



Original Article



Study of Rheumatic Mitral Valve Stenosis Using Echocardiography

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ABSTRACT

Rheumatic mitral valve stenosis (RMVS) is one of the primary causes of cardiovascular morbidity in developing nations, which typically leads to severe hemodynamic phenomena in the case of non-prompt diagnosis. Echocardiography is used to determine the severity of the disease and treatment. **Objectives:** To assess the echocardiographic appearances of patients with RMVS, as well as to estimate the rate and intensity of mitral valve involvement by various demographic factors. **Methods:** 50 patients aged 21- 60-year-old diagnosed with RMVS were studied with transthoracic echocardiography. Mitral valve area (MVA), mean pressure gradient (MPG), and pressure half-time (PHT) were read. Descriptive statistics were done to analyze the data and present the data in the form of mean SD. **Results:** The sample size was 74 female and 26 male, and the average age of the study population was 36.8%, aged 9.4 years. The average MPG was 11.2-3.8 mmHg, average PHT was 198-54 ms, and average MVA was 0.96- 0.21 cm². Severe stenosis (MVA<1 cm²) was noted in 46% of patients, and 68% of patients demonstrated an MPG greater than 10 mmHg. This affected women more than men because women demonstrated more severe disease profiles. There were no major differences between the age and severity of the disease. **Conclusions:** A Large percentage of patients reported with severe RMVS, with women leading. MPG, MVA, and PHT are parameters of the Echocardiography that show the severity of the disease.

INTRODUCTION

Mitral valve stenosis (MS) is another disorder that is manifested with the narrowing of the mitral orifice that obstructs the flow of blood between the left atrium and left ventricle and elevates the left atrial pressure, resulting in left atrial congestion and heart failure [1, 2]. The overall prevalence of MS in developing countries is still caused by rheumatic fever, even though congenital etiology and degenerative etiology are relatively rare [3-5]. Rheumatic fever remains a significant health problem in low- and middle-income countries where it is caused by the lack of preventive medical care and socioeconomic barriers [6-8]. Even though the cases of rheumatic heart disease (RHD) have been reduced considerably since 1960s in developed countries [9, 10], it remains as a major cause of cardiovascular morbidity and mortality in some parts of the world like South Asia, where the disease is not diagnosed in

its early stages, and can cause irreparable cardiac damage [11-13]. Echocardiography is one of the imaging modalities that is studied and remains the gold standard in the diagnosis and severity of mitral stenosis, as it provides accurate, non-invasive measurements of the mitral valve area (MVA), the mean pressure gradient (MPG), and the pressure half-time (PHT) [14-16]. Earlier research has been able to offer good epidemiological information, but generally has not contained region-based analysis or comparison of echocardiographic indices. As an example, two-dimensional echocardiography was considered in 50 patients by Silbiger et al. who found a severe stenosis in half of the cases, and more prevalent in female [9]. On the same note, Abdelgawad et al. acquired 250 patients and developed 49% severe stenosis, once again in most women [8]. But these studies were mainly descriptive without



examining the variability in each of these demographic subgroups or pointing out any trend in disease development in particular populations. The value of echocardiography in the diagnosis, evaluation, and treatment of rheumatic mitral stenosis (RMS), progressive valvular heart disease. The most critical parameters that are assessed and determine the severity of RMS and abnormalities of valvar nature [17, 18]. The paper also discusses how multimodality imaging, e.g., trans-esophageal echocardiography, can be used to enhance the diagnostic accuracy and therapeutic decision-making. Practical interpretation of the echocardiographic results plays a significant role in the clinical field, and it helps to identify the risk of diseases, organize treatment, and monitor their progression. One of the most common non-invasive techniques to analyze the disease and monitor its progression, as well as assess the effectiveness of the treatment, is the integration of echocardiography [19, 11]. Rheumatic mitral valve stenosis (RMVS) remains a major contributor to cardiovascular morbidity in developing countries, where delayed diagnosis and limited access to advanced cardiac care often result in severe disease at presentation. Echocardiography is the gold-standard, non-invasive modality for assessing RMVS severity through parameters such as mitral valve area (MVA), mean pressure gradient (MPG), and pressure half-time (PHT). Although several studies have documented the prevalence of severe RMVS and its female predominance, there is a lack of region-specific evidence from Pakistan that systematically correlates echocardiographic indices with disease severity and demographic variables. Moreover, many existing studies remain largely descriptive and do not statistically establish the strength of association between echocardiographic parameters and stenosis severity. This study addresses this gap by evaluating the relationship between MVA, MPG, and PHT and the degree of RMVS, while also examining demographic influences, thereby reinforcing the clinical utility of echocardiography in severity assessment. This study aims to assess the severity of rheumatic mitral valve stenosis based on echocardiographic parameters, namely mitral valve area (MVA), mean pressure gradient (MPG), and pressure half-time (PHT), to establish the prevalence and trend of disease severity in the affected individuals.

