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Rheumatic mitral stenosis based on Wilkins score and echo score revisited for patients undergoing balloon mitral valvuloplasty

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ABSTRACT

Background: An important factor for obtaining good results with good clinical outcomes from BMV procedure in rheumatic mitral stenosis is selecting the right candidate. This study aimed to determine rheumatic mitral stenosis characteristics based on conventional scoring system and echo score revisited for patients undergoing balloon mitral valvuloplasty.

Method: This was a retrospective descriptive study with a cross-sectional approach. The study was conducted at the Department of Cardiology and Vascular Medicine, Sanglah Hospital Denpasar. Data were collected between January 1, 2019 and December 31, 2019 from registry and medical records.

Result: Both groups had the same median age, which is 43 years old. The majority of research subjects were female, namely 16 people or 94.4%. There were no subjects from the failed group who had low echo score revisited. A total of 3 subjects (100.0%) with Wilkins score of 7 and high echo score revisited categorized as failed because of occurrence of significant mitral regurgitation post-procedure. In the successful group with Wilkins score of 8, there were no subjects who had a low echo score revisited value. In subjects with a Wilkins score of 8 and high echo score revisited value, 3 subjects categorized as failed and 1 subject obtained significant mitral regurgitation post-procedure.

Conclusion: Patients with a low Wilkins score, but a high echo score revisited had a higher procedure failure rate.

Keywords: Rheumatic heart disease, mitral stenosis, balloon mitral valvuloplasty, echo score.

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INTRODUCTION

Rheumatic heart disease (RHD) is a chronic, progressive condition caused by complement-mediated damage to the atrioventricular valve that occurs due to the inflammatory response to rheumatic fever.[1] According to an annual report by the World Heart Federation, an estimated 12 million people are currently affected by rheumatic fever and rheumatic heart disease worldwide, and a high incidence rate is reported in the South Pacific Islands. The annual incidence prevalence of RHD has been estimated at more than 280,000 cases per year, and results in approximately 220,000 deaths per year.[1] Several studies were conducted on the prevalence of RHD, reporting 0.14/1,000 in Japan, 1.86/1,000 in China, 0.5/1,000 in Korea, 4.54/1,000 in India, and 1.3/1000 in Bangladesh.[2]

Although the incidence of CHD has decreased in developed countries in the past decade, it remains a serious public health problem in developing countries. The decline in the incidence of rheumatic heart disease in developed countries began in 1910. The prevalence of rheumatic heart disease in developing countries is not only related to the limited availability of medications such as penicillin but also the socioeconomic status of the country (i.e., population boom, population density, poverty, and poor access to medical care).[2]

In fast-developing Asian countries, awareness of RHD has increased as the use of transthoracic echocardiography has become widespread. In addition, the demand for adequate medical therapy is growing along with the explosive socio-economic growth which may contribute to the expanding use of balloon mitral valvuloplasty (BMV) as the management of rheumatic mitral stenosis.[2]

BMV, also known as Percutaneous Transcatheter Mitral Commissurotomy (PTMC) is the treatment option for patients with mitral stenosis. Compared with valvotomy surgery, BMV has a lower risk, shorter length of stay in hospital, but comparable results to valvotomy surgery. An important factor for obtaining good results with good clinical outcomes from BMV procedure is the selection of the right candidate.[3]

Table 1. Characteristics of research subjects

Variable	Failed (n = 6)		Successful (n = 12)	
	n (%)	Median (min-max)	n (%)	Median (min-max)
Age (in years)		43 (37-57)		43 (24-48)
Sex				
Male	0 (0%)		2 (16.7%)	
Female	6 (100.0%)		10 (83.3%)	
AF	4 (66.7%)		3 (25.0%)	
LAVI		45.9 (35 – 51.6)		46.5 (24-48)
MVA Pre		0.90 (0.4-0.96)		0.51 (0.35-0.74)
MVA Post		0.98 (0.51-2.6)		1.11 (0.77 – 2.09)
MV mean PG Pre		14 (10-19)		13.1 (9.49-18.25)
MV mean PG Post		11 (9-14)		6.55 (2-11.47)
Significant MR	4 (66.7%)		0	

Abbreviations: AF = atrial fibrillation, max = maximum value, min = minimum value, MR = mitral regurgitation, MVA pre = mitral valve area pre-procedure, MVA post = mitral valve area post-procedure, MV mean PG Pre = mitral valve mean pressure gradient pre-procedure, MV mean PG Post = mitral valve mean pressure gradient post-procedure, LAVI = LA volume index

