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Mitral Valve Repair in Nursing Care

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Abstract

Background: Mitral valve disease, particularly mitral regurgitation and mitral stenosis, represents a significant cause of cardiovascular morbidity and mortality worldwide. Mitral valve repair is widely recognized as the preferred therapeutic option for degenerative mitral valve disease due to its superior clinical outcomes compared with valve replacement.
Aim: This paper aims to review mitral valve repair with a focus on its anatomical considerations, clinical indications, surgical techniques, complications, and the essential role of nursing care in optimizing patient outcomes.
Methods: A comprehensive narrative review was conducted using current clinical guidelines and evidence-based literature addressing mitral valve anatomy, pathology, indications for repair, operative techniques, postoperative complications, and interprofessional nursing management.
Results: Mitral valve repair demonstrates reduced operative mortality, improved preservation of left ventricular function, and enhanced long-term survival, especially in primary degenerative mitral regurgitation. Early surgical intervention, accurate patient selection, and experienced surgical teams are key factors influencing success. Nursing and allied health interventions significantly contribute to postoperative recovery, complication prevention, and patient education.
Conclusion: Mitral valve repair remains the gold standard for suitable patients with mitral valve disease. Integrating surgical expertise with comprehensive nursing care improves clinical outcomes, promotes recovery, and enhances quality of life.
Keywords: Mitral valve repair, mitral regurgitation, mitral stenosis, nursing care, cardiac surgery

Introduction

Mitral valve (MV) repair remains the preferred intervention for degenerative mitral valve disease, offering superior outcomes compared with replacement in appropriately selected patients. Surgical repair is associated with lower operative mortality, improved preservation of left ventricular function, and enhanced long-term survival when performed at experienced centers. The success of MV repair depends not only on the surgical technique but also on patient-specific factors, including preoperative functional status, the severity of mitral regurgitation (MR), comorbidities, and the expertise of the operating surgeon. Early recognition and timely surgical intervention are critical, as delayed repair in symptomatic patients is associated with progressive ventricular remodeling, heart failure, and increased perioperative risk. In high-risk populations, decision-making requires balancing surgical intervention against percutaneous or conservative management strategies, guided by individual risk profiles and available institutional expertise [1]. Mitral valve pathology is prevalent, affecting approximately 2% to 3% of the adult population in the United States. Degenerative MR is the most common form in developed countries and is associated with significant morbidity and mortality if left untreated. Symptomatic patients with severe MR

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demonstrate annual mortality rates up to 34% without surgical correction [2][3]. Conversely, mitral stenosis (MS), primarily of rheumatic origin, is less amenable to repair, and percutaneous mitral balloon commissurotomy (PMBC) or valve replacement often constitutes the treatment of choice. In such cases, repair is generally not feasible due to extensive valvular and subvalvular involvement [1].

MR is classified as primary or secondary, reflecting the etiology of valvular incompetence. Primary MR originates from structural abnormalities of the leaflets, chordae tendineae, or papillary muscles, whereas secondary MR results from left ventricular dilation and remodeling, typically in the context of ischemic or non-ischemic cardiomyopathy. Surgical repair remains the gold standard for severe primary MR, particularly in degenerative disease, with the goals of restoring leaflet coaptation, preserving ventricular function, and minimizing long-term complications. Percutaneous repair and replacement techniques, such as transcatheter edge-to-edge repair, are increasingly utilized in high-risk patients or those deemed unsuitable for conventional surgery. Mitral valve replacement is considered in cases of papillary muscle rupture, failed prior repair, extensive degenerative disease, or ischemic MR, where durable repair is unlikely [4]. In summary, mitral valve repair offers clear advantages in degenerative disease, including improved survival, functional outcomes, and ventricular preservation. Optimal results rely on early diagnosis, careful patient selection, and management within specialized centers with multidisciplinary cardiac expertise [1][2][3][4].

