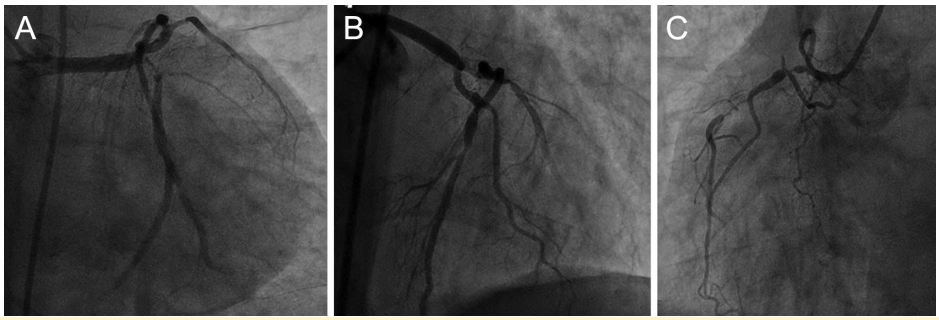

Figure 1. Initial diagnostic angiographic images of the right anterior-oblique-caudal (A), anterior-oblique-cranial (B) view of the left coronary system, and left anterior-oblique view of the right coronary artery (C) are shown.

80% narrowing on the mid-segment (Figure 1C, Video 3). The patient was discussed with the heart team immediately and performing ad-hoc percutaneous coronary intervention (PCI) was decided regarding the patient's unstable clinical status, favorable anatomic features for PCI, moderate SYNTAX score, initially mild mitral regurgitation, high risk for urgent by-pass surgery. After loading a dose of 60 mg of prasugrel, intra-aortic balloon pump (IABP) was inserted from the right femoral artery for hemodynamic support during PCI. Due to slight hypotension and tachycardia, early preventive IABP insertion was performed for keeping hemodynamic stability and improving coronary blood flow during high-risk left-main PCI without waiting for severe hemodynamic deterioration. Successful PCI was performed using 3 drug-eluting stents with appropriate steps for the mini-crush technique into LMCA, CX, and LAD (Figure 2, Video 4 and 5). The patient was transferred to the coronary intensive care unit after the procedure for advanced medical treatment and close follow-up. Intra-aortic balloon pump support was continued and low-dose dopamine was initiated to maintain normal blood pressure. The day after the procedure, blood pressure was slightly decreased and the patient complained about shortness of breath and orthopnea. The inotrope dose was increased and intravenous furosemide infusion was initiated for symptom relief. Bedside TTE showed a left ventricle ejection fraction (LVEF) of 40%, akinesia on the posterior and lateral wall, and severe FMR without chords or papillary muscle rupture. Although the implementation of intensive medical therapy, non-invasive ventilatory support, and continuation of IABP for up to 5 days, restoration of stable hemodynamic condition and improvement on neither the degree of FMR nor the severity of pulmonary edema were not able to be achieved. Additionally, various types of arrhythmias

ABBREVIATIONS

ACS	Acute coronary syndrome
CAG	Coronary angiography
CX	Circumflex
FMR	Functional mitral regurgitation
IABP	Intra-aortic balloon pump
LAD	Left anterior descending artery
LMCA	Left-main coronary artery
LVEF	Left ventricle ejection fraction
MI	Myocardial infarction
SMR	Severe mitral regurgitation
TEER	Transcatheter edge-to-edge repair
TTE	Transthoracic echocardiography

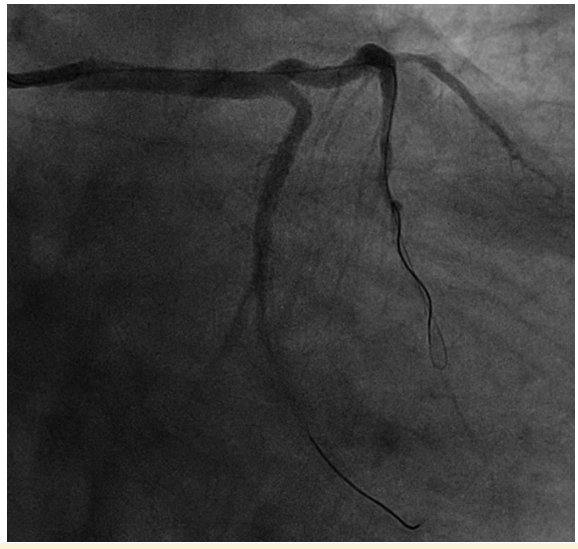

Figure 2. Right anterior-oblique-caudal image after stent implantation.

