Midterm Results of Totally Endoscopic Mitral Valve Replacement Via Right Minithoracotomy at Hanoi Heart Hospital

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ABSTRACT

Objective: To describe the diagnostic features, surgical techniques, and outcomes of totally endoscopic mitral valve replacement via the right anterolateral thoracic approach.

Methods: A retrospective cross-sectional descriptive study was conducted on patients diagnosed with mitral valve disease, indicated for valve replacement, and underwent minimally invasive mitral valve replacement via totally endoscopic right anterior axillary approach at Hanoi Heart Hospital from January 2024 to January 2025.

Results: This was a cross- sectional study included 121 patients with mean age of 57 ± 9.2 years (35 - 75), 80.2% of patients was women. All patients had heart failure classified by NYHA as moderate to severe, with 66.9% falling into NYHA classes 3-4. Surgical statistics showed: Mean aortic clamping time: 75,3 ± 24,6 minutes (35 – 191), mean cardiopulmonary bypass time: 125,7 ± 36,8 minutes (62 – 297), operative time: 199,3 ± 52,7 minutes (120 – 390), mean ventilation time was 14.4 ± 13.9 hours. 94.2% of patients were extubated within 24 hours. Mean ICU stay time was 2.8± 1.3 days (1-10), and mean hospital stay time was 11.4 ± 4.4 days (6-28). Pneumonia was the most common posoperative complication, occurring in 7 patients (5.7%). Other complications included: Venous perforation: 1 patient (0.8%), cognitive dysfunction: 2 patients (1.7%), stroke: 1 patient (0.8%), chest wall bleeding requiring reoperation: 2 patients (1.7%), pericardial effusion requiring drainage: 1 patient (0.8%), chest wound infection: 2 patients (1.7%), in-hospital mortality 0%.

Conclusion: This study demonstrates that minimally invasive mitral valve replacement via totally endoscopic right anterior axillary approach at Hanoi Heart Hospital is safe, has low complication rates, reduces recovery and hospital stay times, and provides good early outcomes.

Keywords: *mini-invasive mitral valve replacement, totally endoscopic, right minithoracotomy.*

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I. Introduction

Mitral valve disease was the most common heart valve pathology, primarily consisting of acquired valve diseases, accounting for approximately 40%[1].

The traditional method of valve replacement surgery, involving a full sternotomy, has been the standard approach for over 50 years. However, this method had disadvantages, including significant surgical trauma, risk of sternal infection, poor cosmetic outcomes, postoperative infections, and pain[2].

Minimally invasive mitral valve replacement surgery was increasingly common and has become routine. Studies indicated that this method was safe, with low postoperative mortality, reduced trauma, less pain, less bleeding, shorter ventilation time, shorter hospital stay and recovery, improved cosmetic outcomes, and lower rate of wound infections[2].

The right anterior axillary incision provided excellent access to the mitral valve, both through direct visualization and camera-assisted approaches[2].

In Vietnam, minimally invasive mitral valve replacement via endoscopy has been performed at major cardiovascular surgery centers, such as Hanoi Heart Hospital, E Hospital, and Ho Chi Minh City University of Medicine and Pharmacy Hospital, demonstrating the widespread adoption of this technique in clinical practice[3].

At Hanoi Heart Hospital, minimally invasive mitral valve replacement via totally endoscopic right anterior axillary approach was performed routinely, offering advantages such as good cosmetic outcomes, direct visualization of the mitral and tricuspid valves through the right chest incision, a wider intercostal space, a 90-degree working angle between the valve and instruments for easier technical manipulation[4], and shorter operative times. However, this method was not yet widely adopted or extensively published in Vietnam. Therefore, we conducted this study to evaluate the short-term outcomes of minimally invasive mitral valve replacement via totally endoscopic right anterior axillary approach at Hanoi Heart Hospital.

II. Methods

A retrospective cross-sectional descriptive study was conducted on patients diagnosed with mitral valve disease, indicated for valve replacement, and underwent minimally invasive mitral valve replacement via totally endoscopic right anterior axillary approach at Hanoi Heart Hospital from January 2024 to January 2025. Data were analyzed using SPSS 20.0 software.

III.Totally Endoscopic Mitral Valve Replacement via Right Anterior Axillary Approach at Hanoi Heart Hospital

Skin Incision:

A 3-6 cm incision was made along the right anterior axillary line, dissecting the chest wall muscle bundles and accessing the chest through the 4th intercostal space.

