Mid-term results of surgical aortic valve replacement for aortic stenosis at 108 Military Central Hospital

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Summary

Objective: To study on medium-term results after aortic valve replacement surgery for aortic stenosis (AS) at 108 Military Central Hospital. *Subject and method:* 67 patients with AS received aortic artificial valves replacement. The results collected at the time of 3, 6, 12, 24, 36 and 48 months include: NYHA class, echocardiography (LVEDd, LVEDs, AVA, mean PG), Sokolow-Lyon, PPM and complications. Evaluation is based on the criteria of the Vietnam National Heart Association and the Guidelines of the ACC/AHA. *Result:* NYHA 1 was increased (76.1%) and NYHA 2 - 3 was 23.9% with $p<0.05$ in 6 months and an increasing trend at later times ($p>0.05$). Sokolow-Lyon index < 35mm after surgery > 90%, mid-term echocardiography AVA about 1.6cm^2, LVEF > 60%, mean PG < 20mmHg, LVEDd and LVEDs within normal limits. Hemorrhagic complications, stuck aortic valve (≤ 3.8%), fuite paraprosthetiques did not appear after 6 months. *Conclusion:* The medium-term outcome after aortic valve replacement for aortic stenosis has good clinical and subclinical improvement and the rate of medium-term complications is low.

Keywords: Aortic valve replacement, aortic stenosis.

1. Background

Aortic stenosis (AS) causes obstruction to the left ventricular outflow tract, resulting in a frequently high transvalvular gradient and left ventricular muscle hypertrophy, affecting the patient's systemic perfusion [1], [2].

Aortic stenosis progresses silently without symptoms. When symptoms appear, the survival rate is reduced and the mortality rate is high even with intensive treatment. Currently, surgery is still considered an effective treatment for AS [2]. Many domestic and foreign studies show that the early results after valve replacement surgery are significantly improved, but the medium-term results are very variable with many unpredictable features such as PPM status, muscle mass degeneration left ventricle... 108 Military Central Hospital has been conducting this technique since the 2000s and has had many positive results. This study was conducted for the following purposes: *To evaluate some medium-term results in patients undergoing aortic valve replacement for aortic stenosis at 108 Military Central Hospital.*

2. Subject and method

2.1. Subject

Including 67 patients with aortic stenosis who underwent aortic valve replacement at 108 Military Central Hospital during the period from 5/2010- 5/ 2020.

2.2. Method

Research method: Prospective research, descriptive and longitudinal study.

Conduct research: The patients were prepared for surgery, aortic valve replacement surgery and

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followed up after surgery according to a unified procedure. The research objectives include:

NYHA class of heart failure: Evaluating criteria based on the standards of the Vietnamese National Heart Association and ACC/AHA guidelines (USA) [1], [2].

Subclinical:

Sokolow-Lyon: S wave in V1 + R wave in lead V5 or V6 > 3.5mV (35mm on standard ECG) or R wave in V5 or V6 > 2.6mV (26mm on standard ECG).

Echocardiogram:

Left heart chamber size and left ventricular muscle mass were measured by M-mode ultrasound according to the American Society of Echocardiography [2]:

Diameter of end-diastolic (LVEDd), systolic (LVEDs). Their normal values are 37 - 56mm and 27 - 37mm.

Left ventricular ejection fraction (LVEF%) by Simpson's method: The ultrasound probe is placed at the apex cordis and pointing up to the base of the heart. Select a 4-chamber view in both systole and diastole. Draw a contour around the intima border of the left ventricle. The machine automatically calculates systolic volume, diastolic volume and EF (EF > 50%) [2].

Aortic valve area: Determined on 2D echocardiography and Doppler echocardiography. Usually AVA is calculated per m^2 of body skin area (EOA) [36].

Pressure difference across the aortic valve [2]: usually measured by continuous Doppler, based on the modified Bernoulli formula ($\Delta P = 4*V^2$) to determine the mean pressure difference and the maximum pressure difference (immediate peak - peak) between aorta and left ventricle (Table 1).