such as ventricular tachycardia and atrial fibrillation with rapid ventricular response causing hemodynamic instability occurred during the third day of follow-up. Transesophageal echocardiography (TEE) was performed in order to exclude visible thrombus prior to cardioversion. Transesophageal echocardiography revealed severe eccentric FMR with suitable anatomic features for TEER. Therefore, the heart team again came together to make a decision about how to resolve severe mitral regurgitation (SMR) and concluded to perform TEER with the MitraClip system instead of surgical repair considering the patient's poor hemodynamic status and very high risk for surgery. Intraoperative TEE confirmed the severe posterior eccentric FMR (Video 6 and 7), and TEER of the mitral valve was successfully performed with implantation of 3 MitraClips following interatrial septal puncture (Figure 3A, B, C). Marked reduction on FMR was observed in the TEE at the final of the procedure with a mean gradient of 4 mmHg. Both hemodynamic and clinical dramatic responses were observed early after the procedure. Inotropic and diuretic doses were gradually decreased, pulmonary edema was finally resolved, and weaning of the IABP was achieved 2 days later. He was discharged within 1 week after TEER and completed near 1-year follow-up uneventfully under medical therapy with maintaining favorable functional class and mild degree FMR.

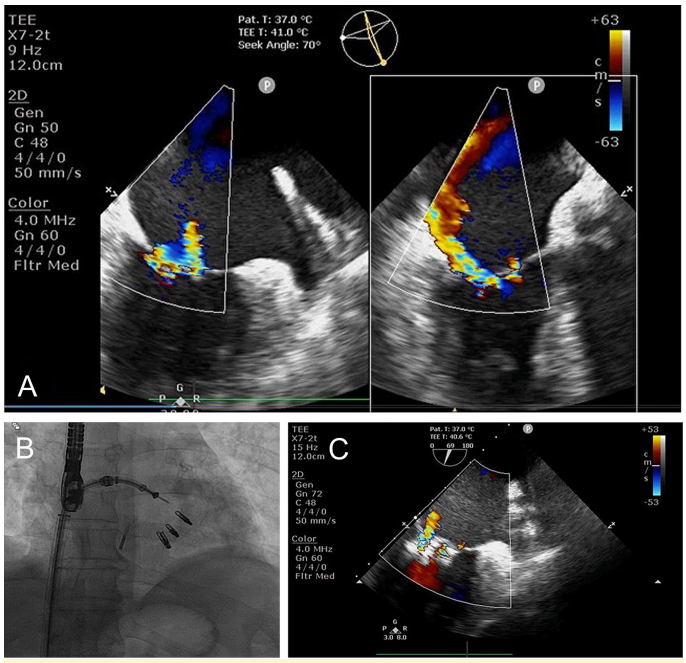

Figure 3. Initial TEE showed severe functional MR (A). Three MitraClips were successfully implanted (B) and a marked reduction was observed by TEE on the degree of MR at the final of the procedure (C). MR, mitral regurgitation; TEE, transesophageal echocardiography.

Discussion

Severe mitral regurgitation can occur due to either papillary muscle rupture or remodeling of the left ventricle after myocardial infarction (MI). Regardless of the underlying pathological mechanism, acute-onset SMR leads to hemodynamic compromise including depressed stroke volume, increased left ventricle end-diastolic, and left atrial pressure which may cause resistant pulmonary edema and even cardiogenic shock.[1] Therefore, patients with SMR early after ACS clearly have poor short- and long-term prognoses and need urgent treatment.[2] While surgical treatment is mandatory for acute SMR due to papillary muscle rupture, FMR is generally managed with intravenous diuretics, vasodilators, inotropes, invasive or non-invasive ventilation, and temporary hemodynamic support devices. According to the conventional approach, surgery is the last treatment option for unresponsive patients to extensive medical therapy although having an extremely high perioperative mortality risk of almost 25%.[3] Despite the data supporting the safety and efficacy of TEER with MitraClip system for acute severe FMR, the primary utilization of this device is still limited.

In this case report, early treatment with TEER, following medical therapy and IABP support, provided remarkable benefits in terms of clinical and hemodynamic parameters. A patient presenting with unstable chest pain and a hemodynamic compromise was initially treated with a double stent technique for the left main in order to restore coronary blood flow in the acute setting of MI. Following complete revascularization, severe FMR caused profound pulmonary edema resistant to both medical and mechanical supportive therapy. Due to the high surgical risk, percutaneous treatment of FMR was more feasible for an individual case. As expected, eliminating the SMR with TEER enabled to resolve pulmonary edema and keep the patient in a stable hemodynamic status. Moreover, the patient is still asymptomatic with medical therapy including low-dose oral furosemide and has maintained favorable functional class during mid-term follow-up.

