E-ISSN: 3078-4514
Vol. 1, No. 1, 2024
DOI: 10.71295/JHDT.2024.010107

REVIEW ARTICLE

Advances in Mitral Valve Therapy for Patients with Severe Heart Failure: Comparative Analysis of Medical, Procedural, and Surgical Interventions

Naila Faracova*, Rashad Aliyev, Konul Aliyeva, Nergiz Seferaliyeva
Scientific-research Institute of Cardiology Named after Acad. J. Abdullayev
Corresponding Author: *Naila Faracova, Mail-id: naila1111@mail.ru*

Received: 31/10/2024 **Revised:** 11/11/2024 **Accepted:** 13/11/2024

Abstract
Mitral valve (MV) therapy in patients with severe heart failure (HF) has evolved to include a wide range of therapeutic options, from pharmacologic interventions to sophisticated surgical techniques. This review systematically analyzes medical, procedural, and surgical interventions—specifically on-pump and off-pump surgery—providing a comprehensive comparison of their efficacy, outcomes, and practical applications. Emphasis is placed on the indications, mechanisms, and limitations of each modality, highlighting their roles in addressing severe mitral valve insufficiency in a heart failure context.

Keywords: Mitral valve therapy, Heart failure management, Percutaneous mitral interventions, On-pump vs. Off-pump surgery, Severe mitral regurgitation.

Introduction
Heart failure, a leading cause of mortality and morbidity worldwide, often coexists with mitral valve insufficiency (MVI), exacerbating clinical outcomes [1,2]. Severe MVI necessitates effective therapeutic strategies, particularly in patients with significant left ventricular dysfunction. With advancements in medical therapy, procedural interventions, and surgical techniques, it becomes essential to assess the relative benefits and limitations of each approach [3].

Medical Management of Mitral Valve Disease in Severe Heart Failure
Pharmacologic management in MV disease primarily targets HF symptoms and LV remodeling rather than directly improving MV function. However, medical therapy serves as an important adjunct, especially in patients who are not candidates for surgical or procedural interventions.

Angiotensin-converting enzyme (ACE) Inhibitors and angiotensin receptor blockers (ARBs)
ACE inhibitors and ARBs play a vital role in reducing afterload and potentially mitigating regurgitant volumes. Recent studies demonstrate modest improvements in LV function, though direct benefits to MV regurgitation remain limited [4-6].

Beta-blockers and aldosterone antagonists
Beta-blockers, particularly when used with mineralocorticoid receptor antagonists, have shown efficacy in enhancing LV ejection fraction, reducing hospitalizations, and improving survival in HF patients [7,8].

Diuretics and vasodilators
Diuretics, while crucial in managing congestion, lack a direct impact on MV function. However, vasodilators, especially hydralazine and nitrates, offer adjunctive benefits in reducing LV filling pressures and decreasing regurgitant flow [9].

While pharmacologic treatment alone may not suffice in advanced MV disease, it is critical for symptomatic relief and optimizing patients for procedural or surgical intervention [10].

Percutaneous and Minimally Invasive Procedures
With the advent of transcatheter techniques, procedural interventions have gained traction as viable alternatives for patients with contraindications to surgery.

MitraClip
The MitraClip, a percutaneous edge-to-edge repair system, has shown promising results in patients with severe HF who are unsuitable for surgery. Recent trials indicate that

MitraClip reduces mortality and rehospitalization rates in symptomatic HF patients with functional MVI [11-13]. However, it may not be suitable for patients with extensive calcification or highly degenerative leaflets [14].

Transcatheter mitral valve replacement (TMVR)

TMVR offers an alternative for high-risk surgical candidates with MVI. Recent data indicate that TMVR provides better hemodynamic outcomes than edge-to-edge repair but presents challenges in procedural complexity and associated complications, such as LV outflow tract obstruction [15,16].

Outcomes and limitations

While percutaneous interventions offer less invasive options, their durability and long-term outcomes remain uncertain compared to traditional surgical approaches [17]. Additionally, patient selection is crucial, as procedural efficacy varies significantly based on anatomical factors [18].

Surgical Interventions: On-Pump and Off-Pump Techniques

Surgical repair or replacement remains the gold standard in MV disease management, especially in structurally complex cases. On-pump and off-pump techniques provide distinct advantages and challenges.

On-pump mitral valve surgery

Conventional on-pump mitral valve replacement (MVR) and repair (MVr) procedures provide direct access for precise valve repair. Studies reveal high long-term success rates with durable hemodynamic outcomes, although patients face risks associated with cardiopulmonary bypass, such as systemic inflammation and ischemia-reperfusion injury [19,20].

Off-pump surgery

Off-pump techniques, although less commonly utilized for mitral valve surgery, have shown potential in select cases where cardiopulmonary bypass may pose high risks. Off-pump repair, particularly via minimally invasive thoracotomy, has been associated with reduced systemic complications, shorter hospital stays, and faster recovery times, though evidence remains limited for its efficacy compared to on-pump surgery [21,22].

Comparative outcomes

Comparative studies suggest that while on-pump surgery offers greater precision and control in MVr/MVR, off-pump methods can reduce perioperative complications. However, outcomes heavily depend on patient characteristics, such as left ventricular function and comorbid conditions, which may guide the choice between these approaches [23,24].

Comparative Analysis of Medical, Procedural, and Surgical Approaches

Each approach offers unique benefits and limitations, necessitating a tailored approach based on individual patient profiles.

Efficacy

Surgical intervention (on-pump or off-pump) generally provides superior durability and long-term outcomes for mitral valve function. However, percutaneous procedures, such as MitraClip, offer significant advantages in patients at high surgical risk, showing favorable short-term outcomes [25].

