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Special article

Edge-to-edge therapy in acute mitral regurgitation. Proposal for a management protocol of the Ischemic Heart Disease and Acute Cardiac Care, Interventional Cardiology, and Cardiovascular Imaging Associations of the Spanish Society of Cardiology

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ABSTRACT

The approach to patients with acute mitral regurgitation poses a therapeutic challenge. These patients have a very high morbidity and mortality rate, thus requiring a multidisciplinary approach. This document presents the position of 3 associations involved in the management of these patients: the Ischemic Heart Disease and Acute Cardiovascular Care Association, the Interventional Cardiology Association, and the Cardiac Imaging Association. The document discusses aspects related to patient selection and care, technical features of the edge-to-edge procedure from both the interventional and imaging unit perspectives, and the outcomes of this process. The results of mitral repair and/or replacement surgery, which is the first-line treatment option to consider in these patients, have not been included as they exceed the scope of the aims of the document.

Keywords: Mitral regurgitation. Acute myocardial infarction. Left ventricular ejection fraction. Papillary muscle rupture. Transcatheter edge-to-edge mitral valve repair.

Tratamiento de borde a borde en la insuficiencia mitral aguda. Propuesta de protocolo asistencial de las Asociaciones de Cardiopatía Isquémica y Cuidados Agudos Cardiovasculares, de Cardiología Intervencionista y de Imagen Cardiaca de la Sociedad Española de Cardiología

RESUMEN

El tratamiento de los pacientes con insuficiencia mitral aguda supone un reto terapéutico. Estos pacientes tienen una morbimortalidad muy elevada, que requiere un abordaje multidisciplinario. El presente documento recoge el posicionamiento de tres asociaciones implicadas en el tratamiento de estos pacientes: la Asociación de Cardiopatía Isquémica y Cuidados Agudos Cardiovasculares, la Asociación de Cardiología Intervencionista y la Asociación de Imagen Cardiaca. Incluye aspectos relacionados con la selección y los cuidados del paciente, los aspectos técnicos del tratamiento de borde a borde desde el punto de vista intervencionista y de la imagen cardiaca, y los resultados de este proceso. No se han incluido los resultados de la cirugía de reparación o sustitución mitral, que es la primera opción terapéutica a considerar en estos pacientes, por exceder los objetivos del documento.

Palabras clave: Insuficiencia mitral. Infarto agudo de miocardio. Fracción de eyección del ventrículo izquierdo. Rotura del músculo papilar. Tratamiento de reparación percutánea de borde a borde.

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Abbreviations

LV: left ventricle. **MR:** mitral regurgitation. **PMR:** papillary muscle rupture. **TEER:** transcatheter edge-to-edge repair.

PATIENT SELECTION, OPTIMAL TIMING, AND MANAGEMENT IN THE CARDIAC INTENSIVE CARE UNIT

In severe acute mitral regurgitation (MR), the sharp increase in left ventricular (LV) end-diastolic volume leads to a rapid rise in LV and left atrial end-diastolic pressure. This ultimately results in marked pulmonary congestion and the development of acute pulmonary edema.[1] Concurrently, the large volume of regurgitation reduces forward flow and cardiac output. Patients with pre-existing MR and normal ventricles have better hemodynamic tolerance; conversely, those with with associated ischemia and ventricular dysfunction experience clinical worsening.[1,2]

The etiology of acute MR can be divided into 2 groups (table 1): ischemic and nonischemic. Ischemic causes include acute ischemia of the papillary muscle, its rupture in the context of acute myocardial infarction, ventricular remodeling, and increased leaflet traction and tethering. Nonischemic causes encompass chordal rupture in myxomatous valve disease and complications from interventional cardiology procedures. Other causes include endocarditis, trauma, and dynamic MR due to anterior systolic motion of the mitral valve in patients with hypertrophic or stress-induced cardiomyopathy.[2,3]

Patients with acute MR are usually symptomatic. The clinical presentation varies depending on the mechanism, speed of onset, presence of prior MR, and ventricular function. Flash pulmonary edema can occur in patients with dynamic MR and normal ventricular function, often due to increased afterload. In these patients, blood pressure may remain normal or be elevated.[1-4] The most severe form of severe acute MR is cardiogenic shock, which is. It commonly arises in patients with LV systolic dysfunction but can also develop in those with preserved ventricular function and sudden onset of MR due to papillary muscle rupture (PMR). In intermediate stages, patients may have acute pulmonary edema and maintained blood pressure without progressing to shock.[3,5]