Table 2. Characteristics of the Wilkins score in patients underwent balloon mitral valvuloplasty

Variable	Failed (n = 6) Median (min-max)	Successful (n = 12) Median (min-max)
Wilkins score	8 (7-8)	7 (7-8)
Subvalvular thickening	2 (2-2)	2 (1-2)
Leaflet thickening	2 (1-2)	2 (1-2)
Calcification	2 (2-2)	2 (1-2)
Mobility	2 (2-2)	2 (2-2)

Abbreviations: max = maximum value, min = minimum value

This study aimed to determine the characteristics of rheumatic mitral stenosis based on conventional scoring system and echo score revisited for patients undergoing balloon mitral valvuloplasty.

METHODS

This was a retrospective descriptive study with a cross-sectional approach that collected data of patients characteristics with mitral stenosis who were undergoing balloon mitral valvuloplasty at Sanglah General Hospital. The study was conducted at the Department of Cardiology and Vascular Medicine, Sanglah Hospital Denpasar. Data were collected between January 1, 2019 and December 31, 2019. Data were obtained from registry and medical records.

The inclusion criteria were diagnosis of mitral stenosis and fulfilling criteria for undergoing balloon mitral valvuloplasty. Patients excluded from the study if medical records were incomplete and failed to perform transeptal puncture.

BMV was categorized as successful if it met the echocardiography or catheterization criteria. Echocardiographic criteria were defined as increased MVA area more than 50% or the final area more than 1.5 cm^2 without complications in the form of significant mitral regurgitation (no more than mild mitral regurgitation as assessed by echocardiography 24 hours post-procedure). Catheterization criteria were defined as the post-BMV transmitral gradient is lower than 10 mmHg.

Data were processed using SPSS software version 25.0 (IBM Corporation, Armonk, USA). Variables were described in terms of number (n) and percentage (%), as well as the median value with a range of minimum and maximum values. Processed data are presented in the form, images and narration.

RESULTS

The baseline characteristics of the study population are shown in Table 1. Eighteen subjects who had met the inclusion and exclusion criteria included in this study. Six subjects were in failed group and 12 subjects were in successful group. Both groups had the same median age, which is 43 years old, with the minimum and maximum value in the failed group was 37-57 years old and in the successful group was 24-48 years old. The majority of research subjects were female, namely 16 people or 94.4%.

In the failed group, the proportion of atrial fibrillation was 66.7% of the total subjects, while in the successful group it was 25.0% or 3 subjects.

Based on the results of the study, the left atrial volume index (LAVI) scores indicated similar median value in both groups, 45.9 (35 - 51.6) in the failed group and 46.5 (24 - 48) in the successful group. The median of the mitral valvular area pre-procedure was 0.90 (0.4-0.96) in the failed group and 0.51 (0.35-0.74) in the successful group. The median of the mitral valvular area post-procedure was 0.98 (0.51-2.6) in the failed group and 1.11 (0.77 - 2.09) in the successful group. The mean mitral valve pressure post-procedure in the failed group was 11 (9-14), while in the successful group it was 6.55 (2-11.47). A total of 4 subjects (66.7%) experienced significant mitral regurgitation in the failed group.

Characteristics of the Wilkins Score in Patients Underwent Balloon Mitral Valvuloplasty

Both the failed and successful groups had a total Wilkins score with a median score of 7 with a minimum-maximum score

Table 3. Characteristics of the echo score revisited in patients underwent balloon mitral valvuloplasty

Variable	Failed (n = 6)		Successful (n = 12)	
	n (%)	Median (min-max)	n (%)	Median (min-max)
Echo Score Revisited		8.0 (8-11)		5 (2-8)
Low	0 (0.0%)		3 (25.0%)	
Intermediate	0 (0.0%)		6 (50.0%)	
High	6 (100.0%)		3 (25.0%)	

Table 4. Cross-tabulation between BMV, Wilkins score, and echo score revisited

Wilkins score	Echo score revisited	Successful	Failed
Score 7	Low	3 (42.9%)	0 (0.0%)
	Intermediate	3 (42.9%)	0 (0.0%)
	High	1 (14.3%)	3 (100.0%)*
Score 8	Low	0 (0.0%)	0 (0.0%)
	Intermediate	3 (60.0%)	0 (0.0%)
	High	2 (40.0%)	3 (100.0%)†

*3 subjects showed significant mitral regurgitation after BMV procedure
†1 subjects showed significant mitral regurgitation after BMV procedure

range of 7-8. Each parameter measured on the Wilkins score had a median value of 2 in both groups. The minimum and maximum values for each parameter varied from 1-2 and 2-2. The data were presented in Table 2.