Figure 1: Skin incision line

(Source: Hanoi Heart Hospital)

Advantages of the right anterior axillary incision:

- More lateral approach offered wider intercostal space
- Direct visualization of the mitral valve with a 90-degree working angle between the valve and instruments.

Good cosmetic outcomes for both males and females

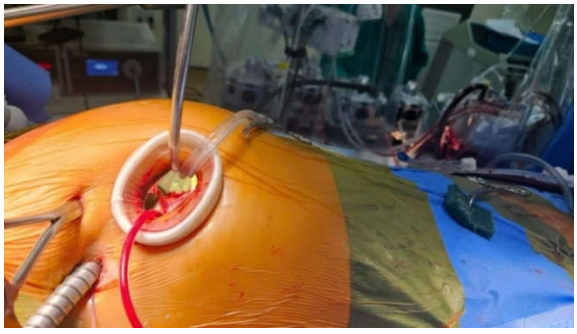

Figure 2: Direct view of the mitral valve

(Source: Hanoi Heart Hospital)

Figure 3:"Invisible scar" in both males and females

(Source: Hanoi Heart Hospital)

Innovation in exposing the mitral valve via the right anterior axillary approach:

To facilitate easy exposure of the left atrium and mitral valve without causing additional trauma to the patient and to allow rapid manipulation, we developed a customized atrial retractor placed directly through the chest incision. This instrument significantly reduced the time for exposing the valves.

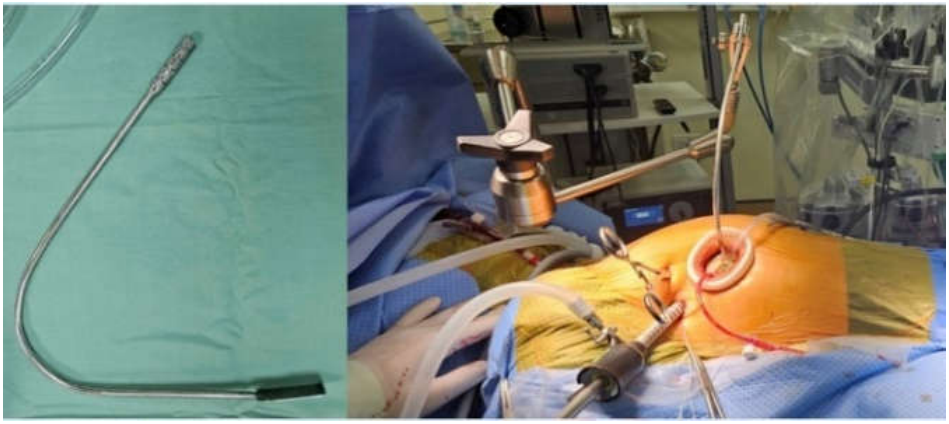

Figure 4: Atrial retractor device at Hanoi Heart Hospital

(Source: Hanoi Heart Hospital)

IV. Results

4.1. General Characteristics

Table 1: General Characteristics

General Characteristics		Cases (n=121)	%
Age	Mean (years)	57 ± 9,2 (35 – 75)	
Gender	Male	24	19,8
	Female	97	80,2

The mean age of patients was 57 years (range 35–75). The proportion of males and females was 19.8% and 80.2%, respectively.

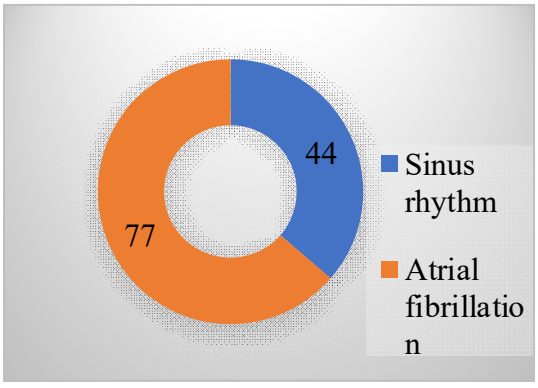

Chart 1: Preoperative Electrocardiogram Characteristics

Before surgery, 77 patients had atrial fibrillation, accounting for 63.6%.

4.2. Intraoperative Characteristics

All patients underwent surgery using cardiopulmonary bypass and cardiac arrest. Intraoperative variables are presented in Table 2.