The primary objective of treatment should be clinical and hemodynamic stabilization (figure 1). These patients should be promptly transferred to a tertiary referral center with specialized acute/intensive cardiac care units, cath labs, and cardiac surgery units. High-dose intravenous loop diuretics are the cornerstone of medical treatment, preferably administered in continuous infusion. Inotropic agents are recommended in patients with LV systolic dysfunction. In patients with normal or elevated blood pressure, intravenous vasodilators—mainly nitroprusside or nitroglycerin—are recommended because they reduce LV afterload and thereby mitigate MR severity.[6-8] The use of vasopressors is reserved to patients in cardiogenic shock with hypotension and persistent hypoperfusion despite inotropic therapy. Because these drugs increase afterload and may exacerbate MR, they should be administered at the lowest effective dose to maintain adequate tissue perfusion pressure.[1,7,8]

Noninvasive mechanical ventilation can be beneficial in patients experiencing flash pulmonary edema, commonly associated with hypertension. Positive pressure ventilation improves ventilation-perfusion matching, reduces alveolar edema, decreases dead space, and enhances pulmonary blood flow distribution. However, patients in cardiogenic shock due to severe acute MR require early orotracheal intubation and mechanical ventilation to achieve adequate stabilization, reduce adrenergic stimulation, and ensure effective oxygenation.[8]

Continuous and accurate monitoring of electrocardiographic, hemodynamic, and gasometric parameters is essential. This includes placing an arterial line for invasive arterial monitoring, establishing central venous access in patients with cardiogenic shock, measuring central venous pressure, continuously quantifying urine output, and performing gasometric checks at intervals tailored to the patient's clinical status. If there is inadequate response to diuretics, early initiation of continuous renal replacement therapy is recommended to promptly reduce pulmonary congestion.[9,10]

If initial pharmacological treatment fails and clinical and hemodynamic deterioration persists within the first 12 to 24 hours, consideration should be given to initiating mechanical circulatory support.[11] In such cases, consulting the center's shock team is recommended to collectively determine the most appropriate treatment sequence and select the device to be used. This decision should weigh 4 key factors: *a)* patient-related factors and comorbidities; *b)* the underlying cause and mechanism of MR, and ventricular function; *c)* the patient's hemodynamic status and severity of shock; and *d)* the center's experience. A detailed approach to circulatory support is beyond the scope of this document. Briefly, intra-aortic balloon pump may be useful in patients with myocardial infarction-induced MR in preshock conditions (stage B of the SCAI [Society for Cardiovascular Angiography and Interventions] classification, when the patient is hypotensive or tachycardic but maintains adequate tissue perfusion), or in early shock stages (stage C of the SCAI, when inotropes, vasopressors, or mechanical support are needed to maintain systemic perfusion).[12,13] In more advanced shock stages (stage D of the SCAI classification, when there is no response to measures established in the previous stage), and especially in the presence of PMR, the preferred device is peripheral venoarterial extracorporeal membrane oxygenation with or without LV unloading using an intra-aortic balloon pump or the Impella device (Abiomed, United States), with special caution required in cases involving PMR.[13,14] In patients with ischemic MR in the context of myocardial infarction due to papillary muscle ischemia or ischemic dilated cardiomyopathy, or LV dysfunction with preserved right ventricular function, Impella can be highly effective as it allows direct LV unloading, thus reducing LV end-diastolic pressures and MR while enhancing cardiac output[11] (figures 1 and 2 of the supplementary data). A key aspect to be considered is early initiation of mechanical circulatory support in patients with an indication to anticipate and prevent the onset of established multiple organ failure.

Coronary revascularization is strongly recommended when MR is associated with acute ischemia.[15] In the context of acute myocardial infarction and percutaneous revascularization, the severity of MR may vary from the acute phase near angioplasty to the most chronic stage. Nevertheless, the persistence of significant MR adversely affects patients' short- and mid-term prognosis.[16] Definitive treatment requires mitral valve replacement or repair.