Anatomy and Physiology of the Mitral Valve

The mitral valve (MV) is a complex cardiac structure that ensures unidirectional blood flow from the left atrium (LA) to the left ventricle (LV) during diastole and prevents regurgitation during systole. The MV apparatus consists of the annulus, two leaflets, three types of chordae tendineae, and two papillary muscles. The annulus, a saddle-shaped "D"-shaped structure, forms the junction between the LA, LV, and the mitral leaflets and provides structural support for leaflet coaptation [5]. The annulus is especially susceptible to dilatation along the posterior leaflet, which is thinnest at this junction. Blood supply to the mitral apparatus is provided by the left circumflex artery laterally and the coronary sinus posteriorly, both contributing to the perfusion of the valve leaflets [6]. The leaflets are asymmetric, with the anterior leaflet being tall and narrow and the posterior leaflet shorter and broader. The anterior leaflet occupies approximately two-thirds of the valvular area but only one-third of the annular circumference, whereas the posterior leaflet occupies the remaining annular area. Each leaflet is divided into three scallops—A1, A2, A3 for the anterior and P1, P2, P3 for the posterior leaflet—meeting at the anterolateral and posteromedial commissures. Coaptation of the leaflets typically measures 7–9 mm, ensuring effective valve closure and normal hemodynamics. The posterior leaflet is more prone to prolapse due to its attachment to the ventricular free wall, making it more vulnerable to the stresses of ventricular contraction [7][8]. Chordae tendineae anchor the leaflets to the papillary muscles and are classified as primary, secondary, or tertiary based on their insertion. Primary chordae attach to the free leaflet margin to prevent prolapse, secondary chordae insert on the rough leaflet surface, and tertiary chordae attach to the basal portion. The two papillary muscles, anterolateral and posteromedial, receive dual or single coronary artery supply, respectively, and are critical for synchronized leaflet motion [7]. Normal MV area ranges between 4–6 cm², and abnormalities can lead to LV remodeling, dilation, and arrhythmias. Mitral valve anomalies are increasingly recognized in hypertrophic cardiomyopathy (HCM). Anterior displacement of the mitral valve, elongated leaflets, and papillary muscle abnormalities contribute to systolic anterior motion (SAM) and LV outflow tract (LVOT) obstruction. In HCM, the anterior mitral leaflet (AML) may exceed 30–40 mm, altering coaptation and creating distal AML angulation during systole. Papillary muscle anomalies, including hypertrophy, increased numbers, or direct leaflet insertion, are prevalent in over 50% of HCM patients [9][10]. Degenerative, myxomatous, and restrictive changes in MV anatomy are commonly observed in HCM, affecting leaflet mobility and chordal function [11].

Physiology of Mitral Stenosis and Mitral Regurgitation

Mitral stenosis (MS) and mitral regurgitation (MR) represent distinct pathophysiological entities arising from disruption of normal MV function. MS, most commonly caused by rheumatic heart disease, restricts blood flow from the LA to the LV. Chronic inflammation leads to leaflet thickening, commissural fusion, chordal shortening, and a "hockey-stick" appearance of the anterior leaflet on echocardiography. MS increases LA pressure, which can cause atrial enlargement, atrial fibrillation, pulmonary hypertension, right ventricular (RV) failure, and reduced LV filling. Echocardiographic assessment of MS includes measuring the mean diastolic transmitral gradient, valve area, and chamber sizes. Severe MS is defined by a mean gradient $\geq$10 mm Hg or valve area $\leq$1.5 cm², with very severe MS characterized by valve area $\leq$1 cm² [12][13][14][15]. MR involves retrograde blood flow during systole, producing volume overload in the LA and LV. It is classified as primary, arising from intrinsic leaflet or chordal pathology, or secondary, due to LV remodeling and mitral annular dilation. Mitral valve prolapse (MVP) is a primary cause, especially in low-resource countries, whereas degenerative disease predominates in high-income regions [16]. Acute MR results in sudden volume overload, pulmonary edema, and cardiogenic shock, often seen in papillary muscle rupture, infective endocarditis, or post-myocardial infarction. Chronic MR progresses through compensated, transitional, and decompensated stages, leading to LV remodeling, LA enlargement, arrhythmias, and thromboembolic risk. Functional classifications, such as Carpentier's leaflet-motion system, guide surgical decision-making [17][18].

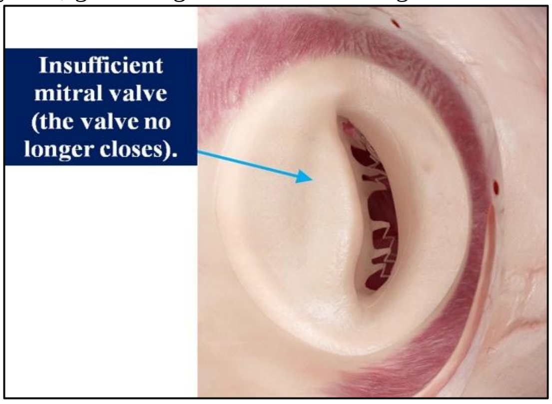

Fig. 1: Insufficient Mitral Valve.

