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TECHNICAL CHARACTERISTICS AND OUTCOMES OF TOTALLY ENDOSCOPIC MITRAL VALVE REPAIR FOR ISOLATED POSTERIOR LEAFLET LESIONS: A SINGLE-CENTER STUDY

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ABSTRACT

Objective: This study aimed to describe repair techniques and evaluate early and mid-term outcomes of totally endoscopic mitral valve repair for primary mitral regurgitation caused by isolated posterior leaflet lesions.

Methods: A retrospective descriptive study was conducted on 183 consecutive patients with primary mitral regurgitation caused by isolated posterior leaflet lesions who underwent totally endoscopic mitral valve repair at the Cardiovascular Center, E Hospital, from January 2021 to June 2025. Patients with rheumatic mitral disease, anterior leaflet involvement, bileaflet lesions, or intraoperative conversion to mitral valve replacement were excluded. Surgical techniques were selected according to lesion morphology and included triangular resection, quadrangular resection, folding repair, commissural repair, vegetation resection, annular decalcification, artificial chordal implantation, and annuloplasty when indicated. Early postoperative outcomes and mid-term follow-up results were analyzed.

Results: The mean age was 55.7 ± 12.6 years, and 67.2% of patients were male. Severe mitral regurgitation was present in 97.8% of patients before surgery. Carpentier type II dysfunction predominated, accounting for 96.7% of cases. The most frequent lesion was chordal rupture, observed in 85.8%, and P2 was the most commonly involved segment. Triangular resection, quadrangular resection, and folding repair were the most frequently used repair techniques. The mean aortic cross-clamp and cardiopulmonary bypass times were 72 ± 24 minutes and 120 ± 30 minutes, respectively. Early mortality occurred in one patient, representing 0.5%. Predischarge echocardiography showed no moderate or severe residual mitral regurgitation. At mid-term follow-up, available in 169 patients, 97.0% remained free from moderate-or-greater recurrent mitral regurgitation, and only one patient required reoperation.

Conclusion: Totally endoscopic mitral valve repair for isolated posterior leaflet lesions is feasible, safe, and effective. In appropriately selected patients, this approach provides excellent early repair quality, low perioperative morbidity, and favorable mid-term durability.

Keywords: *Endoscopic mitral valve repair; posterior leaflet; mitral regurgitation; minimally invasive cardiac surgery; mitral valve repair; degenerative mitral valve disease.*

1. INTRODUCTION

Mitral regurgitation is one of the most common acquired valvular heart diseases requiring surgical treatment. In primary mitral regurgitation, degenerative valve disease is the predominant etiology, and posterior leaflet prolapse, particularly involving the P2 segment, represents the most frequent anatomical lesion. The posterior leaflet is conventionally divided into three scallops: P1 (lateral), P2 (middle), and P3 (medial). Because of its localized and reproducible morphology, isolated posterior leaflet disease is considered one of the most favorable substrates for mitral valve repair [1,2].

Mitral valve repair has become the preferred surgical treatment for degenerative mitral regurgitation whenever a durable repair is feasible. Compared with mitral valve replacement, repair preserves the native subvalvular apparatus, maintains left ventricular function, avoids prosthesis-related complications, and reduces the need for long-term anticoagulation. In patients with posterior leaflet lesions, standard repair techniques such as triangular resection, quadrangular resection, sliding plasty, folding repair, artificial chordal implantation, and ring annuloplasty have been widely used with excellent long-term results [1,3].

Traditionally, mitral valve repair has been performed through median sternotomy. Although this approach provides excellent exposure and reliable outcomes, it is associated with greater surgical trauma, postoperative pain, longer recovery, and potential sternal complications. Over the past three decades, minimally invasive and endoscopic approaches have increasingly been adopted for mitral valve surgery. Video-assisted and totally endoscopic mitral valve repair through a right mini-thoracotomy allows surgeons to perform complex intracardiac procedures while avoiding sternotomy [4,5]. This approach may offer several advantages, including reduced surgical trauma, better cosmetic results, earlier mobilization, shorter recovery time, and improved patient satisfaction [6,7].