Currently, the optimal timing for performing percutaneous coronary interventions in the mitral valve remains under debate. The

Table 1. Etiology, pathophysiology, and clinical presentation of acute mitral regurgitation

Etiology	Pathophysiology	Clinical presentation	Treatment
Papillary muscle ischemia	Increase in left ventricular end-diastolic pressure	Acute heart failure/acute pulmonary edema	Diuretics
Infarction-related papillary muscle rupture	Increase in left atrial pressure	Flash acute pulmonary edema	Inotropes (dobutamine, milrinone)
Ruptured chordae tendineae	Increase in pulmonary capillary wedge pressure	Cardiogenic shock	Vasodilators (nitroprusside) / vasopressors
Anterior systolic motion (obstructive hypertrophic cardiomyopathy, tako-tsubo syndrome)	Decreased output due to reduced antegrade flow		Revascularization
Dilated cardiomyopathy - secondary mitral regurgitation			Mechanical circulatory support (intra-aortic balloon pump, extracorporeal membrane oxygenator, Impella)
Endocarditis			Edge-to-edge repair
Trauma			Surgery
Perioperative complication			

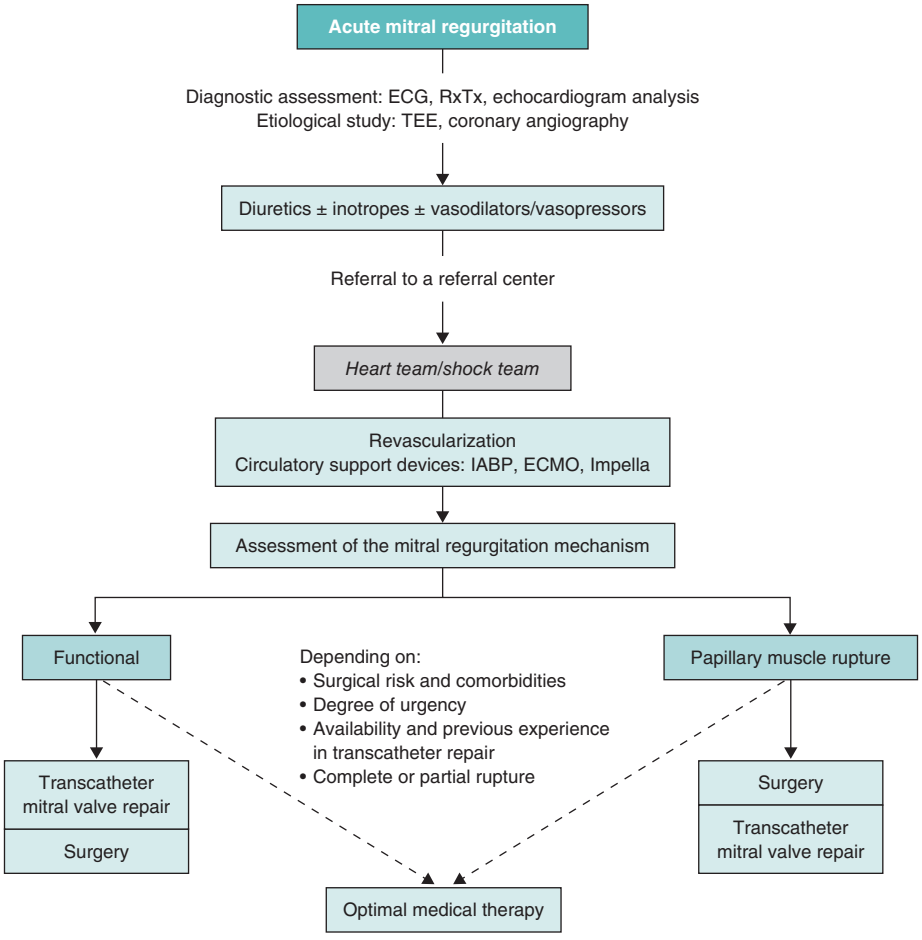
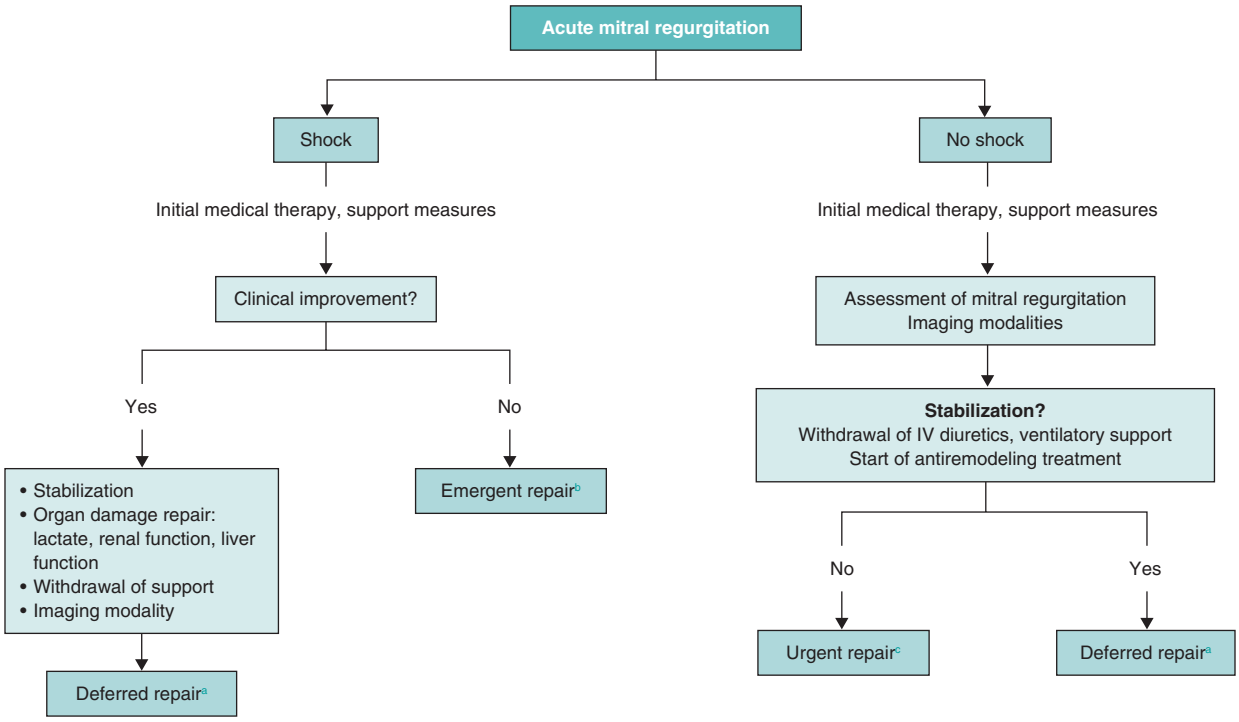