Degree of aortic stenosis [2]:

Table 1. Doppler parameters of prostethic aortic valve (PrAV) function

Parameter	Normal	Possible stenosis	Significant stenosis
Peak velocity (m/s)	< 3	3 - 4	> 4
Mean gradient (mmHg)	< 20	20 - 35	> 35
DVI	> 0.30	0.29 - 0.25	> 0.25
EOA (cm^2)	> 1.2	1.2 - 0.8	> 0.8
Contour of the jet velocity through the PrAV	Triangular, early peaking	Triangular to intermediate	Rounded, symmetrical contour
AT (ms)	< 80	80 - 100	> 100

Prosthesis-patient mismatch (PPM) and postoperative complications: Prosthesis-patient mismatch (PPM) occurs when the effective orifice area (EOA) of the prosthesis being implanted is less than that of the normal human valve. Values between 0.65 - 0.85cm^2/m^2 being classified as moderate PPM and those < 0.65cm^2/m^2 as severe PPM [2].

Fuite paraprosthetiques: According to the criteria of the American Heart Association: Often include signs of endocarditis, hemolysis and Doppler echocardiography showing regurgitation in the annulus [2].

2.3. Statistical analysis

Data were analyzed with SPSS programe 20.0. Value were presented as mean values, SD, percentage rate and p values of under 0.05 were considered as significant.

3. Result

3.1. NYHA classification

Table 1. Medium-term follow-up of NYHA classification (n = 67)

NYHA	After surgery (months) n (%)					
	3 (n = 67)	6 (n = 67)	12 (n = 66)	24 (n = 58)	36 (n = 53)	48 (n = 40)
1	51 (76.1)	57 (85.1)	57 (86.4)	49 (84.5)	40 (75.5)	30 (75.0)

	$p_{(3-0)}$=0.001, $p_{(6-3)}$=0.008, $p_{(12-6)}$=0.56					
2	11 (16.4)	10 (14.9)	9 (13.6)	9 (15.5)	13 (24.5)	10 (25.0)
	$p_{(24-12)}$=0.65, $p_{(24-12)}$ =0.65, $p_{(36-24)}$=0.16, $p_{(48-36)}$=1.00					
3	5 (7.5)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
4	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)

After surgery NYHA class 1 was increased and NYHA class 2 and 3 was significantly decreased (p<0.05) in 6 months and tends to increase at later time points, but the difference was not statistically significant with p>0.05.

3.2. Some subclinical results

Sokolow-Lyon index:

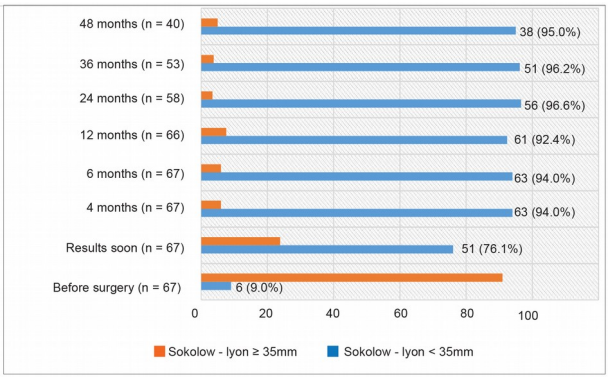

Figure 1. Medium-term follow-up of the Sokolow-Lyon index

After surgery Sokolow-Lyon > 35mm significantly decreased with p<0.05 and there was no difference between follow-up months.