Echocardiography is the standard modality for MR evaluation, using color Doppler to assess regurgitant jet area relative to the LA. Severe MR is indicated by a jet exceeding 40% of the LA area, peak mitral inflow velocity >120 cm/sec, and diastolic pulmonary venous flow reversal [19]. Prognostic indicators include global longitudinal strain, beta natriuretic peptide levels, exercise tolerance, and RV systolic pressure. Timely surgical intervention in severe MR with preserved LV function is critical to prevent adverse remodeling and improve long-term outcomes [20]. Ischemic MR, arising from LV dysfunction due to coronary artery disease, represents a functional subtype where repair outcomes are less predictable. Papillary muscle displacement, leaflet tethering, and impaired coaptation contribute to regurgitation. While repair offers advantages in primary MR, ischemic MR may necessitate valve replacement, although subvalvular procedures have improved repair durability [17]. In summary, the MV is a dynamic and intricately structured apparatus whose anatomy and physiology are central to maintaining efficient cardiac function. Structural abnormalities or acquired lesions disrupt normal hemodynamics, resulting in clinical conditions such as MS or MR, which require careful assessment and management. Understanding the detailed morphology, functional mechanisms, and pathophysiological adaptations is critical for accurate diagnosis, surgical planning, and prognostication in patients with mitral valve disease.

Indications for Mitral Valve Repair

Mitral valve repair is a cornerstone intervention in the management of mitral valve disease, with indications guided by the American College of Cardiology (ACC) and American Heart Association (AHA) clinical practice guidelines. These guidelines emphasize timely intervention to prevent progressive cardiac remodeling, preserve left ventricular (LV) function, and improve long-term survival. The indications vary according to the underlying pathology, whether mitral stenosis (MS) or mitral regurgitation (MR), as well as symptomatology, ventricular function, and comorbidities [21].

Mitral Stenosis

Mitral stenosis is most commonly associated with rheumatic heart disease, though other etiologies such as congenital valve abnormalities, radiation-induced valvulitis, and degenerative processes can contribute. Percutaneous mitral balloon commissurotomy (PMBC) remains the preferred first-line intervention in suitable patients due to its minimally invasive nature and excellent outcomes. Surgical mitral valve repair or commissurotomy is reserved for cases where PMBC is not feasible, such as when valve anatomy is unfavorable, there is extensive leaflet calcification, or contraindications such as left atrial thrombus exist. According to ACC/AHA guidelines, mitral valve repair is indicated in symptomatic patients with severe MS (valve area ≤1.5 cm^2) when PMBC is not an option (class I recommendation). Surgical intervention is also considered in patients with severe MS who develop new-onset atrial fibrillation or recurrent systemic embolization (class IIa), particularly when percutaneous intervention is contraindicated. Additionally, patients with asymptomatic severe MS who develop pulmonary hypertension, defined as pulmonary artery systolic pressure exceeding 50 mm Hg, are candidates for surgical repair or replacement when PMBC is inappropriate (class IIa). In select patients with moderate MS (valve area >1.5 but <2 cm^2) who are symptomatic and have concurrent cardiac surgical indications, such as coronary artery bypass grafting (CABG), mitral valve repair may also be considered (class IIb) [21].

Mitral Regurgitation

Mitral regurgitation, particularly primary MR resulting from degenerative or myxomatous valve disease, is often best treated with surgical repair rather than replacement due to superior preservation of LV function, lower perioperative morbidity, and improved long-term survival. The ACC/AHA guidelines emphasize early intervention in symptomatic and select asymptomatic patients to prevent irreversible LV remodeling. Surgical repair is strongly recommended for symptomatic individuals with severe primary MR and preserved LV function (ejection fraction [EF] >30%) (class I). Asymptomatic patients with severe primary MR who exhibit evidence of LV dysfunction, defined as LVEF ≤60% or LV end-systolic diameter ≥40 mm, are also candidates for early mitral valve repair to prevent progression to heart failure (class I). In patients with severe primary MR who develop atrial fibrillation or resting pulmonary hypertension, even if asymptomatic and with preserved LV function, mitral valve repair is indicated as a class IIa recommendation. Early repair may also be considered in asymptomatic patients with normal LV function if the likelihood of a durable repair is high, particularly in centers with established high success rates (class IIa) [21]. Secondary or functional MR, resulting from LV remodeling or ischemic heart disease, has different considerations. Severe secondary MR in patients undergoing concomitant cardiac surgery, such as CABG or aortic valve replacement, may be addressed with mitral valve repair (class IIb), though replacement may be preferable in ischemic MR depending on LV geometry and function. Similarly, moderate secondary MR in patients undergoing other cardiac surgical procedures may warrant mitral valve repair or replacement to optimize long-term outcomes and reduce the risk of persistent regurgitation (class IIa). Functional MR in the context of LV dysfunction requires careful evaluation, as repair durability can be limited by continued ventricular remodeling, and individualized decision-making is critical [21]. Overall, mitral valve repair is indicated across a spectrum of clinical scenarios where the benefits of intervention outweigh the risks. In MS, repair or commissurotomy is primarily considered when percutaneous options are unsuitable or ineffective. In MR, particularly primary degenerative disease, repair is strongly favored, with early surgical intervention recommended to prevent progressive LV dilation and heart failure. Secondary MR requires individualized assessment in the context of concurrent cardiac disease and LV remodeling. The decision-making process integrates symptom severity, ventricular function, hemodynamic consequences, and the likelihood of durable repair. These guideline-based recommendations aim to optimize long-term survival, reduce adverse remodeling, and preserve functional status in patients with mitral valve disease.