Figure 1. Treatment algorithm for acute mitral regurgitation. ECG, electrocardiogram; ECMO, extracorporeal membrane oxygenator; IABP, intra-aortic balloon pump; RxTx, chest X-ray; TEE, transesophageal echocardiography.

timing varies based on the underlying cause, ventricular function, and the patient's clinical status and any comorbidities. When the clinical and hemodynamic situation allows, a deferred implant is preferable. However, this is not always possible, and sometimes acute treatment of MR with edge-to-edge repair is necessary to stabilize the patient.



[a] Deferred repair: during hospitalization after adequate anatomical assessment of mitral regurgitation.
[b] Emergent repair: within the first 24 hours depending on the center logistics.
[c] Urgent repair: within the first 72 hours.

Figure 2. Optimal timing of mitral valve repair therapy.

Thus, in patients with flash pulmonary edema and normal LV function, in whom MR is usually associated with hypertension, and who respond well to medical treatment with oxygen therapy/noninvasive mechanical ventilation and diuretics, as well as in unstable patients with adequate treatment response, repair should be deferred. This deferred repair should occur after resolution of the acute heart failure, when the patient is in a state of euvolemia, and the diuretic dose has been adjusted.

In some patients with MR-related heart failure who cannot discontinue intravenous diuretic therapy, urgent repair within the first 72 hours should be considered. In the most severe cases—such as patients with MR in cardiogenic shock and inadequate response to treatment, and persistence of refractory shock—the feasibility of emergent mitral valve repair within the next 24 hours should be evaluated. Alternatives such as heart transplantation should also be considered (figure 2). In these more unstable patients, transcatheter repair can alter the severity spectrum, even with partial reductions in MR severity, facilitating the transition to a more stable condition that allows definitive treatment.[3]

ROLE OF IMAGING MODALITIES IN THE QUANTITATIVE ASSESSMENT OF ACUTE MITRAL REGURGITATION

A high level of suspicion is required to identify patients with significant acute-onset MR. Transthoracic echocardiography can be performed at the bedside, including in the emergency room, and should be the initial imaging method for evaluating acute dyspnea. Echocardiography is the preferred imaging modality to identify the underlying mechanism of MR and rule out other causes of a new systolic murmur in this clinical setting. Transesophageal echocardiography is often necessary to confirm the diagnosis, assess the severity of MR, and determine the treatment strategy, including identifying suitable candidates for edge-to-edge mitral valve repair (TEER) (figure 3).

