THE RESULTS OF PRESERVING THE MITRAL SUBVALVULAR APPARATUS IN MECHANICAL MITRAL VALVE REPLACEMENT AT HUE CENTER HOSPITAL

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SUMMARY

Objectives: *To evaluate the results of preserving the mitral subvalvular apparatus in mechanical mitral valve replacement (MVR) at Hue Center Hospital.* ***Subjects and methods:*** *The prospective study of patients with mitral valve disease (MVD) who underwent mechanical MVR with preservation of the mitral subvalvular apparatus, with or without tricuspid at Hue Center Hospital between March 2015 and September 2016.* ***Results:*** *Of 87 patients, the mean age was 46.9 ± 9.4 years old, and the majority was female. 43.7% of patients were NYHA II, 52.9% were NYHA III. Intraoperatively, pericardial adhesions accounted for 5.7%. Regarding the technique of preserving the mitral subvalvular apparatus: 36.8% papillary muscles resection; 88.5% U pledgeted suture; 3.4% posterior leaflet splitting. The average CPB time was 82.3 ± 20.8 minutes, aortic cross clamp time was 56.3 ± 15.9 minutes. Complications: 2 cases of in-hospital death; 2 cases of wound infection, 1 case of reoperation due to bleeding.* ***Conclusions:*** *Mechanical MVR surgery with preservation of the mitral subvalvular apparatus in patients with MVD at Hue Center Hospital was safe with good outcomes and a low rate of complications.*

** Keywords: Mitral valve; Mitral valve replacement; Preservation of the subvalvular apparatus.*

INTRODUCTION

Mitral valve disease (MVD) is a common heart valve disease. MVR surgery has become routine at cardiovascular centers in the whole country. Particularly, the function of the heart depends heavily on the preservation of the mitral subvalvular apparatus after MVR surgery [4]. The study of Lillehei et al. (1964) showed that the mortality after classical MVR decreased from 37% to 13% due to the technique of preserving both papillary muscles [5]. On the other hand, preserving the mitral subvalvular apparatus also reduces the rate of left ventricular rupture and improves the left ventricular systolic function after surgery. Therefore, we carried out this study: *To evaluate the results of mechanical MVR with preservation of the subvalvular apparatus in the treatment of MVD.*

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SUBJECTS AND METHODS

1. Subjects

87 patients with MVD underwent mechanical MVR with preserving the mitral subvalvular apparatus at Cardiovascular Center, Hue Central Hospital, from 3/2015 to 9/2016.

** Selection criteria:*

- Patients with MVD were candidates for surgery;
- The patient underwent mechanical MVR surgery with preserving the subvalvular apparatus;
- The patient agreed to participate in the study;
- Sufficient medical records.

** Exclusion criteria:*

- Patients underwent MVR combined with aortic valve replacement and/or CABG;
- Patients underwent MVR combined with other interventions (except for tricuspid valve repair);
- Insufficient medical records.

2. Methods

This is a prospective, non-controlled study on patients with MVD associated with or without tricuspid regurgitation. The diagnosis of MVD on echography were based on the 2017 European Society of Cardiology criteria [6]. Indications for mitral valve surgery was based on the 2014 ACC/AHA guidelines [7]. The characteristics included: Age, gender, NYHA class of heart failure, electrocardiogram, echocardiogram, lesions of the mitral valve, mechanical valve. Postoperative treatment at ICU, postoperative therapy and complications were monitored and evaluated.

** Data processing:* Using SPSS 20.0 software.

RESULTS

1. Preoperative characteristics

Of 87 selected patients in the study, their mean age was 46.9 ± 9.4 years old, female accounted for 72%.

Table 1: General preoperative characteristics.