However, totally endoscopic mitral valve repair requires a dedicated surgical team, standardized peripheral cardiopulmonary bypass, appropriate myocardial protection, adequate left atrial exposure, and precise endoscopic repair techniques. The learning curve remains an important issue, especially when dealing with complex anterior leaflet or bileaflet disease. In this context, isolated posterior leaflet lesions represent an appropriate anatomical group for standardizing an endoscopic mitral repair program, because the lesions are usually localized and the repair techniques are relatively reproducible [8,9].

In Vietnam, minimally invasive and endoscopic mitral valve surgery has been developed in several major cardiovascular centers. Nevertheless, most domestic studies have reported early experience or mixed populations of mitral valve surgery, including both repair and replacement, or different types of mitral valve lesions. Data focusing specifically on totally endoscopic mitral valve repair for isolated posterior leaflet lesions remain limited. A dedicated analysis of this subgroup may provide valuable information regarding lesion characteristics, repair strategy, perioperative safety, and mid-term durability in the Vietnamese clinical setting.

The Cardiovascular Center of E Hospital has implemented minimally invasive and totally endoscopic mitral valve repair for more than a decade. Based on accumulated experience and a standardized surgical workflow, this study aimed to describe repair techniques and evaluate early

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and mid-term outcomes of totally endoscopic mitral valve repair for primary mitral regurgitation caused by isolated posterior leaflet lesions at our center.

2. MATERIALS AND METHODS

2.1. Study design and patients

This was a retrospective descriptive study conducted at the Cardiovascular Center, E Hospital, Hanoi, Vietnam. The study included all consecutive patients diagnosed with primary mitral regurgitation caused by isolated posterior leaflet lesions who underwent totally endoscopic mitral valve repair between January 2021 and June 2025.

The inclusion criteria were: primary mitral regurgitation with lesions confined to the posterior leaflet; mitral valve repair performed using a totally endoscopic approach; and complete medical records containing preoperative, intraoperative, postoperative, and follow-up data. Posterior leaflet segments were defined according to standard mitral valve segmental anatomy as P1 (lateral scallop), P2 (middle scallop), and P3 (medial scallop).

The exclusion criteria were: rheumatic mitral valve disease or mixed mitral stenosis and regurgitation; involvement of the anterior leaflet or bileaflet lesions; intraoperative failure of repair requiring conversion to mitral valve replacement; and incomplete clinical or echocardiographic data.

2.2. Preoperative assessment

All patients underwent standard preoperative evaluation, including clinical examination, electrocardiography, chest radiography, transthoracic echocardiography, and routine laboratory testing. The severity of mitral regurgitation, left atrial diameter, left ventricular end-diastolic diameter, left ventricular end-systolic diameter, left ventricular ejection fraction, and systolic pulmonary artery pressure were assessed by transthoracic echocardiography. Functional status was classified according to the New York Heart Association classification.

The mechanism of mitral regurgitation was evaluated according to Carpentier's functional classification [1,2]. Particular attention was paid to the location of posterior leaflet involvement, the presence of chordal rupture or elongation, commissural lesions, annular calcification, vegetation, and the degree of leaflet redundancy. Operative risk was assessed using EuroSCORE II.

2.3. Surgical technique

All procedures were performed using a totally endoscopic approach through a right mini-thoracotomy under peripheral cardiopulmonary bypass. The patient was placed in the supine position with slight elevation of the right hemithorax. Cardiopulmonary bypass was established through peripheral cannulation, usually via the femoral vessels, with additional venous drainage when required. Myocardial protection was achieved after aortic cross-clamping and cardioplegic arrest.

The mitral valve was exposed through the left atrium under endoscopic visualization. Adequate exposure of the mitral valve is a critical step in totally endoscopic repair, particularly in patients with a small left atrium, deep thoracic cavity, high right hemidiaphragm, or leftward cardiac displacement. In selected cases, auxiliary traction sutures were used to improve exposure of the posterior leaflet and facilitate precise repair. This technical principle was consistent with our previous experience in endoscopic mitral valve repair and left atrial exposure [12].

Repair techniques were selected according to the anatomical lesion. For limited posterior leaflet prolapse, triangular resection or folding repair was commonly used. In cases with more extensive prolapse or redundant leaflet tissue, quadrangular resection with annular plication or height reduction was performed when appropriate.