Echocardiographic assessment should carefully evaluate the left ventricle (including ejection fraction, dimensions, and wall motion abnormalities), mitral valve anatomy (annulus, leaflets, chordae tendineae, and papillary muscles), and determine the etiology, mechanism, and severity of MR. Quantifying MR requires an integrated approach using qualitative, semiquantitative, and quantitative parameters as per current guidelines.[17,18] Color Doppler often shows markedly eccentric flow, which can underestimate MR severity. The vena contracta width and continuous-wave Doppler signal density are simple techniques to quickly assess significant MR. The velocity-time integral curve in continuous-wave Doppler typically has a triangular shape due to rapid late systolic deceleration, indicating an abrupt increase in left atrial pressure, known as a "v-wave". Ischemic MR is more pronounced in early and late systole due to opposing traction forces (systolic LV contraction). The severity of MR correlates with its holosystolic duration. However, some Doppler parameters may better evaluate chronic rather than acute MR. Hypotension and elevated left atrial pressure lead to a low transmitral gradient and reduced MR jet velocity on color Doppler, potentially underestimating or failing to detect MR. Anatomical features like flail leaflets, PMR, or a hyperdynamic left ventricle in pulmonary edema or cardiogenic shock should confirm the diagnosis, even when color Doppler does not show a large MR jet.

Echocardiography often reveals the underlying cause of acute MR. Among older patients, a frequent cause is chordal rupture associated with fibroelastic degeneration. Ischemic MR, resulting from leaflet tethering, is characterized by wall motion abnormalities in the region supplied by the culprit coronary artery, leading to leaflet tethering. This type of acute ischemic MR may occur during active or reversible myocardial ischemia and can resolve following