Characteristics of the echo score revisited in patients underwent balloon mitral valvuloplasty

In addition to the Wilkins score, subjects were also calculated for echo score revisited. The median score in the failed group was 8, with a minimum and maximum score of 8-11. In the successful group, the median score is 5, with a minimum score of 2 and a maximum score of 8.

There were no subjects from the failed group who had low echo scores revisited, while in the successful group there were 3 subjects. Intermediate scores were obtained for 1 subject (10.0%) in failed group and 6 subjects (50.0%) in successful group. All subjects (6 subjects, 100.0%) in the failed group had high scores, but only 3 subjects (25.0%) from the successful group had high scores. Data is presented in Table 3.

Characteristics of successful balloon mitral valvuloplasty procedure based on Wilkins score and echo score revisited

In this study, the Wilkins score and the echo score revisited were compared with the successful rate of the BMV procedure. The data were presented in Table 4. In the successful group with Wilkins score of 7, 3 subjects had a low echo score revisited value, 3 subjects had a intermediate echo score revisited value, and 1 subject had a high echo score revisited.

There were no subjects in the failed group with Wilkins score of 7, who had low or intermediate echo score revisited value. A total of 3 subjects (100.0%) with Wilkins score of 7 and high echo score revisited categorized as failed because of occurrence of significant mitral regurgitation post-procedure.

In the successful group with Wilkins score of 8, there were no subjects who had a low echo score revisited value, 3 subjects had intermediate echo score revisited ore value, and 2 subjects had a high echo score revisited value. In subjects with a Wilkins score of 8 and high echo score revisited value, 3 subjects categorized as failed and 1 subject obtained significant mitral regurgitation post-procedure.

DISCUSSION

In this study, an analysis was carried out on 18 RHD patients with mitral stenosis who underwent BMV at Sanglah Hospital. Data analysis showed the characteristics of age, sex, atrial fibrillation, LA volume index, and valve morphological parameters of patients. This study also analyzed the Wilkins score and the echo score revisited on the successful rate of BMV procedure.

The sequelae of rheumatic fever may cause mitral stenosis due to deposition of immune complexes and complement on the surface of the mitral valve. This structural abnormality inhibits left ventricular diastolic filling, which reduces preload and increases left atrial systolic pressure and diastolic volume.

The age range for developing mitral stenosis due to RHD is influenced by country demographics. In developed countries, the incidence of RHD tends to be lower and is common in the five to six decades of life. Meanwhile, in many developing countries mitral stenosis is found at a younger age of 20-30 years. In this study, the median age of subjects was 43 years with an age range of 24-57 years. Older patients do have a tendency to develop degenerative valve changes in addition to commissural fusion, and these patients often have comorbidities. However, based on 15-year study by Ramondo, age is not a predictor of long-term BMV success.[4]

The majority of the subjects of this study were female, namely 94.4%. These result were higher than the study by Movahed et al. who conducted a retrospective study of 24,265 cases. Movahed et al. concluded that the prevalence of mitral stenosis between women and men is 2-4: 1. This study has not been able to conclude the reason for the increased prevalence of mitral stenosis due to CHD in women.[5]

Atrial fibrillation is a common complication of mitral stenosis in RHD. This condition affects the survival rate in post-BMV patients. The incidence of atrial fibrillation was also consistently associated with left atrial size.[6] Based on the results of the multivariate analysis of

the BMV study, atrial fibrillation was not associated with an immediate outcome of BMV. Atrial fibrillation is associated with decreased survival rates without surgery or repeated BMV. In this study, the incidence of atrial fibrillation of all subjects was 38.9%, with the incidence rate in the failed group of 66.7% and the successful group of 25.0%. This data was lower than the study by Widowati et al. which found an incidence of atrial fibrillation of 63.6% in pre-procedure BMV patients.[7]