Contraindications

Mitral valve repair requires careful patient selection, with a cardiac surgeon experienced in valve procedures performing a comprehensive preoperative evaluation. Assessment should include coronary artery status, comorbid conditions, prior surgical history, and overall operative risk. The Society of Thoracic Surgeons (STS) risk calculator is commonly used to quantify perioperative mortality and morbidity, providing objective guidance in surgical decision-making [22]. Absolute contraindications are rare, but relative contraindications are common in patients with complex comorbidities. Severe mitral annular calcification, extensive aortic calcification, or significant right ventricular dysfunction can increase surgical risk. Advanced left ventricular (LV) dysfunction is another consideration, as repair restores valve competence, which increases afterload and may unmask true LV performance previously masked by regurgitation. Pulmonary comorbidities, including severe emphysema or restrictive lung disease, as well as longstanding pulmonary hypertension, further elevate surgical risk. Individualized assessment balances the potential benefits of repair with these physiologic and anatomic limitations.

Equipment

Mitral valve repair is performed under cardiopulmonary bypass, with the vast majority of cases requiring full cardiac arrest to allow a bloodless, stable operative field. Standard open cardiac surgical instruments are used, including retractors, scissors, forceps, needle drivers, and specialized valve repair devices such as annuloplasty rings, chordal replacement systems, and leaflet repair tools. Precision instruments for leaflet plication or resection are also employed depending on the surgical technique. Intraoperative imaging is essential for successful repair. Transesophageal echocardiography (TEE) provides real-time assessment of valve morphology, leaflet motion, regurgitant severity, and ventricular function before and after repair. TEE also allows immediate detection of residual regurgitation or functional abnormalities, guiding surgical correction prior to chest closure. Adequate perfusion equipment, including a cardiopulmonary bypass machine, oxygenators, and monitoring systems, is critical to ensure patient safety during cardiac arrest and systemic circulation management.

Personnel

Mitral valve repair necessitates a multidisciplinary, highly skilled surgical team. At a minimum, the operative team comprises a cardiac surgeon with extensive mitral valve experience, a cardiac anesthesiologist proficient in perioperative hemodynamic management, a perfusionist managing cardiopulmonary bypass, a surgical assistant, and scrub and circulating nurses. The team coordinates in real time to ensure precise, efficient, and safe repair procedures. Postoperatively, specialized care is required in an intensive care unit. Critical care intensivists monitor hemodynamics, ventilatory support, and recovery. Cardiologists assess cardiac function and guide postoperative management, while physical therapists support early mobilization and rehabilitation. Social workers, advanced practice nurses, and bedside nursing staff provide patient education, discharge planning, and ongoing support. Effective communication among all team members is essential to reduce complications, optimize recovery, and ensure long-term valve function.

Preparation

Preoperative preparation for patients undergoing mitral valve repair requires a comprehensive evaluation of patient-specific risks, procedural considerations, and comorbid conditions. A detailed medical history and focused physical examination are essential, with attention to cardiovascular status, previous cardiac events, and the presence of comorbidities such as diabetes, hypertension, pulmonary disease, and renal insufficiency. Diagnostic studies, including echocardiography, coronary angiography, and laboratory assessments, provide crucial information on valve morphology, ventricular function, and hemodynamic status. Additional consultations with cardiology, nephrology, or pulmonology may be necessary depending on patient complexity [23]. Cardiac risk stratification is based on preoperative stability, ventricular function, and recent ischemic events. Low-risk patients are hemodynamically stable and scheduled for elective procedures without prior myocardial infarction. Intermediate-risk patients may present with recent infarction but maintain stability with medical management, including anticoagulation and antiplatelet therapy. High-risk patients exhibit hemodynamic compromise after acute events, often requiring inotropic support or mechanical circulatory assistance [23]. Ventricular function assessment is critical, as preoperative left or right ventricular dysfunction informs anesthetic planning, intraoperative monitoring, and postoperative management. Pulmonary hypertension, defined as a mean pulmonary artery pressure exceeding 25 mm Hg at rest, significantly increases perioperative morbidity and mortality, necessitating careful intraoperative hemodynamic control [23].