Table 2: Main Intraoperative Variables

Variable	Min	Mean	Max
Cardiopulmonary bypass time (min)	62	125,7 ± 36,8	297
Aortic clamping time (min)	35	75,3 ± 24,6	191
Operative time (min)	120	199,3 ± 52,7	390
Concomitant procedures	Cases (%) (n=76)		
Left atrial reduction	1 (0,8)		
Left atrial appendage closure	26 (21,5)		
Maze procedure	7 (5,8)		
Tricuspid valve repair	58 (47,9)		
Atrial septal defect repair	1 (0,8)		

The mean operative time was 199 minutes, with a mean cardiopulmonary bypass time of 126 minutes and a mean aortic clamping time of 75 minutes. The most common concomitant procedure was tricuspid valve repair, accounting for 47.9%.

Table 3: Characteristics of Prosthetic Valves

		No	%
Valve Type	Biological	11	9,1
	Mechanical	110	90,9
Valve size	25 mm	32	26,4
	27mm	56	46,3
	29mm	22	18,2
	31mm	11	9,1

The majority of patients underwent mitral valve replacement with mechanical valves, accounting for 90.9%. The most common valve size used was 27 mm, accounting for 46.3%.

4.3. Postoperative Treatment Duration

Table 4: Postoperative Treatment Duration

Time	Min	Mean	Max
Ventilation time (hours)	5	14,4± 13,9	135
ICU stay (days)	1	2,8± 1,3	10
Hospital stay (days)	6	11,4 ± 4,4	28

The mean ventilation time was 14.4 hours, the mean ICU stay was 2.8 days, and the mean hospital stay was 11.4 days

4.4. Surgical Complications

Table 5: Intraoperative and Early Postoperative Complications

Postoperative Complications	Cases (%) (n=121)
Arterial perforation	0 (0)
Venous perforation	1 (0,8)
Mortality	0 (0)
Cognitive dysfunction	2 (1,7)
Stroke	1 (0,8)
Reoperation for bleeding	2 (1,7)
Pericardial effusion (requiring drainage)	1 (0,8)
Pleural effusion (requiring drainage)	0 (0)
Pneumothorax (requiring drainage)	0 (0)
Chest wound infection	2 (1,7)
Thigh wound infection	0 (0)
Pneumonia	7 (5,8)
Renal failure (requiring dialysis)	0 (0)
Paravalvular leak	0 (0)

Pneumonia was the most common complication, occurring in 7 patients (5.8%). Other complications included: superior vena cava perforation in 1 patient (0.8%), psychiatric disorders in 2 patients (1.7%), stroke in 1 patient (0.8%), reoperation for bleeding in 2 patients (1.7%), pericardial effusion requiring drainage in 1 patient (0.8%), and chest wound infection in 2 patients (1.7%). No deaths occurred, and other complications were not observed.

4.5. Early Outcomes

Table 6: Electrocardiogram Characteristics at Discharge

ECG	**Sinus rhythm**	**Atrial fibrillation**
No	51	70
%	42,1	57,9

The number of patients with atrial fibrillation at discharge decreased to 70, accounting for 57.9%.

Table 7: Heart Failure Classification

NYHA	**%**	
	Pre-surgery	**Post-surgery**
I	0	0
II	31,3	77,7
III	62,8	20,7
IV	4,1	1,7
Total	100	100

The proportion of patients with NYHA class III-IV decreased from 66.9% pre-surgery to 22.4% at discharge.

V. Discussion

5.1. Preoperative Characteristics:

The results regarding preoperative characteristics in Table 1 show a mean age of 57 ± 9.2 years, ranging from 35 to 75 years. This is lower than the study by Utz Kapper et al. (66.7 ± 11.4 years) but higher than the studies by Hailong Cao et al. (44.4 ± 6.8 years) and Qing-guo Li et al. (38.6 ± 8.2 years). The difference may be due to racial and geographical factors of the study populations, particularly as the studies included developed countries with better access to healthcare and early care services.

The proportion of females in our study was 80.2%, higher than 40.6% in Hailong Cao et al. , 43.8% in Utz Kapper et al. , and 66.4% in Qing-guo Li et al. .