Echocardiogram results

Table 2. medium-term follow-up of echocardiographic indicators (n = 67)

Echo-cardiogram	Follow-up time (months)					
	3 (n = 67)	6 (n = 67)	12 (n = 66)	24 (n = 58)	36 (n = 53)	48 (n = 40)
AVA (cm^2)	1.6 ± 0.4	1.6 ± 0.4	1.6 ± 0.4	1.6 ± 0.3	1.6 ± 0.3	
	$p_{(6-3)}$=-, $p_{(12-6)}$ = -, $p_{(24-12)}$= -, $p_{(36-24)}$= 0,32, $p_{(48-36)}$= -					
LVEF (%)	63.1 ± 5.9	62.0 ± 5.8	63.3 ± 6.3	61.4 ± 6.4	61.6 ± 6.3	60.7 ± 6.6
	$p_{(6-3)}$=0.001, $p_{(12-6)}$=0.001, $p_{(24-12)}$=0.001, $p_{(36-24)}$=0.15, $p_{(48-36)}$=0.2					
Mean PG (mmHg)	14.0 ± 4.0	14.4 ± 3.7	15.0 ± 4.7	15.4 ± 5.7	15.5 ± 5.8	15.7 ± 6.0
	$p_{(6-3)}$=0.4, $p_{(12-6)}$ = 0.306, $p_{(24-12)}$ = 0.08, $p_{(36-24)}$ = 0.008, $p_{(48-36)}$=0.7					
LVEDd (mm)	45.5 ± 7.0	43.6 ± 7.0	42.5 ± 7.0	45.5 ± 7.0	45.0 ± 7.0	45.2 ± 7.6
	$p_{(6-3)}$=0.001, $p_{(12-6)}$=0.001, $p_{(24-12)}$ = 0.001, $p_{(36-24)}$ = 0.75, $p_{(48-36)}$=0.2					
LVEDs (mm)	31.2 ± 7.4	29.1 ± 7.3	32.2 ± 7.6	32.8 ± 7.9	32.4 ± 7.8	33.5 ± 8.6
	$p_{(6-3)}$=0.001; $p_{(12-6)}$=0.001; $p_{(24-12)}$=0.35; $p_{(36-24)}$=0.82; $p_{(48-36)}$=0.2					

Mid-term follow-up of Mean PG, LVEDd, LVEDs indicators decreased to normal. AVA, LVEF increased and stabilized after surgery.

3.3. PPM

Table 3. Medium-term follow-up of PPM levels

Follow-up time (months)	PPM levels		
	Insignificant	Mild	Moderate/severe

1 (n = 67)	67 (100)	0 (0)	0 (0)
3 (n = 67)	67 (100)	0 (0)	0 (0)
6 (n = 67)	66 (98.5)	1 (1.5)	0 (0)
12 (n = 66)	64 (97.0)	2 (3.0)	0 (0)
24 (n = 58)	52 (89.7)	6 (10.3)	0 (0)
36 (n = 53)	46 (86.6)	7 (12.2)	0 (0)
48 (n = 40)	32 (80.0)	8 (20.0)	0 (0)

During the follow-up period, there were 1.5 - 20% of patients with mild PPM at the time of follow-up, with IEOA in the range of 0.85 - 1.2cm^2/m^2.

3.4. Medium-term follow-up of complications

Table 4. Medium-term follow-up of complications (n = 67)

Follow-up time (months)	Hemorrhage	Stuck aortic valve	Fuite paraprosthetiques
3 (n = 67)	2 (3.0)	0 (0.0)	6 (9.0)
6 (n = 67)	2 (3.0)	0 (0.0)	2 (3.0)
12 (n = 66)	0 (0.0)	0 (0.0)	0 (0.0)
24 (n = 58)	0 (0.0)	1 (1.7)	0 (0.0)
36 (n = 53)	2 (3.8)	1 (1.9)	0 (0.0)
48 (n = 40)	1 (2.5)	0 (0.0)	0 (0.0)

Post-operative complications had a low rate (≤ 3.8%). No case of fuite paraprosthetiques was recorded from the 6th month after surgery.

4. Discussion

The degree of heart failure according to NYHA after surgery in Table 1 shows that NYHA 1 was an increase and decrease of NYHA 2 and 3. Pair comparison to evaluate these changes over time found that this change mainly took place right after surgery and in 6 months postoperatively, the difference was significant with p<0.005. Changing the NYHA class in favor of the patient is one of the success factors for surgery [1], [2]. This result is similar to many domestic and foreign studies [2], [4].