Cerebrovascular risk is particularly relevant in patients with atherosclerotic disease of the proximal aorta or carotid arteries, as manipulation during surgery can precipitate embolic strokes. Preoperative interventions may include antiplatelet therapy, statins, and beta-blockers, with vascular surgery consultation for patients at high stroke risk [24]. Nonmodifiable risk factors, including advanced age, female sex, baseline renal insufficiency, anemia, prior transient ischemic attacks, and history of tobacco use, should be carefully considered. Renal impairment increases the likelihood of perioperative acute kidney injury, while anemia is associated with higher transfusion requirements and increased postoperative morbidity [25]. Optimization of systemic conditions is integral to preparation. Patients with hypertension should maintain chronic oral antihypertensives, excluding ACE inhibitors or ARBs, until surgery. Diabetic patients require strict glucose control to avoid perioperative hypo- or hyperglycemia. Pulmonary optimization, including management of chronic obstructive pulmonary disease and smoking cessation, reduces perioperative respiratory complications [26]. Nutritional status and engagement in rehabilitation programs improve postoperative recovery, particularly in older patients. Procedural considerations, such as anticipated aortic cross-clamp time, cardiopulmonary bypass duration, and institutional or surgeon procedural volume, correlate with operative risk [27]. Medical therapy for mitral valve pathology is maintained preoperatively to stabilize hemodynamics. Diuretics reduce pulmonary congestion, beta-blockers control heart rate, and vasodilators decrease afterload to enhance forward cardiac output and improve mitral valve coaptation. Anticoagulation is indicated in patients with atrial fibrillation to reduce thromboembolic risk. These measures aim to optimize the patient's condition prior to surgical intervention, ensuring a safer operative course and improved postoperative outcomes.

Technique or Treatment

Mitral valve repair (MV repair) is designed to restore competent valve function, optimize hemodynamics, and prevent progressive ventricular remodeling in patients with mitral stenosis (MS) or mitral regurgitation (MR). Advances in surgical techniques, minimally invasive approaches, and percutaneous interventions have allowed repair strategies to prioritize valve preservation whenever feasible. Optimal repair is tailored to the patient's anatomy, valve pathology, comorbidities, and surgeon expertise, with the overarching goal of maintaining durable valve function while minimizing perioperative risk.

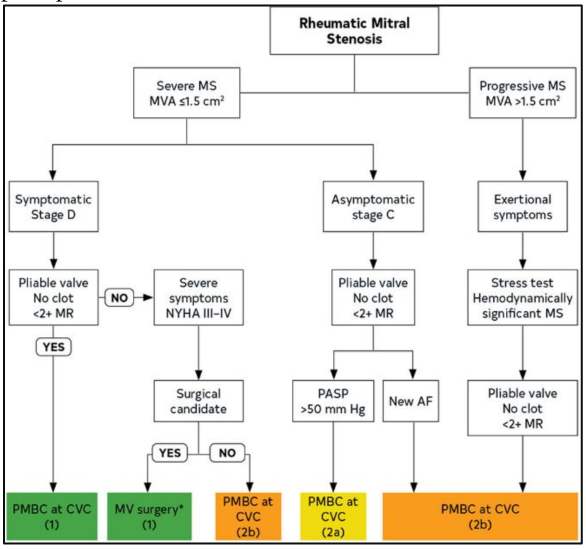

Fig. 2: Treatment flowchart of mitral stenosis.

Standard Mitral Valve Repair

Conventional mitral valve repair is performed under full cardiopulmonary bypass with cardioplegic arrest. Common approaches include median sternotomy, right thoracotomy, and robotic-assisted techniques. The choice of approach is often dictated by concomitant procedures such as coronary artery bypass grafting (CABG) or multi-valve surgery. Median sternotomy remains the standard approach for complex cases requiring additional interventions. Cannulation for cardiopulmonary bypass is achieved via the ascending aorta and bicaval venous access. Cardioplegic arrest is induced antegrade and retrograde, followed by left atriotomy through the interatrial groove or a transseptal approach. Valve inspection includes systematic assessment of leaflet morphology, chordal integrity, and annular dimensions. Surgical repair strategies depend on the specific lesion: isolated P2 prolapse may be corrected by triangular or quadrangular resection with ring annuloplasty, or via neochordae implantation to restore leaflet coaptation. Ring annuloplasty is generally recommended for all repairs to maintain annular geometry and prevent recurrent MR. Correct sizing of the annuloplasty ring is critical, as undersizing can induce systolic anterior motion and left ventricular outflow tract obstruction. The ideal coaptation depth approximates 1 cm.