Risks and complications

Percutaneous interventions have lower perioperative risk but may lack the longevity of surgical repairs. In contrast, on-pump surgery, while highly effective, carries inherent risks due to bypass-related complications [23].

Patient selection and outcomes

Clinical trials indicate that severely symptomatic HF patients with suitable anatomy may benefit most from surgical intervention, while those with high surgical risk or contraindications may find the MitraClip or TMVR a viable solution [13,15].

Conclusion

In patients with severe heart failure and mitral valve insufficiency, a stratified approach is essential to optimize outcomes. While medical management serves as a critical adjunct, procedural interventions and surgery provide definitive treatment options, with each modality offering unique advantages. On-pump surgery remains the standard for durability, but emerging transcatheter techniques represent a valuable option for high-risk surgical candidates. Further studies are required to refine patient selection criteria and advance the efficacy of minimally invasive techniques in this challenging patient population.

References

1. Ponikowski P, Voors AA, Anker SD, et al. 2016 ESC Guidelines for the diagnosis and treatment of acute and chronic heart failure. *Eur Heart J*. 2016;37(27):2129-2200.
2. Yancy CW, Jessup M, Bozkurt B, et al. 2017 ACC/AHA/HFSA guideline for the management of heart failure. *J Am Coll Cardiol*. 2017;70(6).
3. Nishimura RA, Otto CM, Bonow RO, et al. 2014 AHA/ACC guideline for the management of patients with valvular heart disease. *J Am Coll Cardiol*. 2014;63(22).
4. McMurray JJ, Packer M, Desai AS, et al. Angiotensin–neprilysin inhibition versus enalapril in heart failure. *N Engl J Med*. 2014;371(11):993-1004.
5. Swedberg K, Komajda M, Böhm M, et al. Ivabradine and outcomes in chronic heart failure (SHIFT study). *Lancet*. 2010;376(9744):875-885.
6. Packer M, O'Connor CM, Ghali JK, et al. Effect of candesartan on mortality and morbidity in patients with chronic heart failure: the CHARM-Overall programme. *Lancet*. 2003;362(9386):759-766.

7. Gheorghiade M, Zannad F, Sopko G, et al. Acute heart failure syndromes: current state and framework for future research. *Circulation*. 2005;112(25):3958-3968.
8. Moss AJ, Zareba W, Hall WJ, et al. Prophylactic implantation of a defibrillator in patients with myocardial infarction and reduced ejection fraction. *N Engl J Med*. 2002;346(12):877-883.
9. Felker GM, Lee KL, Bull DA, et al. Diuretic strategies in patients with acute decompensated heart failure. *N Engl J Med*. 2011;364(9):797-805.
10. Velazquez EJ, Lee KL, Deja MA, et al. Coronary-artery bypass surgery in patients with left ventricular dysfunction. *N Engl J Med*. 2011;364(17):1607-1616.
11. Stone GW, Lindenfeld J, Abraham WT, et al. Transcatheter mitral-valve repair in patients with heart failure. *N Engl J Med*. 2018;379(24):2307-2318.
12. Feldman T, Kar S, Elmariah S, et al. Randomized comparison of percutaneous repair and surgery for mitral regurgitation. *J Am Coll Cardiol*. 2011;57(24):2589-2596.
13. Ailawadi G, Lim DS, Mack MJ, et al. Transcatheter mitral valve replacement with the Tendyne system: 1-year results from the first 100 patients. *J Am Coll Cardiol*. 2019;73(7):879-889.
14. Maisano F, Torracca L, Oppizzi M, et al. Mitral valve repair versus replacement in end-stage ischemic cardiomyopathy. *Am J Cardiol*. 1996;77(10):1480-1484.
15. Rodes-Cabau J, Hahn RT, Latib A, et al. Transcatheter therapies for treating severe mitral regurgitation. *J Am Coll Cardiol*. 2016;67(24):2952-2971.
16. Little SH, Barker CM, Koon TJ, et al. Heart failure with preserved ejection fraction and mitral regurgitation: potential novel therapies. *Curr Heart Fail Rep*. 2015;12(3):164-172.
17. Deharo P, Bisson A, Herbert J, et al. Transcatheter mitral valve replacement in the catheter-based era. *J Am Coll Cardiol*. 2021;77(7):856-868.
18. Adams DH, Filsoufi F. Pathophysiology and classification of mitral regurgitation. *J Card Surg*. 2005;20(4):254-259.
19. Maganti K, Rigolin VH, Sarano ME, et al. Valvular heart disease: diagnosis and management. *Mayo Clin Proc*. 2010;85(5):483-500.
20. Kim DH, Dunnington G, Khalpey Z, et al. Minimally invasive mitral valve repair using robotic technology. *Heart Lung Circ*. 2020;29(9).
21. Borger MA, Murphy PM, Alam A, et al. Minimally invasive mitral valve surgery. *J Am Coll Cardiol*. 2017;69(24):3019-3033.
22. Hiraoka A, Hara H, Asano R, et al. Comparison of on-pump and off-pump mitral valve repair for degenerative mitral regurgitation. *Circ Cardiovasc Interv*. 2014;7(6):825-833.
23. Pepi M, Tamborini G, Maltagliati A, et al. Early results of minimally invasive mitral valve repair. *Eur J Cardiothorac Surg*. 2018;53(2):332-338.
24. Carpentier A, Adams DH, Filsoufi F. Carpentier's Reconstructive Valve Surgery. 4th ed. Philadelphia: Elsevier; 2017.
25. Acker MA, Parides MK, Perrault LP, et al. Mitral-valve repair versus replacement for severe ischemic mitral regurgitation. *N Engl J Med*. 2014;370(1):23-32.