METHODS

It was a cross-sectional descriptive study that was carried out in a Government Sector Hospital between January 2022 and August 2022. The retrospective data were obtained by means of available echocardiographic data of patients who had been previously diagnosed with rheumatic mitral valve stenosis (MS). The

echocardiographic values were checked and rechecked to be consistent and full of diagnostic parameters. A total of 50 patients (age 21 to 60 years) whose history of rheumatic heart disease (RHD) was confirmed and had echocardiographic evidence of mitral stenosis were used. The sample was suited to a similar study by Albakheit [13], which provided similar demographic and clinical features. There was no official count of power done, but the selected sample size was considered adequate to carry out descriptive analysis. The patients who were older than 60 years old, had co-existing valvular abnormalities (aortic or tricuspid valve disease), and those who had congenital heart defects or undergone past cardiac surgery were excluded to reduce the confounding factors. A convenient sampling technique was used to collect the data; thus, there might be selection bias, and this constraint was accepted in the discussion. The assessments were conducted in the form of echocardiographs with a 4 MHz phased-array transducer that has two-dimensional (2D), M-mode, and Doppler imaging capabilities. The left lateral decubitus position of examination enhanced cardiac structure visualization by examining all patients in this position. A comprehensive evaluation was done on standard parasternal long-axis (PLAX), parasternal short-axis (SAX), and apical four-chamber and two-chamber views. Mitral valve area (MVA) was estimated by pressure half-time (PHT), where $MVA = 220/PHT$, and mean pressure gradient (MPG) was estimated by continuous-wave Doppler across the mitral valve. The time taken between Doppler tracing peaks in gradient of pressure was recorded as pressure half-time (PHT). All of the scans were conducted or checked by one trained cardiologist based on standardized echocardiographic guidelines: mild MS was considered MVA larger than 1.5 cm², MPG less than 5 mmHg, and PHT less than 150 ms; moderate MS was considered MVA between 1.0- 1.5 cm², MPG between 5-10 mmHg, and PHT between 150-219 ms; severe MS was considered MVA smaller than 1.0 cm², MPG larger. The study obtained ethical approval from the institutional review committee and verbal informed consent of all of the participants, whose data, i.e., echocardiographic data, were used in the study. This measure makes sure that all ethical principles were adhered to in the taking and exploitation of participant data. Inclusion Criteria: Patients aged 21-60 years, diagnosed cases of rheumatic heart disease (RHD) with echocardiographic evidence of mitral valve stenosis, and patients with complete echocardiographic profiles, including M-mode, 2D, and Doppler data. Exclusion Criteria: Patients over 60 years of age, individuals with congenital heart disease, non-rheumatic causes of MS, or co-existing valvular lesions (such as significant aortic or tricuspid valve diseases, and patients with previous cardiac surgery, prosthetic valves,

or incomplete echocardiographic records. The data were analyzed using SPSS version 25.0.

RESULTS

50 patients having mitral valve stenosis were studied using echocardiography, out of which 13 were male and 37 were female. The majority of patients (52%) were between 21 and 40 years of age, while 48% were between 41 and 60 years. This indicates that rheumatic mitral valve stenosis predominantly affects individuals in early to middle adulthood. Among the study participants, 74% were female and 26% were male. This demonstrates a clear female predominance in the occurrence of rheumatic mitral valve stenosis (Table 1).