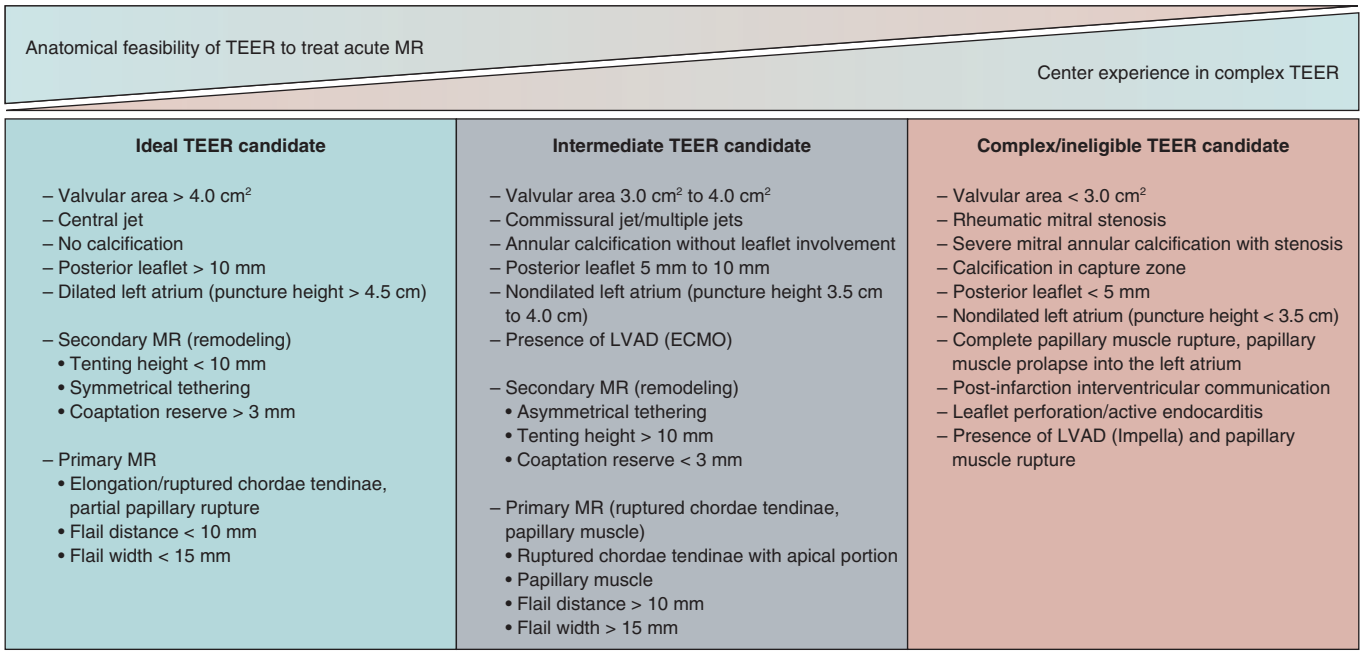


Figure 3. Eligibility assessment for transcatheter edge-to-edge mitral valve repair. ECMO, extracorporeal membrane oxygenator; LVAD, left ventricular assist device; MR, mitral regurgitation; TEER, transcatheter edge-to-edge repair.

ischemia treatment, highlighting the importance of reassessment postrevascularization.[19]

Acute MR due to LV remodeling occurs when the normal spatial relationship between the mitral valve apparatus and the left ventricle is distorted. Adverse remodeling of the left ventricle, characterized by dilation and shape change, causes one or both mitral leaflets to move apically and radially away from the ventricular center, driven outward by the displacement of papillary muscles secondary to remodeling. This pattern is most clearly observed in apical 3- and 4-chamber views.[20] The leaflets are typically normal in the acute phase, but a remodeling process with increased thickness has been described during follow-up.[21] The mitral annulus may also be dilated, a feature more commonly seen in nonacute MR cases. While both regional and global remodeling can lead to MR, the specific location of the remodeling is critical. Inferolateral myocardial infarctions are more likely to be associated with significant MR than anterior myocardial infarctions.[19] The differences between regional and global remodeling typically result in different tethering patterns. Patients with symmetrical tethering exhibit central jets, and those with asymmetrical tethering, eccentric jets.

The most severe form of acute MR is PMR. Common 2-dimensional echocardiographic features include a flail mitral leaflet with severed chordae or a papillary muscle head moving freely within the left heart. Due to differences in coronary vascular anatomy, posteromedial PMR is more common than anterolateral PMR. New-onset leaflet prolapse during the acute phase of myocardial infarction may indicate imminent PMR requiring careful attention. LV function often becomes hyperdynamic due to a sudden decrease in afterload, whereas regional wall motion abnormalities may be subtle or overlooked. Color Doppler assessment typically shows eccentric MR, which can lead to- underestimation of its severity.

TRANSCATHETER INTERVENTION IN ACUTE MITRAL REGURGITATION

To date, surgical treatment remains the primary approach for acute MR, despite the selective nature of patients in surgical studies and the limitations of observational evidence. In the SHOCK Trial Registry, only 38% of postmyocardial infarction acute MR patients complicated by cardiogenic shock underwent mitral valve surgery, with a mortality rate of 40% in these cases.[22] Similarly, a study examining evaluated the presence of PMR in a large cohort of patients with MR found that only 57.5% underwent surgical treatment,[23] a decision influenced by the patients' age, comorbidities, and clinical stability. This group of patients had a 36% mortality rate. Even among those who underwent surgery, outcomes were suboptimal due to early mortality, high transfusion rates, renal insufficiency, and prolonged mechanical ventilation.[24]

Therefore, developing less invasive approaches to address MR in this context, where patients often have a high surgical risk, is crucial to potentially expand the number of patients benefiting from MR correction.

Transcatheter techniques for treating MR have seen significant advancements in recent years. Among all available devices, transcatheter edge-to-edge repair (TEER) with the MitraClip system (Abbott Vascular, USA) is the most widely used and has accumulated extensive clinical experience. TEER with MitraClip has proven to be a safe and effective method for reducing MR in high-surgical-risk patients, and for improving symptoms, quality of life, and prognosis in those with functional and degenerative MR.[25-28] In the randomized CLASP IID trial,[29] the PASCAL Precision system (Edwards Lifesciences, United States) has also demonstrated safe and effective performance compared with MitraClip in patients with degenerative MR. Similarly, registry data have shown no significant differences with MitraClip in secondary MR.[30]

However, while most TEER procedures are performed in stable patients with advanced functional status and chronic MR, patients with acute MR are underrepresented in the literature. Acute MR represents a significant unmet need where the use of transcatheter interventions has grown significantly in recent years.