Carpentier and Lawrie Techniques

Carpentier's repair technique emphasizes anatomical and functional restoration through leaflet resection, annular stabilization, and chordal preservation. Quadrangular resection combined with rigid annuloplasty corrects annular dilatation while maintaining valve competence. Lawrie's approach focuses on functional repair, sparing leaflet tissue and chordae, using flexible annuloplasty rings and artificial chordae when required. Both techniques aim to optimize coaptation, minimize leaflet stress, and preserve left ventricular function. Long-term outcomes of Carpentier repair show high freedom from reoperation in patients with posterior, anterior, and bileaflet prolapse, demonstrating durability and stability over decades. Functional optimization during repair, including preload and afterload management, reduces atrioventricular dyssynchrony and postoperative systolic anterior motion [28][30].

Percutaneous Mitral Balloon Commissurotomy

Percutaneous mitral balloon commissurotomy (PMBC) is indicated in patients with favorable valve morphology, minimal MR (<2+), and no left atrial thrombus. Balloon catheters are advanced across the mitral valve, and inflation separates fused commissures. Suitability for PMBC is guided by valve mobility, calcification, subvalvular fusion, and anatomic scoring systems. Patient age, New York Heart Association class, and atrial rhythm also inform procedural selection and predict outcomes [31].

Commissurotomy

Surgical commissurotomy remains the standard intervention for rheumatic MS with favorable anatomy. Closed commissurotomy is performed without direct visualization, while open commissurotomy allows extensive repair under direct exposure. In cases of severe leaflet thickening, subvalvular fibrosis, or tethering, mitral valve replacement may be indicated. Concomitant procedures, including tricuspid valve repair and atrial fibrillation ablation, improve long-term outcomes when performed alongside mitral surgery [31].

Minimally Invasive Mitral Valve Surgery

Minimally invasive mitral valve surgery (MIMVS) includes partial sternotomy, right thoracotomy, and video-assisted or robotic-assisted approaches. Cannulation is usually via femoral vessels. MIMVS reduces surgical trauma, blood loss, transfusion requirements, mechanical ventilation duration, and ICU stay while facilitating faster recovery. Studies demonstrate equivalent short- and mid-term outcomes compared to conventional surgery in terms of mortality, stroke, and repair durability. Robotically-assisted MIMVS provides 3-dimensional visualization and allows precise leaflet and subvalvular manipulation but carries higher operative costs [32][33].

Transapical Beating-Heart Mitral Valve Repair

Transapical beating-heart repair, utilizing polytetrafluoroethylene (PTFE) neochordae, is an innovative approach for early posterior leaflet prolapse. Access is via a small left anterolateral thoracotomy at the cardiac apex, avoiding cardiopulmonary bypass. Echocardiography guides chordal length adjustment to optimize leaflet coaptation. This technique is particularly useful in patients with minimal annular dilation and limited ventricular remodeling. Early results demonstrate procedural safety and effective MR correction. The omission of ring annuloplasty in percutaneous approaches is associated with poorer long-term outcomes, emphasizing careful patient selection [33]. Mitral valve repair encompasses a spectrum of surgical and percutaneous interventions, all aimed at restoring normal valve function while preserving ventricular geometry. Standard repair via cardiopulmonary bypass remains the cornerstone for complex lesions, while minimally invasive and transapical techniques offer alternatives for select patients, reducing morbidity and promoting faster recovery. Long-term durability relies on appropriate surgical technique, annuloplasty, chordal management, and careful patient selection, with evolving percutaneous options expanding the treatment landscape for patients unsuitable for conventional surgery.

Complications of Mitral Valve Repair

Recurrent mitral regurgitation (MR) remains the most frequent complication following primary mitral valve repair, significantly affecting patient outcomes. Hemodynamic monitoring, particularly pulmonary capillary wedge pressure (PCWP) and left atrial (LA) pressures, provides critical insight into valve function postoperatively. The a wave and v wave on pressure tracings reflect atrial filling and compliance, with large v waves strongly associated with severe MR. Acute MR, such as that caused by chordae tendineae rupture, can produce giant v waves, often exceedingly twice the mean PCWP. Severe mitral paravalvular leaks may elevate LA pressures, contribute to pulmonary hypertension, and precipitate right heart failure. Prompt closure of these leaks typically results in immediate reductions in v wave amplitude and mean LA pressure, improved echocardiographic regurgitation grade, and rapid relief of pulmonary and right ventricular strain [34].