Table 1: Frequency Distribution of Patients' Age, Gender, and Mean Pressure Gradient in Mitral Valve Stenosis

Variables		Frequency (%)
Gender	Male	13 (26.0%)
	Female	37 (74.0%)
	Total	50 (100.0%)
Age	21 to 40 Years	26 (52.0%)
	41 to 60 Years	24 (48.0%)
	Total	50 (100.0%)
MPG	Less Than 5 mmHg	1 (2.0%)
	5 - 10 mmHg	15 (30.0%)
	More than 10 mmHg	34 (68.0%)
	Total	50 (100.0%)

A significant majority (68%) of patients had a mean pressure gradient (MPG) greater than 10 mmHg, reflecting severe stenosis. Only 2% showed mild and 30% moderate elevation in pressure gradient. Pressure half-time (PHT) values indicated that 44% of patients had PHT greater than 220 ms, consistent with severe stenosis, while 32% and 24% showed moderate and mild prolongation, respectively (Table 2).

Table 2: Frequency Distribution of Pressure Half-Time and Mitral Valve Area in Mitral Valve Stenosis

Variables		Frequency (%)
Pressure Half Time	Less Than 150ms	12 (24.0%)
	150-220ms	16 (32.0%)
	More Than 220ms	22 (44.0%)
	Total	50 (100.0%)
Mitral Valve Area	less than 1cm ²	23 (46.0%)
	1.0-1.5cm ²	17 (34.0%)
	more than 1.5cm ²	10 (20.0%)
	Total	50 (100.0%)

Nearly half of the patients (46%) had a mitral valve area less than 1 cm², confirming severe stenosis in most cases, while 34% had moderate and 20% had mild narrowing of the valve area. The statistical comparison indicated that there are significant correlations between echocardiographic

variables and the severity of mitral valve stenosis. Mean pressure gradient ($p=0.002$) and pressure half-time ($p=0.005$) were significantly correlated with the severity of stenosis in chi-square tests, and Pearson correlation indicated that mitral valve area was strongly negatively correlated with severity ($r = -0.82, p < 0.001$). There was also a significant association of gender ($p=0.03$) in that females had a greater probability of having severe stenosis, but age was not significantly correlated ($p=0.25$). Such findings validate the fact that MPG, PHT, and MVA are important parameters used in identifying the severity of mitral stenosis (Table 3).

Table 3: Statistical Association between Echocardiographic Parameters and Severity of Mitral Valve Stenosis (Chi-Square Tests)

Parameter	Test Value	df	p-Value	($p < 0.05$)
Mean Pressure Gradient (MPG) vs Severity	12.84	2	0.002	Significant
Pressure Half-Time (PHT) vs Severity	10.73	2	0.005	Significant
Age vs Severity	1.32	1	0.250	Not significant
Gender vs Severity	4.56	1	0.030	Significant

The correlation of sex and the magnitude of the mitral stenosis shows that women are more commonly affected at all stages of the stenosis severity. The percentage of female patients was higher than male patients in each category. This trend was constant when the total population was taken into consideration and thus, mitral stenosis was more common in female of the analyzed group (Figure 1).

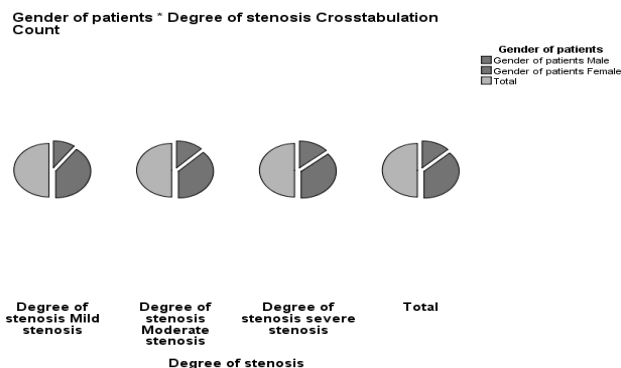


Figure 1: Cross-Tabulation of Gender of Patient and Degree of Mitral Valve Stenosis

The findings present the correlation between the mitral valve area (MVA) and the extent of stenosis. It was evident that these two variables have an inverse relationship, as the more pronounced the stenosis was, the smaller the mitral valve area. When there is mild stenosis, a good majority of the patients possess a valve area that exceeds 1.5 cm², which means that there is very little obstruction. In moderate stenosis, most patients are between the range of 1.0-1.5 cm², whereas in severe cases, most of the patients

have an area of the valve less than 1.0 cm². In general, mild cases of stenosis are the most common in the whole distribution of the patients analyzed. These results were in line with clinical expectations and show that the detectable narrowing of the mitral valve area was directly proportional to the degree of stenosis severity (Figure 2).