Commissural lesions were treated by commissural repair. Artificial chordal implantation was used selectively when leaflet tissue was preserved and chordal replacement was considered more appropriate than resection. Vegetation resection and annular decalcification were performed in selected patients when indicated. Ring annuloplasty was added according to annular size, leaflet morphology, and intraoperative judgment.

After repair, valve competence was assessed by saline testing and intraoperative transesophageal echocardiography after weaning from cardiopulmonary bypass. The main objectives of repair were to eliminate significant residual regurgitation, restore adequate leaflet coaptation, avoid systolic anterior motion, and prevent functional mitral stenosis.

2.4. Data collection and outcome definitions

Data were collected retrospectively from medical records, operative reports, echocardiographic reports, and follow-up files. The main variables included demographic characteristics, clinical status, echocardiographic parameters, mechanism and location of posterior leaflet lesions, repair techniques, aortic cross-clamp time, cardiopulmonary bypass time, intraoperative events, postoperative recovery, early complications, and follow-up outcomes.

Early outcomes were defined as events occurring within 30 days after surgery or during the same hospital admission. Early mortality was defined as death from any cause within 30 days after surgery or before discharge during the index hospitalization. Early postoperative complications included reoperation for bleeding or pleural clot, stroke, acute kidney injury, pneumonia, low cardiac output syndrome, new-onset atrial fibrillation, pleural effusion requiring intervention, and other clinically relevant adverse events.

Mid-term outcomes were assessed in patients with follow-up longer than 6 months. Follow-up data included survival status, reoperation, rehospitalization for cardiovascular causes, recurrent mitral regurgitation, New York Heart Association functional class, and echocardiographic parameters. Recurrent mitral regurgitation was considered clinically significant when it was moderate or severe.

2.5. Statistical analysis

Data were analyzed using SPSS software. Continuous variables were presented as mean ± standard deviation or median with range, depending on data distribution. Categorical variables were expressed as frequencies and percentages. Comparisons between preoperative and postoperative echocardiographic parameters were performed using paired statistical tests when appropriate. A p value <0.05 was considered statistically significant.

2.6. Ethical considerations

The study was approved by the institutional ethics committee of E Hospital. Because this was a retrospective study using existing medical records, no additional intervention was performed. Patient confidentiality was maintained throughout the study.

3. RESULTS

3.1. Baseline characteristics

From January 2021 to June 2025, 183 consecutive patients with primary mitral regurgitation caused by isolated posterior leaflet lesions underwent totally endoscopic mitral valve repair at the Cardiovascular Center, E Hospital. All patients met the inclusion criteria and were included in the final analysis.

The baseline characteristics and preoperative clinical status are summarized in Table 1. The mean age was 55.7 ± 12.6 years, and 67.2% of patients were male. Most patients were symptomatic before surgery, with dyspnea on exertion recorded in 89.6%. Preoperative atrial fibrillation was

present in 30.6% of patients. According to the New York Heart Association functional classification, 49.2% of patients were in class III–IV before surgery.

Table 1. Baseline characteristics and preoperative clinical status

Variable	Value
Number of patients	183
Age, years	55.7 ± 12.6
Age range, years	32–72
Male sex	123 (67.2%)
Female sex	60 (32.8%)
Body mass index, kg/m²	22.8 ± 2.7
Body surface area, m²	1.65 ± 0.12
Dyspnea on exertion	164 (89.6%)
Apical systolic murmur	178 (97.3%)
Preoperative atrial fibrillation	56 (30.6%)
Peripheral edema	17 (9.3%)
Hepatomegaly	10 (5.5%)
NYHA class I	15 (8.2%)
NYHA class II	78 (42.6%)
NYHA class III	84 (45.9%)
NYHA class IV	6 (3.3%)
NYHA class III–IV	90 (49.2%)

Data are presented as mean ± standard deviation or n (%).

NYHA: New York Heart Association.

3.2. Echocardiographic findings

Preoperative, predischarge, and mid-term echocardiographic findings are shown in Table 2. Severe mitral regurgitation was present in 97.8% of patients before surgery. Left ventricular systolic function was generally preserved, with a mean preoperative left ventricular ejection fraction of 61.5 ± 5.9%.