Transcatheter edge-to-edge repair with MitraClip system is a promising intervention for symptomatic patients with chronic heart failure and severe FMR despite maximal medical therapy. However, patients with recent MI were excluded in large randomized trials showing the efficacy of TEER such as EVEREST II (Endovascular Valve Edge-to-Edge Repair Study)[4] and COAPT (Cardiovascular Outcomes Assessment of the MitraClip Percutaneous Therapy for Heart Failure Patients with Functional Mitral Regurgitation)[5] because FMR may recover after medical therapy and revascularization. Thus, the evidence-based high-level recommendation is missing yet for utilization of TEER for FMR early after MI.[3]

Few multicenter retrospective cohort studies relevant to percutaneous treatment of acute FMR after MI have been reported beyond case reports and single-center small case series.[6,7,8] Safety and feasibility of TEER in the acute setting of MI were initially reported.[9] Largest recent study has been reported by Haberman et al[10] which comprised 471 patients with SMR shortly after MI. Retrospective patient cohort was divided into 2 treatment arms as managed with conservative treatment (n=266) and interventional treatment (n=205). Of 205, 99 patients in the interventional arm were treated with TEER and the other 106 patients underwent surgical mitral valve repair. Patients who underwent intervention even in worse clinical status in terms of Killip class showed lower in-hospital and 1-year mortality than the conservative treatment group [11% vs. 27%, $P < 0.01$ and 16% vs. 35%, $P < 0.01$; adjusted hazard ratio (HR) 0.28, 95% CI 0.18–0.46, $P < 0.01$]. Moreover, patients treated with surgical repair demonstrated higher early and 1-year mortality than patients to whom TEER was performed (16% vs. 6%, $P=0.03$ and 31% vs. 17%, $P=0.04$; adjusted HR 3.75, 95% CI 1.55–9.07, $P < 0.01$). According to this study, patients managed with only medical therapy have the worst prognosis. Surgical mitral valve repair promises favorable long-term outcomes but has severe perioperative mortality risk during the acute phase of MI. Thus, percutaneous TEER seems to be effective in patients complicated with severe FMR during acute settings of MI and having poor clinical status and high surgical risk. Moreover, the safety and efficacy of TEER have been confirmed in patients with both LVEF <35% and LVEF ≥35%.[11] Transcatheter edge-to-edge repair demonstrated marked benefit regardless of either patients' initial hemodynamic status or degree of left ventricle systolic functions.[12] In our presented case, the patient deteriorated both hemodynamically and clinically due to acute SMR although having LVEF ≥35%. Acute SMR due to papillary muscle rupture as a mechanical complication of acute MI is excluded in previous studies; however, TEER with MitraClip system might be feasible in this indication according to the limited number of case reports.[13-15]

Elimination of the SMR percutaneously or surgically is pivotal. Additionally, utilization of hemodynamic support devices such as

IABP, Impella, percutaneous ventricular assist devices, or extracorporeal membrane oxygenation before intervention may be considered in selected cases for promoting left ventricle stroke volume and systemic perfusion.[16] Intra-aortic balloon pump, which was immediately implanted in the present case, increases coronary blood flow and reduces myocardial ischemia but has a very limited effect on stroke volume.[17] A novel circulatory support device Impella promises better efficacy during cardiogenic shock. Furthermore, Impella facilitates hemodynamics during the MitraClip procedure; hence combining these 2 devices is safe and feasible as reported previously.[18-20]

Conclusion

In our case report, safety and efficacy of TEER were confirmed for acute severe FMR early after MI which is related to poor prognosis and needs urgent management. Transcatheter edge-to-edge repair may be considered as an alternative treatment strategy in selected patients with high risk for surgery.

Peer-review: Externally peer-reviewed.

Informed Consent: Written informed consent was obtained from all participants.

Author Contributions: Conception: A.H.; Design: A.H.; Supervision: B.B.; Fundings: İ.O.K.; Materials: A.Y.; Data Collection and/or Processing: İ.O.K., A.Y.; Analysis and/or Interpretation: A.Y.; Literature Review: İ.O.K.; Writing: A.H.; Critical Review: İ.A.

Declaration of Interests: The authors declare that they have no competing interest.

Funding: The authors declare that this study had received no financial support.

Video 1: Initial diagnostic angiography of the left coronary system from right anterior-oblique-caudal view.

Video 2: Initial diagnostic angiography of the left coronary system from anterior-oblique-cranial view.

Video 3: Initial diagnostic angiography of the right coronary artery from left anterior-oblique view.

Video 4: Final angiography from right anterior-oblique-caudal view after stent implantation.

Video 5: Final angiography from right anterior-oblique-cranial view after stent implantation.

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