After surgery with a decreasing in left ventricular outflow tract pressure, the left ventricular muscle tends to regress to normal with the Sokolow-Lyon index decreasing after surgery. When comparing pairs at the time of surgery, but the difference is not statistically significant. This may be because the change of left ventricular depolarization takes place slowly over time, the research results have proven that with Sokolow-Lyon early after surgery was 31.1 ± 2.9mm, then the 12th month after surgery was 24.1 ± 5.0mm.

Echocardiographic results: After surgery, the echocardiographic indices stabilized within the normal range from 6 months with LVEDd, LVEDs and mean PG decreasing and stabilizing, similar to other published studies [3], [4].

The results of EF% showed that left ventricular systolic function was significantly improved after valve replacement surgery, the difference in EF index compared with before treatment was statistically significant with p<0.05. The group with EF < 50% after surgery EF improved clearly and maintained with a threshold above 50%. In the PARTNER study in the aortic valve replacement group after 2 years of follow-up, the EF index increased statistically with p<0.001 and the EF level after 2 years increased from 53.4 ± 12.6% to 57.1 ± 10.4%. After 6 months, the mean EF was 57.0 ± 9.8% [5]. Gaudino M. after 1 year of follow-up mean EF increased from 55 ± 21% to 57 ± 16% [6].

We also found that the majority of patients preoperative EF valve replacement surgery was preserved, so when the cause of LV outflow obstruction was released, the mean EF improved well. In particular, the group of patients with EF < 50% improved after surgery compared with the group with EF > 50% before surgery. These results show that valve replacement surgery can reverse

the decline in left ventricular systolic function in patients with aortic stenosis after valve replacement.

According to the recommendations of the Vietnam Heart Association and AHA/ACC [1], [2]: in the first few weeks after surgery, the baseline left ventricular systolic function is little changed and the EF may even be lower than before surgery (due to reduced preload). The reversible ejection fraction was increased over the next several months. Mean PG was markedly decreased and tends to be stable < 20mmHg. The mean differential pressure across the valve depends on prosthetic valve operation, AVA, and PPM status. Follow-up results showed that most of the prosthetic valves worked well, some patients appeared to have regurgitation, but mild fuite paraprosthetiques. In our study, patients with PPM were found, but the rate was low and the severity was mild, so it had little effect on the mean transvalvular gradient.

PPM was mainly present in the medium term and increased the incidence of adverse events after valve replacement with an incidence of about 1.5 to 20%. The results also showed that the percentage of PPM gradually increased over time with changes in body mass index, VSH fibrosis and other cardiovascular degenerative factors. This result is lower than other studies abroad with the rate of severe PPM from 2 to 10%, mild PPM from 10 to 80% [7]. The resulting difference was due to the different causes of aortic stenosis in the study groups, so the prevalence of using multiple biovalves in these studies.

PPM is associated with mortality [7], reports have shown that patients with severe PPM have significantly worse survival rates than those without this phenomenon [7]. If PPM with EF% < 40%, mortality is 77 times higher than in patients with normal EF [8]. In addition, prosthetic valve disproportionately aggravates heart failure, increasing the degeneration of biological valves [7]. The predictors according to the author Bilkhu R et al include: Female, advanced age, hypertension, diabetes and renal failure. The authors also recognize that PPM may be a marker of comorbidities rather than a risk factor for adverse outcomes and that PPM should be suspected in patients with persistent cardiovascular symptoms after surgery replace the aortic valve [9]. The results of PPM in this study are lower than other studies in the world possibly due to the high rate of using mechanical valves.

Post-operative complications in this study were lower than that in other studies at home and abroad. Maybe the number of studies was still low, so the overall complication rate at the hospital could not be confirmed. However, the results also show that this is a safe, effective and low complication surgery [3], [5], [9].

5. Conclusion

Through medium-term follow-up, the results after valve replacement surgery to treat aortic stenosis showed marked improvement in clinical and subclinical. However, there is a donation of PPM over time, so it is necessary to manage well after surgery, especially the problem of overweight and obesity.

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