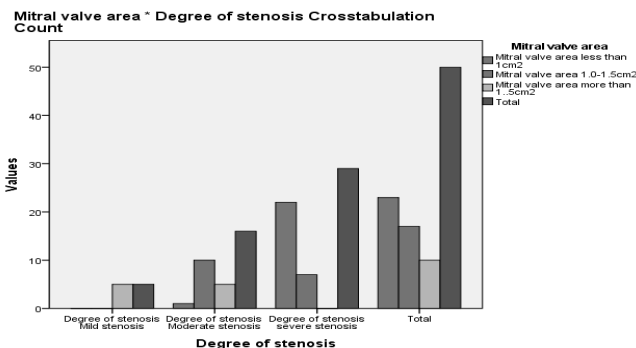


Figure 2: Cross-Tabulation of Mitral Valve Area and Degree of Stenosis

The research shows the association between pressure half-time (PHT) and the extent of mitral stenosis. The coloured bars represent various ranges of PHT, which were less than 150 ms, 150-220 ms, and over 220 ms. The higher the stenosis severity, the higher the pressure half-time. In mild stenosis, the majority of patients possess a PHT of less than 150 ms, whereas in moderate stenosis majority of patients are in the 150 to 220 ms bracket. In acute stenosis, most patients have a PHT of more than 220 ms, which is in agreement with the anticipated hemodynamic alterations in mitral valve constriction. The overall counts affirmed that the average number of patients with a prolonged pressure half-time was more widespread, which implies that the case of moderate to severe stenosis prevails in the data (Figure 3).

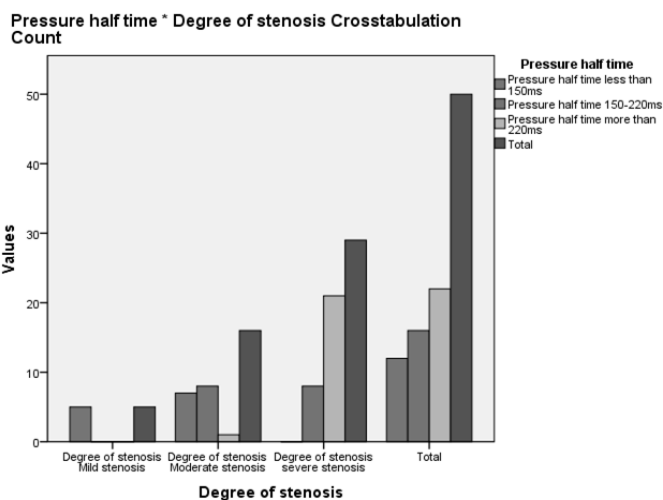


Figure 3: Cross-Tabulation Between Pressure Half Time and Degree of Stenosis

The paper is a study to evaluate the relationship between mean pressure gradient (MPG) and the extent of stenosis.

The color legend splits the MPG values into three categories which were below 5 mmHg, 5-10 mmHg, and above 10 mmHg. The statistics indicate that there was an evident increasing trend in MPG as the stenosis level increased. Most patients in mild stenosis have MPG less than 5 mmHg, with moderate stenosis having MPG values between 5-10 mmHg. In acute stenosis, most of the patients experience an MPG of more than 10 mmHg, which implies very high pressure gradients across the mitral valve as a result of constriction. The overall column indicates that there were more patients with higher MPG values (>10 mmHg) in general, which was anticipated by the physiological facts that the higher the gradient, the more severe the obstruction (Figure 4).