Factors	Figures
Female, n (%)	63 (72.4)
History of mitral valve interventions	
PMBC, n (%)	5 (5.7)
Mitral valve repair, n (%)	2 (2.3)
BSA (m^2), ($\overline{X} \pm$ SD)	1.5 ± 0.1
NYHA	
I, n (%)	2 (2.3)
II, n (%)	38 (43.7)
III, n (%)	46 (52.9)
IV, n (%)	1 (1.1)

Factors	Figures
ECG	
Sinus rhythm, n (%)	49 (56.3)
AF, n (%)	38 (43.7)
CT ratio	
< 50%, n (%)	13 (14.9)
50 - 60%, n (%)	44 (50.6)
> 60%, n (%)	30 (34.5)
Preoperative echo	
LA thrombus, n (%)	10 (11.5)
MR ≥ ¾, n (%)	6 (6.8)
LA diameter (mm), ($\overline{X}$ ± SD)	50.9 ± 8.0
LVEDd (mm), ($\overline{X}$ ± SD)	47.8 ± 7.8
LVESd (mm), ($\overline{X}$ ± SD)	34.7 ± 7.4
LVEF (%),($\overline{X}$ ± SD)	52.8 ± 8.3
PAPs (mmHg), ($\overline{X}$ ± SD)	52.0 ± 16.7
TAPSE (mm), ($\overline{X}$ ± SD)	20.0 ± 4.5

** BMI: Body mass index; BSA: Body surface area; NYHA: New York Heart Association*

2. Intraoperative characteristics

Of 87 patients who underwent mechanical MV replacement, 14 patients (16.1%) had simple MS, 11 patients (12.6%) had simple MR, and 62 patients (71.3%) had MS combined with MR.

Table 2: Intraoperative characteristics.

Factors	Figures
Pericardial adhesion, n (%)	5 (5.7)
Sizes of prosthetic valve	
25 mm, n (%)	17 (19.5)
27 mm, n (%)	44 (50.6)
29 mm, n (%)	24 (27.6)
31 mm, n (%)	2 (2.3)
Techniques of posterior leaflet preservation	
Decalcification, n (%)	32 (36.8)
Posterior leaflet splitting, n (%)	3 (3.4)
U - pledgeted suture , n (%)	77 (88.5)
Other, n (%)	9 (10.3)

Factors	Figures
Techniques of tricuspid valve repair, n (%)	34 (39.1)
De Vega, n (%)	7 (20.6)
Pericardial band, n (%)	15 (44.1)
Dacron band, n (%)	12 (35.3)
CBP time (min)	
$\overline{X} \pm$ SD (min - max)	82.3 ± 20.8 (45 - 141)
Aortic cross clamp time (min)	
$\overline{X} \pm$ SD (min - max)	56.3 ± 15.9 (28 - 108)

3. Postoperative characteristics

Table 3: Postoperative characteristics.

Factors	Figures
Ventilation (hour), $\overline{X} \pm$ SD (min - max)	23.3 ± 51.1 (3 - 432)
Time at ICU (day), $\overline{X} \pm$ SD (min - max)	5.0 ± 2.7 (1 - 18)
Early complications	
Bleeding, n (%)	1 (1.1)
Wound infection, n (%)	2 (2.3)
Early death, n (%)	2 (2.3)

Table 4: Postoperative monitoring.

Factors	Preoperative (n = 87)	Third month (n = 85)	Sixth month (n = 85)	Twelfth month (n = 85)	p
NYHA					
I	2	14	28	29	$P^{21} < 0.05$
II	38	69	57	56	$P^{31} < 0.05$
III	46	1	0	0	$P^{41} < 0.05$
IV	1	1	0	0	
ECG					
Sinus rhythm	49	68	63	57	
AF	38	17	22	28	
Correct prosthetic MV, n (%)		85 (100)	85 (100)	85 (100)	
LA (mm) $\overline{X} \pm$ SD (min - max)	50.9 ± 8.0 (40.0 - 78.0)	42.4 ± 5.2 (32.0 - 54.0)	40.9 ± 4.5 (33.0 - 52.0)	40.4 ± 3.9 (32.0 - 51.0)	$P^{21} < 0.05$ $P^{31} < 0.05$ $P^{41} < 0.05$