Before discharge, no patient had moderate or severe residual mitral regurgitation. No or trivial residual mitral regurgitation was observed in 85.2% of patients, while mild residual regurgitation was observed in 14.8%. Improvements were also noted in left atrial diameter, left ventricular end-diastolic diameter, and systolic pulmonary artery pressure.

At mid-term follow-up, no or trivial mitral regurgitation was present in 80.5% of patients, mild mitral regurgitation in 16.0%, moderate mitral regurgitation in 3.0%, and severe mitral regurgitation in 0.6%. The left ventricular ejection fraction remained preserved during follow-up.

Table 2. Echocardiographic parameters before surgery, before discharge, and at mid-term follow-up

Parameter	Preoperative	Before discharge	Mid-term follow-up
No/trivial mitral regurgitation	0	156 (85.2%)	136 (80.5%)
Mild mitral regurgitation	0	27 (14.8%)	27 (16.0%)
Moderate mitral regurgitation	0	0	5 (3.0%)
Severe mitral regurgitation	179 (97.8%)	0	1 (0.6%)
Moderate-to-severe mitral regurgitation	4 (2.2%)	0	0
Left atrial diameter, mm	49.2 ± 6.8	44.8 ± 6.1	42.6 ± 5.8
LVEDD, mm	58.6 ± 5.4	51.6 ± 5.2	50.2 ± 5.1
LVESD, mm	36.4 ± 4.8	34.2 ± 4.6	33.8 ± 4.4
LVEF, %	61.5 ± 5.9	60.8 ± 5.7	61.2 ± 5.8
sPAP, mmHg	38.7 ± 9.6	32.5 ± 8.7	30.8 ± 7.5

Data are presented as mean ± standard deviation or n (%).

LVEDD: left ventricular end-diastolic diameter; LVESD: left ventricular end-systolic diameter; LVEF: left ventricular ejection fraction; sPAP: systolic pulmonary artery pressure.

3.3. Posterior leaflet lesions and repair techniques

The characteristics of posterior leaflet lesions and repair techniques are presented in Table 3. Degenerative mitral valve disease was the predominant etiology, accounting for 94.0% of cases. According to Carpentier's classification, type II dysfunction was observed in 96.7% of patients [1,2].

Chordal rupture was the most common anatomical lesion, recorded in 85.8% of patients. The P2 segment was the most frequently involved posterior leaflet segment, accounting for 85.8% of cases.

Repair techniques were selected according to lesion morphology. The most frequently used techniques were triangular resection, quadrangular resection, and folding repair. Commissural repair, vegetation resection, annular decalcification, and artificial chordal implantation were used selectively. Several patients underwent a combination of repair techniques.

Table 3. Posterior leaflet lesions and repair techniques

Variable	Value
Etiology	
Degenerative mitral valve disease	172 (94.0%)
Infective endocarditis	11 (6.0%)
Carpentier classification	
Type I dysfunction	6 (3.3%)
Type II dysfunction	177 (96.7%)
Anatomical lesions	
Chordal rupture	157 (85.8%)
Chordal elongation	17 (9.3%)
Commissural prolapse	11 (6.0%)
Leaflet vegetation	6 (3.3%)
Posterior annular calcification	2 (1.1%)
Involved posterior leaflet segment	
P1	3 (1.6%)
P2	157 (85.8%)
P3	23 (12.6%)
Repair techniques	
Triangular resection	60 (32.8%)
Quadrangular resection	52 (28.4%)
Folding repair	53 (29.0%)
Commissural repair	13 (7.1%)
Vegetation resection	6 (3.3%)
Annular decalcification	2 (1.1%)
Artificial chordal implantation	5 (2.7%)

Data are presented as n (%). Several patients underwent a combination of repair techniques.

3.4. Operative and early postoperative outcomes

Operative and early postoperative outcomes are summarized in Table 4. All procedures were completed using a totally endoscopic approach through a right mini-thoracotomy. The mean aortic cross-clamp time was 72 ± 24 minutes, and the mean cardiopulmonary bypass time was 120 ± 30 minutes. No intraoperative aortic dissection was recorded.