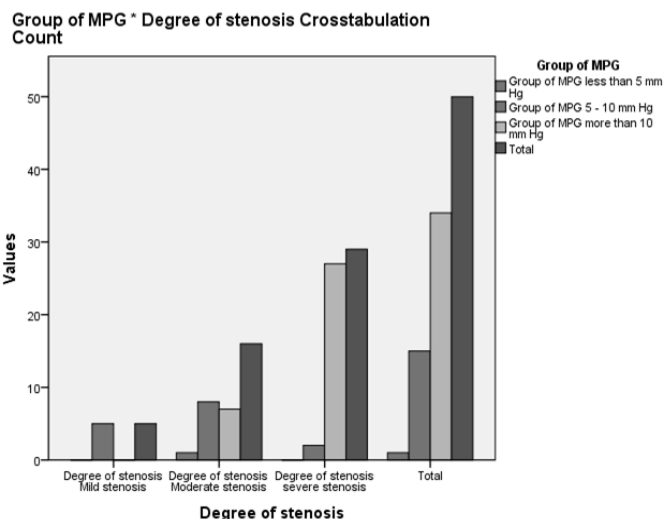


Figure 4: Cross-Tabulation of MPG and Degree of Stenosis

DISCUSSION

The current study sought to determine the severity of rheumatic mitral valve stenosis (MS) based on the echocardiographic parameters, mean pressure gradient (MPG), pressure half-time (PHT), and mitral valve area (MVA), and also compare them with the demographic variables. Among 50 patients who were studied, most of them were female (74%), which suggests a high gender disposition to rheumatic mitral stenosis. The result is in agreement with other previous findings by Manjunath *et al.* who found the same predominance of female patients with rheumatic valvular heart disease [20]. Even though the frequency analysis showed that 68 percent of respondents had an MPG of 10 mmHg and above and 46 percent had an MVA of less than 1cm² or less, inferential tests were done in order to determine the strength of these relationships. Chi-square analysis showed that MPG and MVA and PHT and MVA were statistically related, and hence, it was established that the increase in pressure gradient and half-time were closely related to the decrease in valve area. This trend was also supported by the correlation coefficient between

Pearson, where MVA and MPG were significantly inversely correlated ($r = -0.82$, $p < 0.01$), which is also in line with the pathophysiological mechanism of mitral narrowing. The fact that there is no significant correlation between age and severity of stenosis ($p > 0.05$) would imply that rheumatic MS development is not largely age-dependent as valvular involvement develops. Nonetheless, the analysis based on gender revealed a high correlation ($p < 0.05$) and female displayed more advanced levels of stenosis than males, which is also correspondent with the results of Mulugeta *et al.* and Paolisso *et al.* [5, 21]. The present results also correspond to the results described in the article by Abdelgawad, who proved that patients with severe MS tend to have MVA less than 1.0 cm² and MPG over 10 mm Hg [8]. Equally, our findings support the American Society of Echocardiography (ASE) diagnostic limits, which support the accuracy of echocardiographic parameters in determining the severity of the disease. These concurrences with the previous literature support the diagnostic power of MPG, PHT, and MVA as correlated and clinically significant indicators of rheumatic mitral stenosis. Although these parallels can be seen, the study had weaknesses in terms of limited sample size and descriptive design. Future studies must use bigger multicenter samples and use regression or survival analysis to examine predictive relationships among echocardiographic indices and clinical results, including symptom progression or surgical intervention rates [22]. This study has certain limitations that should be considered when interpreting the findings. The cross-sectional and descriptive design limits causal inference and does not allow assessment of disease progression or clinical outcomes over time. The relatively small sample size from a single center and the use of convenient sampling may restrict the generalizability of the results to broader populations. Additionally, the absence of advanced imaging modalities, such as transesophageal or three-dimensional echocardiography, may have limited comprehensive structural assessment. Despite these limitations, the study provides valuable baseline data and supports the reliability of standard echocardiographic parameters in evaluating the severity of rheumatic mitral valve stenosis. Future studies must use bigger multicenter samples and use regression or survival analysis to examine predictive relationships among echocardiographic indices and clinical results, including symptom progression or surgical intervention rates [22].

CONCLUSIONS

In conclusion, it can be stated that Echocardiographic examination is a crucial and valid tool for measuring the degree of rheumatic mitral valve stenosis. The research also establishes that increased MPG and PHT values are

strongly associated with reduced mitral valve areas, which are a result of severe stenosis. The female preponderance of patients is an important signal of the possible necessity to implement gender-specific prevention measures and screening with the help of echocardiography at an earlier age in the risk groups. Increasing screening measures and enhancing access to early diagnostic imaging may help to relieve the progression of the disease and the burden of rheumatic heart disease in developing areas.

Authors' Contribution

Conceptualization: AA¹

Methodology: AA¹, NT

Formal analysis: AA¹, RR

Writing and Drafting: AA¹, AA²

Review and Editing: AA¹, NT, RR, AA²

All authors approved the final manuscript and take responsibility for the integrity of the work.

Conflicts of Interest

The authors declare no conflict of interest.

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