Increasing evidence supports the safety and efficacy profile of TEER in patients who develop severe symptomatic acute functional

MR. The EREMMI group (European registry of MitraClip in acute MR following an acute myocardial infarction) has published the largest series to date on this topic. The first article—published in 2020—revealed the European experience with MitraClip in this context.[31] The study included 44 patients with a mean age of 70 years and high surgical risk (median EuroSCORE II of 15.1%) from 2016 through 2018. Notably, the median time from acute myocardial infarction diagnosis to MitraClip intervention was 18 days, and from MR onset to treatment was 12.5 days, indicating insufficient stabilization with medical management alone. Patients were markedly symptomatic, with 63.6% classified as New York Heart Association (NYHA) class IV at the time of the procedure. In this series, technical success reached 86.6%. During follow-up, the 30-day mortality rate was 9.1%, a figure deemed acceptable considering that surgery for acute ischemic MR has the highest mortality rate among all surgical procedures performed for acute MR.[32] At 6 months, MR ≤ 2+ was reported in 72.5%, with 75.9% of surviving patients achieving NYHA functional class I-II.

Subsequently, the researchers examined the role of TEER in treating acute severe MR in a cohort of 93 patients with cardiogenic shock.[33] Technical success was high, and although 30-day mortality was higher among those in cardiogenic shock, the difference compared with nonshock patients was not statistically significant (10% vs 2.3%; $P = 0.212$). Conversely, mortality rates were markedly low in nonshock patients, even in a population at very high risk, highlighting the beneficial hemodynamic impact of percutaneous MR correction. Therefore, provided the TEER team has ample experience, cardiogenic shock should not preclude consideration of this therapeutic approach. These findings, together with recent insights into the efficacy of TEER in patients with shock,[34-36] should position this therapy as a viable strategy due to its safety and efficacy.

When comparing patients with a left ventricular ejection fraction above or below 35%, the study found no significant differences in either in-hospital mortality or at 1 year (11% vs 7%, $P = .51$, and 19% vs 12%, $P = .49$), nor in the 3-month rehospitalization rate. Therefore, the positive effect of transcatehter treatment is maintained in patients with lower ejection fractions.[37]

Finally, the most extensive analysis of the group compared 3 strategies for the management of MR early after infarction: conservative management, surgical intervention, and TEER.[38] The series included involved 471 patients, with 266 managed conservatively and 205 undergoing intervention (106 surgically and 99 with TEER). Consistent with prior research, medically managed patients experienced the highest mortality rates, twice that of the intervention groups. Notably, surgical correction resulted in poorer outcomes compared with MitraClip, with hospital mortality exceeding twice that at 1 year, largely driven by higher in-hospital mortality (16% vs 6%; $P = .03$). This trend was independent of the patients' surgical risk profiles.

In the context of PMR, the largest series treated with TEER has been reported.[39] The study included 23 patients, with a mean age of 68 years, and 56% were male. All were deemed ineligible for surgery due to high surgical risk. Nearly 90% were in cardiogenic shock, with 17 receiving mechanical circulatory support (11 with intra-aortic balloon pump, 2 with Impella, and 4 with venoarterial extracorporeal membrane oxygenation). Immediate success after the intervention was achieved in 87% of the patients, resulting in rapid hemodynamic improvement. Hospital mortality was 30%, which, while still high, was deemed acceptable given that these patients had no surgical options and faced poor prognoses with medical management alone. Importantly, 5 discharged patients underwent successful surgical mitral valve replacement during follow-up, highlighting the importance of stabilizing patients before considering deferred surgical interventions

In this scenario, guidelines and recommendations[40-42] advise transcatheter therapy only in selected high-risk patients who are unsuitable for surgery. However, due to the difficulty of decision-making, limitations in offering surgery more broadly, and the complexity of managing patients in cardiogenic shock, most patients should be evaluated by a shock team to consider various therapeutic options, including percutaneous interventions (figure 1).