The early postoperative course was generally favorable. The mean mechanical ventilation time was 12.6 ± 5.8 hours, the mean intensive care unit stay was 1.9 ± 0.8 days, and the mean postoperative hospital stay was 7.6 ± 2.1 days.

Early mortality occurred in 1 patient, accounting for 0.5%. This patient developed severe rhythm disturbance after surgery, followed by progressive heart failure despite intensive treatment. Other early complications included reoperation for right pleural clot, stroke, acute kidney injury, pneumonia, low cardiac output syndrome, new-onset atrial fibrillation, and pleural effusion requiring intervention. No unilateral pulmonary edema or pericardial tamponade was recorded.

3.5. Mid-term outcomes

Mid-term follow-up longer than 6 months was available in 169 patients, accounting for 92.3% of the study population. The mean follow-up duration was 24.6 ± 11.8 months.

No late surgery-related death was recorded. Two patients were readmitted for cardiovascular causes and were stabilized with medical treatment. One patient required mitral valve reoperation because of recurrent severe mitral regurgitation 6 months after the initial repair. At mid-term follow-up, 97.0% of followed patients remained free from moderate-or-greater recurrent mitral regurgitation.

Functional status remained favorable during follow-up. Overall, 98.2% of followed patients were in NYHA class I–II, and no patient was in NYHA class IV.

Table 4. Operative, early postoperative, and mid-term outcomes

Variable	Value
Operative data	
Aortic cross-clamp time, min	72 ± 24
Cardiopulmonary bypass time, min	120 ± 30
Right pleural adhesions	8 (4.4%)
Pericardial adhesions	2 (1.1%)
Right internal jugular vein injury during cannulation	1 (0.5%)
Systolic anterior motion after repair	3 (1.6%)
Intraoperative aortic dissection	0
Early postoperative outcomes	
Mechanical ventilation time, hours	12.6 ± 5.8
Prolonged mechanical ventilation >72 hours	5 (2.7%)
Intensive care unit stay, days	1.9 ± 0.8
Prolonged intensive care unit stay >3 days	9 (4.9%)
Postoperative hospital stay, days	7.6 ± 2.1
Chest drainage volume, mL	285 ± 120
Postoperative red blood cell transfusion	27 (14.8%)
Early mortality	1 (0.5%)
Reoperation for right pleural clot	5 (2.7%)
Stroke	1 (0.5%)
Acute kidney injury	2 (1.1%)
Pneumonia	4 (2.2%)
Low cardiac output syndrome	5 (2.7%)
New-onset atrial fibrillation	16 (8.7%)
Pleural effusion requiring intervention	6 (3.3%)
Unilateral pulmonary edema	0
Pericardial tamponade	0
Mid-term follow-up	
Patients with follow-up >6 months	169 (92.3%)
Follow-up duration, months	24.6 ± 11.8
Late surgery-related death	0
Cardiovascular readmission	2 (1.2%)
Mitral valve reoperation	1 (0.6%)
Freedom from moderate-or-greater recurrent MR	164/169 (97.0%)
NYHA class I at follow-up	128 (75.7%)
NYHA class II at follow-up	38 (22.5%)
NYHA class III at follow-up	3 (1.8%)
NYHA class IV at follow-up	0
NYHA class I–II at follow-up	166 (98.2%)

Data are presented as mean ± standard deviation or n (%).

MR: mitral regurgitation; NYHA: New York Heart Association.

4. DISCUSSION

This study evaluated the technical characteristics and outcomes of totally endoscopic

mitral valve repair in 183 patients with primary mitral regurgitation caused by isolated posterior leaflet lesions. The main findings were as follows. First, isolated posterior leaflet disease in our cohort was predominantly degenerative, with Carpentier type II dysfunction and P2 prolapse being the most frequent mechanism and location. Second, totally endoscopic repair was feasible in all included patients, with a repair strategy mainly based on triangular resection, quadrangular resection, and folding repair. Third, early repair quality was excellent, with no patient having moderate or severe residual mitral regurgitation before discharge. Finally, mid-term outcomes were favorable, with 97.0% of followed patients remaining free from moderate-or-greater recurrent mitral regurgitation.