LAVI is said to be a prognostic marker for cardiovascular outcomes in the general population, as well as for various heart diseases, such as heart failure, hypertrophic cardiomyopathy, and ischemic cardiomyopathy. In valvular heart disease, LAVI is a prognostic marker of cardiovascular outcome after mitral valve surgery and in pharmacologically treated mitral regurgitation patients. Study by Kang et al. also found that greater post-procedure LAVI was an independent predictor of new-onset atrial fibrillation.[8,9]

In this study, the LAVI scores in both groups showed a similar median value, namely, 45.9 (35 - 51.6) in the failed group and 46.5 (24 - 48) in the successful group. However, the failed group's LAVI range showed a higher minimum and maximum value than in the successful group. In addition, LAVI> 50 is an independent universal predictor of cardiac events in progressive mitral stenosis.[8]

The expected outcomes of BMV procedure include an increase in MVA and a decrease in the transmitral gradient. BMV is defined as successful if the MVA area increases ≥50% or the final area ≥1.5 cm^2 without complications in the form of significant mitral regurgitation, or if a post-BMV transmitral gradient is obtained <10 mmHg.[10]

The results of this study indicate that there are 4 subjects in the failed group who experienced post-procedure mitral regurgitation. Kim et al. found that post BMV mitral regurgitation often results from separation of the commissure. There are several mechanisms by which mitral regurgitation occurs after BMV. In that study, it was found that significant mitral regurgitation only occurred due to post-BMV non-commissural tears. Separation of the fused commissure usually causes only mild mitral regurgitation or without clinical importance. Patients with commissural mitral regurgitation had an 8-year higher event-free survival than patients with non-commissural mitral regurgitation.[11]

In this study, as many as 3 subjects experienced transeptal puncture failure so that they were excluded from the study sample. Transeptal puncture is a risky procedural step with the main complications of cardiac perforation and the development of cardiac tamponade. One of the main keys in this procedure is to determine the exact puncture site, namely the fossa ovalis. Transeptal puncture procedures are usually fluoroscopy-guided, but often this approach does not produce satisfactory results. Imaging modalities such as intracardiac or transesophageal echocardiography may be considered to increase the safety and efficacy of transeptal puncture. The downside of this approach is more expensive than fluoroscopy-guided method.[12]

Based on the analysis of the cross-tabulation, it was found that even though the subject had a Wilkins score of 7 or 8, but had a high echo score revisited, the failure of the procedure was still quite high. This can be explained from a study conducted by Nunes et al. They observed that although all Wilkins score components were associated with immediate outcome, only leaflet calcification and subvalvular thickening were independent predictors.[13]

When all univariate predictors including commissural area (CA) ratio and displacement leaflet were included in the multivariable model, the independent predictors included baseline MVA, leaflet displacement, CA ratio, and subvalvular thickening. This score has a significantly greater predictive value than the Wilkins model and takes into account increased MVA and mitral regurgitation.[13]

The quantitative assessment of leaflet mobility which was stated as the maximum leaflet displacement relative to the annulus was a predictor of the success of increasing MVA. Whereas the CA ratio assessment can be considered as a continuum where the higher the value, the greater the risk of post-procedure mitral regurgitation, which may mean an increase in procedure failure.[13]

The echo score revisited significantly improved the reclassification of subjects with poor BMV results, with a 45.2% increase in net reclassification compared to the Wilkins score. Although there is a high correspondence between the Wilkins score and the echo score revisited in high-risk patients, patients classified as having a low Wilkins score may have a high echo score reviewed. The study by Nunes et al. concluded that the high failure rate in the subgroup that had a low Wilkins score with a high echo score revisited, mainly due to the occurrence of mitral regurgitation post-BMV. This also confirms that the Wilkins score is not good at predicting post-procedure mitral regurgitation.[13]

The limitation of this study included small sample size. A total of 4 samples were excluded from the study because they did not have complete post-BMV echocardiography data and experienced transeptal puncture failure. The authors suggested that post BMV echocardiography is performed in 24 hours post-procedure so that the data can be recorded completely. Further research is needed to assess the outcome of subjects post BMV procedure, based on their echo score.

In conclusion, patients with a low Wilkins score, but a high echo score revisited had a higher procedure failure rate.

CONFLICTS OF INTEREST

The author declares there is no conflict of interest regarding publication of this article.

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ETHICAL CONSIDERATION

This study only based on secondary registry data and ethical clearance is not mandatory.

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