Factors	Preoperative (n = 87)	Third month (n = 85)	Sixth month (n = 85)	Twelfth month (n = 85)	p
LVEDd (mm) $\overline{X}$ ± SD (min - max)	47.8 ± 7.8 (34.0 - 68.0)	45.1 ± 5.4 (36.0 - 57.0)	44.7 ± 4.9 (36.0 - 56.0)	44.5 ± 4.6 (37.0 - 64.0)	$P^{21} < 0.05$ $P^{31} < 0.05$ $P^{41} < 0.05$
LVESd (mm) $\overline{X}$ ± SD (min - max)	34.7 ± 7.4 (23.0 - 54.0)	31.1 ± 2.9 (24.0 - 42.0)	30.9 ± 3.3 (23.0 - 47.0)	30.9 ± 2.8 (24.0 - 44.0)	$P^{21} < 0.05$ $P^{31} < 0.05$ $P^{41} < 0.05$
LVEF (%) $\overline{X}$ ± SD (min - max)	52.8 ± 8.3 (32.0 - 67.0)	56.2 ± 6.4 (40.0 - 67.0)	57.8 ± 6.7 (44.0 - 70.0)	58.4 ± 7.5 (39.0 - 70.0)	$P^{21} < 0.05$ $P^{31} < 0.05$ $P^{41} < 0.05$
PAPs (mmHg) $\overline{X}$ ± SD (min - max)	52.0 ± 16.7 (25.0 - 120.0)	26.6 ± 2.7 (25.0 - 35.0)	26.4 ± 2.8 (25.0 - 35.0)	26.6 ± 2.4 (25.0 - 35.0)	$P^{21} < 0.05$ $P^{31} < 0.05$ $P^{41} < 0.05$
PG_{max} (mmHg) $\overline{X}$ ± SD (min - max)	22.5 ± 8.7 (4.0 - 41.0)	9.5 ± 3.2 (4.0 - 20.0)	10.0 ± 3.1 (8.0 - 12.0)	10.3 ± 2.9 (8.0 - 12.0)	$P^{21} < 0.05$ $P^{31} < 0.05$ $P^{41} < 0.05$
PG_{mean} (mmHg) $\overline{X}$ ± SD (min - max)	11.9 ± 5.3 (2.0 - 22.0)	4.0 ± 1.3 (2.0 - 8.0)	4.6 ± 1.6 (4.0 - 5.7)	4.7 ± 1.4 (4.0 - 5.7)	

Note: P^{21}: 3 months after surgery compared to before surgery.

P^{31}: 6 months after surgery compared to before surgery.

P^{41}: 12 months after surgery compared to before surgery.

DISCUSSION

1. Preoperative characteristics

Of 87 patients who underwent mechanical MVR surgery with preserving the mitral subvalvular apparatus, their mean age was 46.9 ± 9.4 years old, female accounted for 72%. This is the age of the major labors in the community. The results were consistent with other studies in our country or developing countries. In the study of Dang Hanh Son, the average surgical age was 43.58 ± 10.01 years old [1]. Rheumatic MVD is acquired during the period of adolescence, commonly from 5 to 15 years of age. The manifestations present at least 2 years after the first episode of rheumatic fever [1]. If patients are not treated to prevent *Streptococci* reinfection after the first episode, cardiac tissue will be damaged continuously due to recurrent rheumatic fever. That is why post rheumatic heart disease accounts for a high rate at working ages. The severity of heart failure showed 43.7% NYHA II, 52.9% NYHA III, only 1.1% at the stage of NYHA IV and 2.3% at NYHA I. According to the European authors, the survival rates were 62% after 5 years and 38% after 10 years at the stage of NYHA III, respectively [8]. In our study, the CT ratio > 50% accounted for 85.1%, the CT ratio 50 - 60% accounted for 50.6% and > 60% accounted for 34.5%. These results were

also consistent with the results of Dang Hanh Son with 90% of patients with the CT ratio > 50% [1]. Atrial fibrillation is the most common arrhythmia in MVD. Increasing left atrial pressure, especially in MS, caused remodeling in the atrial substrate and early onset of atrial fibrillation [9, 10]. We recorded 43.7% of patients with MVD with atrial fibrillation before surgery. This result is equivalent to the study of domestic and foreign authors [1, 8, 9].