Isolated posterior leaflet prolapse is generally considered the most favorable anatomical lesion for mitral valve repair. In the present study, degenerative disease accounted for 94.0% of cases, and Carpentier type II dysfunction was observed in 96.7%. These findings are consistent with the classical concept of degenerative mitral regurgitation, in which leaflet prolapse due to chordal rupture or elongation is the principal mechanism [1,2]. The predominance of P2 lesions in our cohort also reflects the typical anatomical distribution of degenerative posterior leaflet disease. From a surgical perspective, this lesion pattern is particularly suitable for a standardized repair strategy because the prolapsing segment is usually well localized and can be corrected using reproducible techniques.

Mitral valve repair is the preferred treatment for degenerative mitral regurgitation when a durable repair is achievable. The advantages of repair over replacement include preservation of the native valve and subvalvular apparatus, maintenance of left ventricular function, avoidance of prosthesis-related complications, and reduced need for long-term anticoagulation. Carpentier's reconstructive principles remain the foundation of modern mitral repair, particularly in posterior leaflet disease [1,2]. In our series, resectional techniques, including triangular and quadrangular resection, were frequently used. These techniques are well established and provide reliable correction for localized posterior leaflet prolapse. In addition, folding repair was used in 29.0% of patients. This nonresectional approach may be particularly useful in totally endoscopic surgery because it is technically straightforward, preserves leaflet tissue, and allows flexible adjustment of leaflet height and coaptation before final fixation.

The choice between resectional and nonresectional repair techniques has been widely discussed in mitral valve surgery. Resectional techniques, especially triangular and quadrangular resection, have long-term durability and remain highly effective for excess posterior leaflet tissue [1,2]. Conversely, the "respect rather than resect" concept emphasizes leaflet preservation, most commonly through artificial chordal implantation or nonresectional remodeling. Previous studies have shown that minimally invasive nonresectional repair can achieve excellent outcomes in appropriately selected patients [9]. In our practice, the repair strategy was not based on a single fixed philosophy. Instead, techniques were individualized according to leaflet morphology, extent of prolapse, leaflet height, chordal pathology, and intraoperative valve testing. This flexible approach may explain the high rate of satisfactory early repair in our cohort.

Totally endoscopic mitral valve repair requires several technical conditions, including stable peripheral cardiopulmonary bypass, safe aortic occlusion, adequate myocardial protection, good left atrial exposure, and precise intracardiac manipulation under endoscopic vision. The early development of minimally invasive and video-assisted mitral valve surgery demonstrated the feasibility of avoiding sternotomy while maintaining acceptable safety [4,5]. Subsequent studies reported that minimally invasive mitral valve repair could provide early and late outcomes

comparable to conventional sternotomy in experienced centers [6,7]. In our study, all patients underwent repair through a right mini-thoracotomy using a totally endoscopic approach. The mean aortic cross-clamp and cardiopulmonary bypass times were 72 ± 24 minutes and 120 ± 30 minutes, respectively. These operative times are acceptable for totally endoscopic mitral repair and may reflect both the favorable anatomy of isolated posterior leaflet lesions and accumulated institutional experience.

Adequate exposure of the mitral valve is one of the most important steps in totally endoscopic repair. Limited exposure may prolong operative time and increase the difficulty of precise leaflet reconstruction. In patients with a small left atrium, deep chest, high right hemidiaphragm, or leftward cardiac displacement, additional exposure maneuvers may be necessary. Our previous experience emphasized the importance of standardized left atrial exposure techniques in endoscopic mitral valve repair [12]. In the present study, auxiliary traction sutures were used selectively to improve visualization of the posterior leaflet and facilitate accurate repair. This technical refinement is particularly relevant in totally endoscopic surgery, where optimal visualization can directly affect repair quality.