Intraoperative transesophageal echocardiography (TEE) is essential for assessing valve repair adequacy. Persistent mild or greater MR identified during TEE requires immediate consideration for re-repair or valve replacement. This decision is especially critical in patients with impaired left ventricular (LV) function, as these individuals may not tolerate prolonged ischemic periods or repeated cardioplegic arrest. Despite technically successful repair, long-term durability remains unpredictable. Flameng et al reported that only 50% of patients remained free from mitral incompetence seven years post-repair [35]. Similarly, Chikwe et al found no long-term survival benefit in patients over 60 undergoing concomitant CABG [36], and octogenarians with nonrheumatic disease showed comparable outcomes between repair and replacement [37]. STS database analysis of over 8,500 repairs and 3,500 replacements confirmed reduced operative mortality in the repair cohort, regardless of chordal preservation [38].

Postoperative atrial fibrillation (AF) and preexisting pulmonary hypertension are significant predictors of reduced survival and compromised repair longevity [39]. AF occurs in up to 24% of patients with previously normal sinus rhythm, particularly in the presence of LA enlargement, and is associated with increased mortality [40]. To mitigate this, surgical ablation of AF during mitral valve repair is increasingly performed. STS data indicate that 32.2% of patients presenting for repair have AF, with 61.5% undergoing concomitant ablation [41]. Gillinov et al reported that AF ablation increased freedom from AF at one year (63.2% versus 39.4%) without affecting mortality, though pacemaker implantation was more frequent in the ablation group [42]. Systolic anterior motion (SAM) is another notable complication, typically arising when annular size and leaflet tissue are mismatched. SAM results from anterior mitral valve leaflet motion into the LV outflow tract during systole, often triggered by undersized annuloplasty rings or excess leaflet tissue [43]. It can cause residual MR and LV outflow obstruction, which are detectable on intraoperative TEE. Management includes optimization of ventricular filling, atrioventricular pacing to improve synchrony, and reduction of hypercontractility. Postoperative beta-blocker therapy can also help mitigate SAM-related hemodynamic compromise. Long-term freedom from MR varies based on the affected leaflet: 65–80% at 12 years, with recurrence rates of 9.8% in patients with Barlow disease [44][45].

Iatrogenic injury to the circumflex artery is rare but serious due to its proximity to the anterolateral mitral commissure. The risk is increased in Barlow disease, where annular dilatation and leaflet hypermobility complicate identification of the artery's course. Reported incidence ranges from 0.3% to 1.8%, with iatrogenic myocardial infarction occurring slightly more often after repair (2.2%) than replacement (1.7%), and minimally invasive approaches do not reduce this risk [18]. Immediate surgical revascularization is preferred if detected intraoperatively, whereas postoperative percutaneous coronary intervention (PCI) is often employed for delayed recognition. Surgical intervention remains necessary if PCI fails due to technical limitations [46][47]. Atrioventricular (AV) groove disruption represents a catastrophic complication, typically arising from excessive posterior leaflet excision or annular stretch. The incidence is approximately 1.2% in mitral valve replacements, with mortality up to 75% [48]. Repair can be performed internally or externally, though internal approaches are generally preferred despite technical challenges in exposure. Age-related annular calcification and fragile tissue increase risk, and preserving the posterior leaflet and basal chordae can reduce AV groove rupture likelihood. Certain AV dissociations may be managed via atriotomy, but complete ruptures carry high mortality due to proximity to the circumflex artery and the complexity of exposure [49]. In summary, complications following mitral valve repair range from recurrent MR, SAM, and postoperative AF to iatrogenic coronary injury and AV groove disruption. Early recognition and management are essential for optimizing outcomes, and intraoperative TEE is critical for identifying residual MR or structural complications. Long-term repair durability depends on patient age, preoperative ventricular function, annular size, leaflet pathology, and surgical technique, with ongoing surveillance required to detect and address recurrence or hemodynamic compromise. These complications highlight the importance of careful patient selection, meticulous surgical technique, and comprehensive perioperative monitoring to minimize morbidity and mortality following mitral valve repair.