There are several potential advantages to the trancatheter approach in the management of acute MR. These patients often show significant clinical deterioration, primarily due to the development of MR affecting a small and noncompliant left atrium. This leads to markedly elevated pulmonary pressures and a low effective ejection volume, which are the main physiological factors causing the disease. TEER induces almost immediate hemodynamic improvement by reducing MR. This decreases pressures in the left chambers and pulmonary artery, increases cardiac output, and facilitates faster recovery with minimal tissue damage.[43] Furthermore, TEER does not rule out scheduled cardiac surgery in the event of device failure or recurrent MR. Indeed, the role of TEER as a bridge to lower-risk surgery is appealing. In patients with poor progress, heart transplantation remains a viable option.

While outcomes with TEER in this condition are promising, evidence is currently limited to retrospective observational analyses of small patient populations. There may be selection bias among patients treated with TEER, as only those who responded well to medical therapy and cardiac support likely underwent the intervention. Long-term clinical and echocardiographic follow-up is also sparse. In additional, nearly all studies have included patients treated before 2020, before the introduction of newer generations of devices with independent capture capabilities or larger sizes, potentially limiting the effectiveness of TEER.

To provide more robust information on the appropriateness of this treatment for acute MR, ideally, prospective registries and a well-designed, executed randomized trial should be developed.

Currently, 2 very early-phase trials are underway that could shed light in this scenario. The international multicenter trial EMCAMI (Early Transcatheter Mitral Valve Repair After Myocardial Infarction; ClinicalTrials.gov: NCT06282042) was designed to prospectively evaluate the role of early treatment with MitraClip edge-to-edge repair vs conservative conventional treatment in acute MR occurring within 90 days of acute myocardial infarction, focusing on mortality and heart failure readmissions. The MINOS trial (Transcatheter Mitral Valve Repair for Inotrope Dependent Cardiogenic Shock; ClinicalTrials.gov: NCT05298124) will assess these treatment strategies in patients with cardiogenic shock and acute MR.

Technical and organizational considerations

The use of TEER in acute MR poses technical and organizational challenges, with several important considerations.

The left atrium is usually small and noncompliant. Therefore, transseptal puncture and positioning to achieve sufficient height above the valve can be complex and requires experience. Likewise, puncturing outside the fossa ovalis may be required. Systems allowing radiofrequency puncture for a precise entry point may be recommended for accurate placement.[44]

The complexity of valvular anatomy, especially in cases of primary MR in which large, wide gaps and commissural jets are common, suggests the use of the new features of the MitraClip G4 or PASCAL Ace devices,[45,46] which allow independent leaflet capture and optimization to improve outcomes. With these new generation devices, most cases are technically feasible. For primary MR due to posterior

medial prolapse, stabilizing the papillary muscle and controlling additional movement typically occurs after deploying multiple devices, preventing further tissue tears. Care must be taken to avoid device interference with the muscle and prevent additional damage or complete rupture in cases of partial tears.

Clinical deterioration can be rapid in some patients, raising the question of whether specialized mitral valve teams should be prepared to perform emergency treatment. If patients are too unstable for transfer, these teams may even need to travel to centers lacking such capabilities. In this context, teams should aim to initiate treatment within 24 hours of clinical deterioration for primary MR and patients in cardiogenic shock, and as promptly as feasible in other patients. These treatments should be considered within the framework of a "shock code", a concept still under development in many regions, and organized based on available resources.

CONCLUSIONS

Patients with acute MR require a multidisciplinary approach both for their diagnostic assessment and in decision-making about treatment strategy. TEER is an effective treatment option for acute MR, either as a definitive treatment or as a bridge to a more stable scenario for other treatments, with a high procedural success rate and improved patient prognosis in centers experienced with the technique. Proper patient selection, meticulous anatomical evaluation, and choosing the optimal timing for implantation are key to treatment success.

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STATEMENT ON THE USE OF ARTIFICIAL INTELLIGENCE

No artificial intelligence was used in the preparation of this article.

AUTHORS' CONTRIBUTIONS

All authors contributed to the writing of the text and its critical review, and approved the article final version.

CONFLICTS INTEREST

None declared.

SUPPLEMENTARY DATA

Supplementary data associated with this article can be found in the online version available at https://doi.org/10.24875/RECIC.M24000464.

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