The early clinical outcomes in this study were favorable. Early mortality occurred in one patient, accounting for 0.5%. This rate is comparable to or lower than those reported in many series of minimally invasive mitral valve surgery [5–7]. The major early complications were relatively infrequent, including reoperation for right pleural clot in 2.7%, stroke in 0.5%, acute kidney injury in 1.1%, pneumonia in 2.2%, and low cardiac output syndrome in 2.7%. These results suggest that totally endoscopic mitral valve repair can be performed safely in selected patients when the surgical team has adequate experience. Although minimally invasive approaches avoid sternotomy, they introduce specific risks related to peripheral cannulation, one-lung ventilation, de-airing, and limited access for hemostasis. Therefore, careful patient selection, preoperative vascular assessment, meticulous de-airing, and systematic postoperative surveillance remain essential.

Residual mitral regurgitation after repair is one of the most important determinants of repair durability. In our study, predischarge echocardiography showed no moderate or severe residual mitral regurgitation. No or trivial residual regurgitation was observed in 85.2% of patients, and only mild residual regurgitation was observed in 14.8%. This finding indicates excellent early repair quality. In mitral valve repair, achieving adequate leaflet coaptation without causing functional mitral stenosis or systolic anterior motion is more important than pursuing complete absence of any minimal regurgitant jet. The low incidence of systolic anterior motion in our cohort also suggests that posterior leaflet height, coaptation depth, and annuloplasty strategy were generally well controlled.

The postoperative echocardiographic changes observed in this study were consistent with favorable reverse remodeling after correction of severe mitral regurgitation. Left atrial diameter, left ventricular end-diastolic diameter, and systolic pulmonary artery pressure decreased before discharge and remained improved during follow-up. Left ventricular ejection fraction was preserved throughout the study period. After mitral valve repair, a slight reduction in ejection fraction may occur because elimination of the low-resistance regurgitant pathway increases the effective afterload of the left ventricle. In our cohort, the maintenance of preserved ejection fraction suggests that most patients were operated on before irreversible left ventricular dysfunction developed.

Mid-term durability is a key concern after mitral valve repair. In the present study, follow-up longer than 6 months was available in 92.3% of patients, with a mean duration of 24.6 ± 11.8 months. No late surgery-related death was recorded, and only one patient required reoperation for

recurrent severe mitral regurgitation. At follow-up, 97.0% of patients remained free from moderate-or-greater recurrent mitral regurgitation. These results are consistent with previous reports showing good durability after minimally invasive repair for degenerative mitral regurgitation [6–8]. The favorable mid-term result in our cohort may be explained by the predominance of isolated posterior leaflet disease, the relatively localized nature of the lesions, and the consistent use of lesion-oriented repair techniques.

Functional improvement was also substantial. Before surgery, nearly half of the patients were in NYHA class III–IV. At mid-term follow-up, 98.2% of followed patients were in NYHA class I–II, and no patient remained in NYHA class IV. This clinical improvement reflects the hemodynamic benefit of eliminating mitral regurgitation and supports the value of a minimally invasive strategy in improving postoperative recovery and quality of life. Although this study did not include a sternotomy control group, shorter ventilation time, brief intensive care stay, and acceptable hospital stay are consistent with the expected advantages of minimally invasive mitral valve surgery [5–7].

This study has several limitations. First, it was a retrospective, single-center study and may therefore be affected by selection bias. Second, there was no control group undergoing conventional sternotomy or mitral valve replacement, so direct comparison between approaches was not possible. Third, although the follow-up rate was high, the mean follow-up duration was approximately two years, which is not sufficient to assess long-term durability. Finally, detailed quantitative echocardiographic parameters such as effective regurgitant orifice area, regurgitant volume, transmitral gradient, and coaptation length were not systematically analyzed. Further prospective studies with longer follow-up and comparative design are needed to confirm the long-term durability of totally endoscopic repair for isolated posterior leaflet lesions.

Despite these limitations, the present study provides one of the largest focused analyses of totally endoscopic mitral valve repair for isolated posterior leaflet lesions in Vietnam. The results demonstrate that, in a center with appropriate experience and standardized techniques, this approach is feasible, safe, and associated with excellent early repair quality and favorable mid-term outcomes.

5. CONCLUSION

Totally endoscopic mitral valve repair for primary mitral regurgitation caused by isolated posterior leaflet lesions is feasible, safe, and effective. In appropriately selected patients, a lesion-oriented repair strategy provides excellent early repair quality, low perioperative morbidity, and favorable mid-term durability, supporting its routine use in experienced cardiac surgery centers.

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