2. Intraoperative characteristics

Of 87 patients (100%) who underwent mechanical MV replacement surgery, 14 patients (16.1%) had simple MS, 11 patients (12.6%) had simple MR, and the other 62 patients (71.3%) had MS combined with MR. Intraoperatively, the mechanical valves in size of 27 mm and 29 mm were most commonly used: 27 mm-size valves accounted for 50.6%, 29 mm-size valves accounted for 27.6%. Our results were similar to the results of Nguyen Hong Hanh [2]. Some authors suggested that preserving the apparatus may obstruct of the left ventricular outflow tract [12]. In addition, the large-size valve can cause severe pressure on the heart tissue [11]. However, a prosthetic valve is appropriate when the effective orifice area (EOA) is suitable for patients with normal transvalvular pressure gradient and mild obstruction of blood flow. In terms of preservation techniques, removing the anterior leaflet with the anterior leaflet ligaments and preserving the posterior leaflet with posterior marginal ligaments were applied in all patients. The thickened annular was thinned to widen the valve hole; the calcified lumps in the annular were also removed as much as possible. In case of severe calcification at the posterior leaflet, cutting calcifications can be required. After that, the posterior leaflet was sutured and folded with U-shaped stitches. Le Quang Thu and Nguyen Hong Hạnh also performed these procedures in their research [2]. The mean aortic clamp time was 56.3 ± 15.9 minutes and the average CEC time was 82.3 ± 20.8 minutes. This was equivalent to the study of Dang Hanh Son [1].

3. Postoperative outcomes

Our study recorded 5 patients with complications (5.7%), including 2 cases of early deaths (within 30 days after surgery); 2 cases of wound infection and 1 case of reoperation due to bleeding. In the study of Doan Quoc Hung, of 45 samples of culture, 28.5% was positive, Gram (-) was major, especially only 70.8% of those were consistent with the antibiograme. 9.8% of patients with acute heart failure had abnormal ECG, proBNP (> 125 pg/mL) or BNP (≥ 35 pg/mL) and echocardiography [3]. 2 cases died due to prolonged aortic clamp and postoperatively worsened heart failure. The patients relied on mechanical ventilation. The family asked to go home on the 12^{th} and 18^{th} days after surgery. With MVR surgery, ventricular rupture is one of the fatal complications [15]. We did not record any case of ventricular rupture after surgery. In the studies of other authors, preserving the subvalvular apparatus

minimized the rate of postoperative ventricular rupture [12]. Long-term follow-up showed significant sinus rhythm recovery and heart failure improvement (mainly NYHA II, III preoperatively and mainly NYHA I, II postoperatively) ($p < 0.05\%$) at the time of 3 months, 6 months and 12 months follow-up compared to preoperative period. Recovering of sinus rhythm depends on several factors, such as the duration of atrial fibrillation, the preoperative left atrial diameter, the postoperative antiarrhythmic therapy, etc. [9]. MVR with preserving the apparatus improves myocardial contractility, reduces abnormal regional movement, and improves left ventricular systolic function postoperatively. Our results are equivalent to those of other domestic and foreign authors.

At the end of follow-up period, all survivals had correct prosthetic valves. The diameters of the left heart chambers and the pulmonary artery pressure decreased significantly ($p < 0.05$) postoperatively. These results were completely consistent with other studies of domestic and foreign authors. The maximal transvalvular pressure gradients were varied from 9.0 to 9.6 mmHg, the mean ones ranged from 4.0 to 4.3 mmHg; There were no cases of pressure gradients more than 10 mmHg. These results showed that the prosthetic mitral valves helped to stabilize the structure of the heart and left ventricular diastolic function. In the study of Doan Quoc Hung, the maximal transvalvular pressure gradient was 10.65 ± 3.40 mmHg at the re-examination time and there was no difference compared to the perioperative measurements (10.43 ± 3.38 mmHg) [3].

CONCLUSION

The complication rate was significantly low of 87 patients with MVD who underwent mechanical valve replacement surgery with preserving the mitral subvalvular apparatus at Hue Center Hospital. These outcomes showed that this procedure was safe, effective, and helped to improve left ventricular function postoperatively.

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