In our study, the prevalence of atrial fibrillation preoperatively was 63.6%, which is lower compared to the study by Le Van Hung et al[9]

5.2. Intraoperative Results:

In our study, cardiopulmonary bypass time, aortic clamping time, and operative time were presented in Table 2. Compared to Utz Kapper et al. (cardiopulmonary bypass: 88.7 ± 26.6 minutes, aortic clamping: 64.4 ± 22.3 minutes, operative time: 132 ± 31 minutes), Hailong Cao et al. (cardiopulmonary bypass: 86 ± 18 minutes, aortic clamping: 53 ± 15 minutes, operative time: 206 ± 73 minutes), Qing-guo Li et al. (cardiopulmonary bypass: 105.3 ± 16.2 minutes, aortic clamping: 70.2 ± 18.2 minutes, operative time: 202.7 ± 17.2 minutes), and Guochang Zhao et al. (cardiopulmonary bypass: 156 ± 23 minutes, aortic clamping: 100 ± 17 minutes, operative time: 266 ± 42 minutes), our study had longer cardiopulmonary bypass and aortic clamping times and a longer total operative time than Utz Kapper et al. but was similar to Hailong Cao et al. and Qing-guo Li et al. , and faster than Guochang Zhao et al. .

These differences can be explained by the following reasons: First, the surgical approach—studies by Utz Kapper, Hailong Cao, and Qing-guo Li used direct visualization through the incision and used rib spreader, while our study and Guochang Zhao's used a totally endoscopic approach and didn't use rib spreader. Second, the concomitant procedures performed with mitral valve replacement reflect the superiority of the incision approach, allowing multiple complex techniques in a single session and the skill level of the surgeons. Concomitant procedures in our study included left atrial reduction, tricuspid valve repair, left atrial appendage closure, Maze procedure for atrial fibrillation, and atrial septal defect repair, with 76 cases (62.8%) involving additional procedures, predominantly tricuspid valve repair (47.9%). This rate was higher than in Hailong Cao et al. (21.9%), Qing-guo Li et al. (28.1%), and Guochang Zhao et al. (22.2%), where only tricuspid valve repair was performed as a concomitant procedure. The third reason is that we utilized a single-lumen endotracheal tube rather than a double-lumen tube as employed by international authors. This necessitated a prolonged duration of cardiopulmonary bypass to achieve hemostasis before resuming ventilation and discontinuing extracorporeal circulation. Fourth, surgeon experience-Utz Kapper was a leading European expert in minimally invasive cardiac surgery, while our study at Hanoi Heart Hospital involved both experienced and younger surgeons. Fifth, our continuous innovation to

streamline and shorten the surgical process, as demonstrated by the atrial retractor innovation, facilitated mitral and tricuspid valve exposure and reduced operative time.

The characteristics of prosthetic valves in our study are presented in Table 3. In comparison with the study by Pham Thanh Dat et al[10], where the proportion of mechanical valves was 73.7%, our study shows a higher proportion of mechanical valves. This difference can be easily explained by the patient age distribution in our study, where the majority were under 65 years old, and our indications for mechanical valve replacement fully adhered to the guidelines for mitral valve prosthesis replacement. In the study by Pham Thanh Dat et al[10], the most common valve size was 29mm, accounting for 42.1%.

5.3. Surgical Complications:

Surgical complications in our study were presented in Table 5. Compared to Utz Kapper et al. , common postoperative complication rates were: reoperation for bleeding (3.8%), renal failure requiring dialysis (0.6%), stroke (1.2%), psychiatric disorders (15%), pneumonia (16.9%), and chest wound infection (2.5%). Hailong Cao et al. reported rates of pneumonia (21.8%) and renal failure requiring dialysis (3.1%), with no cases of reoperation for bleeding. Our study's stroke and wound infection rates were comparable to Utz Kapper et al. . Our rates of pneumonia, postoperative psychiatric disorders, and reoperation for bleeding were lower than those in Kapper et al. and Hailong Cao et al. . However, our rates of complications due to cannula (venous perforation) and pericardial effusion requiring drainage were higher than in Kapper et al. and Hailong Cao et al. .

A review of complications in our study showed that pneumonia cases were associated with prolonged ventilation (>24 hours), the venous perforation case involved the superior vena cava due to a kinked cannula, psychiatric disorders resolved within 24 hours, the stroke case resulted in hemiparesis, reoperation for bleeding was due to chest wall bleeding, pericardial effusion requiring drainage occurred after electrode removal, and wound infections occurred in obese patients with underlying diabetes.

