

Percutaneous Mitral Valve Repair in Patients with Functional Mitral Regurgitation: A New Frontier in Heart Failure Therapy

Anjali Desai*

Department of Cardiology, University of Delhi, Delhi, India

Introduction

Functional Mitral Regurgitation (FMR) is a common condition in patients with Heart Failure (HF), particularly in those with left ventricular dysfunction. Unlike primary mitral regurgitation, where the mitral valve itself is structurally abnormal, FMR occurs due to distortion of the mitral valve apparatus, primarily as a result of left ventricular remodeling, including dilation and dysfunction. This condition leads to retrograde blood flow into the left atrium during systole, worsening symptoms of heart failure, including dyspnea, fatigue, and exercise intolerance. FMR is associated with a poor prognosis, with increased morbidity, hospitalization rates, and mortality, particularly when left untreated. Despite its significant clinical burden, management options for FMR have traditionally been limited to medical therapy aimed at controlling heart failure symptoms, with surgery reserved for cases of severe mitral regurgitation or end-stage heart failure. [1]

However, recent advances in percutaneous mitral valve repair techniques, such as the MitraClip procedure, have provided a promising option for treating FMR in high-risk patients who are not candidates for conventional surgery. The MitraClip, a device that clips together the leaflets of the mitral valve to reduce regurgitation, has shown encouraging results in improving symptoms and quality of life in patients with FMR. This intervention is minimally invasive and can be performed in patients with significant comorbidities, advanced age, or frailty—factors that typically preclude surgical intervention. As the understanding of the pathophysiology of FMR continues to evolve, the role of percutaneous mitral valve repair in this patient population is becoming increasingly important. This paper explores the emerging role of percutaneous mitral valve repair in the treatment of functional mitral regurgitation, its mechanisms, clinical outcomes, and the potential for improving long-term prognosis in heart failure patients. [2]

Description

Functional mitral regurgitation is a secondary condition that arises in the context of left ventricular dysfunction and remodeling. In this condition, the mitral valve leaflets fail to close properly due to the distortion of the valve apparatus, including annular dilation, leaflet tethering, and papillary muscle displacement. Unlike primary mitral regurgitation, which involves structural abnormalities of the valve itself, FMR is a consequence of impaired left ventricular function and geometry. The severity of FMR is often linked to the degree of left ventricular dilation and the extent of myocardial dysfunction. As the left ventricle dilates and its function deteriorates, the mitral valve annulus enlarges, and the mitral leaflets become increasingly tethered. This results in incomplete coaptation of the leaflets, allowing blood to flow backward into the left atrium during systole. FMR exacerbates symptoms of heart failure

by increasing pulmonary congestion and preload, thus contributing to the vicious cycle of heart failure progression. While medical therapies such as angiotensin-converting Enzyme Inhibitors (ACE inhibitors), beta-blockers, and diuretics are used to manage symptoms of heart failure, they do not address the underlying mitral regurgitation, leaving many patients with refractory symptoms and poor quality of life. [3]

Percutaneous mitral valve repair using devices such as the MitraClip represents a major advancement in the management of functional mitral regurgitation. The MitraClip procedure involves the placement of a clip on the mitral valve leaflets, which helps to reduce the gap between the leaflets and alleviate the regurgitation. The clip is introduced via a transcatheter approach, usually through the femoral vein, and positioned across the mitral valve using real-time echocardiographic guidance. By reducing mitral regurgitation, the MitraClip improves left ventricular loading conditions, reduces left atrial volume, and alleviates pulmonary congestion, thereby improving symptoms of heart failure. Studies, including the pivotal COAPT trial, have demonstrated that MitraClip therapy in patients with moderate-to-severe FMR significantly improves both functional capacity and quality of life, with a reduction in heart failure hospitalizations and a lower rate of mortality. This percutaneous approach is particularly beneficial in patients who are not candidates for conventional mitral valve surgery due to advanced age, frailty, or multiple comorbidities, offering a minimally invasive alternative to improve clinical outcomes in this high-risk population. [4]

The clinical outcomes of percutaneous mitral valve repair have shown promise in improving both short-term and long-term prognosis in heart failure patients with functional mitral regurgitation. Patients treated with the MitraClip have experienced significant reductions in mitral regurgitation, improvements in New York Heart Association (NYHA) functional class, and enhanced exercise tolerance. Furthermore, the procedure has been associated with a reduction in hospitalizations due to heart failure, reflecting its impact on overall heart failure burden. The COAPT trial, one of the largest studies on percutaneous mitral valve repair, demonstrated that MitraClip therapy was associated with a significant reduction in the composite of death from any cause or hospitalization for heart failure, compared with medical therapy alone. Additionally, the benefits of MitraClip therapy in patients with FMR have been shown to persist over time, with sustained improvements in quality of life and a reduced need for hospitalization at one-year follow-up. However, despite the promising results, the procedure is not without its limitations. The MitraClip procedure can be technically challenging, particularly in patients with complex mitral valve anatomy, and not all patients with FMR are candidates for this intervention. Additionally, the durability of the MitraClip's effects is still under investigation, and long-term follow-up is essential to fully assess the impact on heart failure progression, valve function, and survival. [5]

Conclusion

Percutaneous mitral valve repair represents an important breakthrough in the treatment of functional mitral regurgitation (FMR), particularly in high-risk patients with heart failure. The MitraClip procedure has demonstrated substantial benefits in improving symptoms, reducing hospitalizations, and enhancing quality of life in patients with severe FMR who are not candidates for surgery. By addressing the underlying pathophysiology of FMR—mitral valve dysfunction due to left ventricular remodeling—percutaneous mitral valve repair provides an effective solution for patients who would otherwise

*Address for Correspondence: Anjali Desai, Department of Cardiology, University of Delhi, Delhi, India; E-mail: anjali.desai@du.ac.in

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have limited treatment options. Long-term outcomes of MitraClip therapy show promise, with sustained improvements in functional status and reduced heart failure-related events. The results of large clinical trials, including the COAPT trial, have solidified the role of percutaneous mitral valve repair as a standard of care for select patients with FMR. However, challenges remain in identifying the optimal patient population, determining long-term durability, and addressing potential complications, such as residual mitral regurgitation or the need for repeat procedures. Ongoing studies and follow-up are essential to fully understand the long-term impact of percutaneous mitral valve repair on mortality, heart failure progression, and overall survival. With further advancements in technology and patient selection, percutaneous mitral valve repair is likely to become a cornerstone of heart failure therapy, offering a minimally invasive option that can improve outcomes and quality of life for patients with functional mitral regurgitation.

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