Clinical Significance

Degenerative mitral valve disease is the leading cause of mitral regurgitation (MR) in older adults. Mitral valve repair remains the gold standard for managing degenerative MR and is strongly endorsed by current American and European guidelines. Both guideline sets use identical criteria to define left ventricular (LV) dysfunction in primary MR, with a left ventricular ejection fraction (LVEF) below 60% or an LV end-systolic diameter above 40 mm considered indicative of impaired function. There is strong agreement regarding the timing of intervention: symptomatic patients with severe primary MR should undergo surgery as a class I recommendation, regardless of LV function, and asymptomatic patients with early LV dysfunction are also candidates for early repair. Mitral valve repair is preferred over replacement due to superior long-term outcomes, preservation of ventricular function, and lower operative risk. Early repair prevents progressive volume overload, myocardial remodeling, and subsequent heart failure. In high-risk or surgically challenging patients, minimally invasive mitral valve surgery (MIMVS) and transcatheter repair technologies expand treatment options while minimizing operative stress. These approaches enable timely intervention in patients who might otherwise be poor candidates for conventional open-heart procedures, helping preserve cardiac function and improve long-term survival [50].

Enhancing Healthcare Team Outcomes

MR is the second most prevalent valvular heart disease after aortic stenosis and requires a coordinated interprofessional approach for optimal management. In industrialized countries, degenerative MR is most commonly caused by myxomatous degeneration or fibroelastic deficiency, resulting in leaflet prolapse. Mitral valve repair is preferred over replacement when feasible and durable. Without intervention, MR can lead to progressive LV decompensation and increased mortality, particularly in patients with symptomatic heart failure and reduced LVEF. Patient selection is critical, as severe leaflet calcification, advanced disease, or challenging anatomy may preclude repair or reduce its durability. Surgical outcomes are heavily influenced by the experience of the surgeon and the procedural volume of the center. Collaboration with cardiac anesthesia, the use of intraoperative transesophageal echocardiography (TEE), and adherence to procedural guidelines are essential. Current recommendations advocate performing repairs in Heart Valve Centers of Excellence (HVCE), where higher procedural volumes, advanced imaging, and systematic outcome reporting enhance both safety and repair success. Evidence indicates that centers performing fewer than 25 repairs annually have lower repair rates, higher 1-year mortality, and increased need for reoperation [51][52][53]. A multidisciplinary team at HVCEs should include cardiologists, anesthesiologists, intensivists, and specialty nurses, ensuring comprehensive perioperative management, accurate diagnostics, and adherence to clinical guidelines. Research and procedural innovation are integral to maintaining high standards and improving patient outcomes.

Nursing, Allied Health, and Interprofessional Team Interventions

Nursing care is central to the postoperative management of mitral valve repair patients. Nurses provide continuous assessment, monitor vital signs and neurological status, track fluid balance, and ensure compliance with prescribed medications. They oversee mediastinal drainage and assess wound integrity, while coordinating daily lab review and radiographic imaging. Nursing interventions also focus on patient education, promoting understanding of disease processes, encouraging ambulation, and guiding incentive spirometry to reduce pulmonary complications. Nutritional guidance supports recovery and strengthens cardiac function. Allied health professionals, including physiotherapists, occupational therapists, and respiratory therapists, collaborate to optimize mobility, respiratory function, and overall rehabilitation. Pharmacists play a key role in medication management, especially for anticoagulation, heart failure therapy, and postoperative pain control. Interprofessional collaboration ensures that each team member contributes their expertise, enhancing patient safety, reducing complications, and improving functional recovery. Structured teamwork supports timely intervention, reinforces adherence to evidence-based guidelines, and fosters patient-centered care, ultimately improving quality of life and long-term outcomes following mitral valve repair [51][52].

Conclusion:

Mitral valve repair plays a critical role in the management of mitral valve disease and is strongly favored over valve replacement in appropriately selected patients. Its advantages include preservation of left ventricular function, reduced perioperative mortality, and superior long-term survival outcomes. Early diagnosis and timely surgical intervention are essential to prevent irreversible ventricular remodeling and heart failure, particularly in patients with severe mitral regurgitation. Successful outcomes depend not only on advanced surgical techniques and institutional expertise but also on comprehensive interprofessional collaboration. Nursing care is central to postoperative management, encompassing continuous monitoring, early detection of complications, patient education, medication management, and rehabilitation support. Through evidence-based nursing interventions and coordinated teamwork, patient safety and recovery are significantly enhanced. Ultimately, integrating surgical excellence with holistic nursing care ensures optimal functional outcomes and improved quality of life for patients undergoing mitral valve repair.

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