5.4. Early Postoperative Outcomes:

Treatment duration in our study was presented in Table 4, and early postoperative outcomes were shown in Table 5. Compared to Utz Kapper et al. (ventilation time: 6.4 ± 6.4 hours, ICU stay: 2.5 ± 1.9 days, hospital stay: 11.7 ± 5.2 days) and Hailong Cao et al. (hospital stay: 11.3 ± 3.8 days), our study had similar ICU and hospital stay durations but longer ventilation times. Qing-guo Li et al. reported shorter ventilation time (5.2 ± 1.4 hours) and hospital stay (8.6 ± 1.3 days) compared to our study. Overall, postoperative ventilation times in these studies were short, influenced by various factors, including anesthesia and critical care approaches.

The number of patients with atrial fibrillation decreased from 77 preoperatively to 70 at discharge, from 63.6% to 57.9%, corresponding to 7 patients undergoing the Maze procedure. The success rate was considered to be 100%. The relatively low number of Maze procedures can be explained by several factors: the high proportion of patients undergoing mechanical valve replacement in the study, significant left atrial dilation, and the fact that 100% of the procedures used monopolar energy, which increased the risk of prolonged surgical time.

Improving clinical symptoms to allow patients to return to normal life and activities is a primary goal of minimally invasive mitral valve replacement via totally endoscopic right anterior axillary approach at Hanoi Heart Hospital. In our study, the proportion of patients with moderate to severe symptoms (NYHA III-IV) was 66.9% pre-surgery, comparable to Utz Kapper et al. (65.6%), but lower than Hailong Cao et al. (75%) and Guochang Zhao et al. (86%). This reflects the role of preoperative medical treatment and early disease detection.

Our study results showed significant clinical improvement: the proportion of NYHA class III-IV decreased from 66.9% to 22.4%.

VI. Conclusion

This study demonstrates that minimally invasive mitral valve replacement via totally endoscopic right anterior axillary approach at Hanoi Heart Hospital is safe, has low complication rates, reduces recovery and hospital stay times, and provides good early outcomes.

References

1. Dang Van Phuoc, Chau Ngoc Hoa, Ta Thi Thanh Huong, "Mitral Valve Stenosis," Internal Medicine. Medical Publishing House; 2012, pp. 1–10.

2. Lawrence H. Cohn. *Cardiac Surgery in the Adult*. The McGraw – Hill Companies, Inc; 2008.

3. Nguyen Huu Uoc, Nguyen Tien Quan, Nguyen Thu Ngan, Pham Quoc Dat. Outcomes of minimally invasive open-heart surgery with endoscopic assistance at Viet Duc University Hospital. Vietnam Surgery Journal. 2016;66(2):12-23.

4. Nguyen Sinh Hien, Tran Le Cong Thang, Nguyen Minh Ngoc. Early and mid-term outcomes of minimally invasive mitral valve repair via a small right chest incision at Hanoi Heart Hospital. Vietnam Medical Journal; 2021 507(2). https://doi.org/10.51298/vmj.v507i2

5. Taghizadeh-Waghefi, A.; Arzt, S.; De Angelis, V.; Schiffarth, J.; Petrov, A.; Tomko, M.; Alexiou, K.; Matschke, K.; Kappert, U.; Wilbring, M. Safety and Efficacy of the Transaxillary Access for Minimally Invasive Mitral Valve Surgery-A Propensity Matched Competitive Analysis. Medicina 2022, 58, 1850. https://doi.org/10.3390/ medicina58121850

6. Hailong Cao, MD, PhD, Qing Zhou, MD, Yunxing Xue, MD, Fudong Fan, MD, Dongjin Wang, MD, PhD, Mitral Valve Surgery via a Right Infra-axillary Thoracotomy in High-Risk Reoperative Patients.Heart Surg Forum. 2020 Apr 10;23(2):E200-E204. doi: 10.1532/hsf.2897

7. Li et al.: The right vertical infra-axillary incision for mitral valve replacement. Journal of Cardiothoracic Surgery 2010 5:104

8. Zhao, G., Gao, J., Liu, Y., Gu, S., Guo, Y., Xie, B., & Su, P. X. (2017). *Two-Incision Totally Thoracoscopic Approach for Mitral Valve Replacement. International Heart Journal, 58(6), 894–899.* doi:10.1536/ihj.16-450

9. Le Van Hung. Results of Endoscopic Bioprosthetic Mitral Valve Replacement at the Cardiology Center, E Hospital, Hanoi Medical University; 2022.

10. Pham Thanh Dat. Early Outcomes of Minimally Invasive Mitral Valve Replacement with Endoscopic Assistance at the Cardiology Center, E Hospital, Hanoi Medical University; 2015.