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Prevalence of Angiographically Significant Coronary Artery Disease in Patients Undergoing Surgery for Rheumatic Valvular Heart Disease.

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Abstract

Background: Coronary artery disease (CAD) may coexist with rheumatic valvular heart disease and can influence perioperative planning and surgical management. This study aimed to determine the prevalence of angiographically significant CAD among patients aged 40 years and above undergoing valve replacement surgery for rheumatic valvular heart disease.

Methodology: This descriptive cross-sectional study was conducted at the Medical Teaching Institution, Lady Reading Hospital, Peshawar, from January 2020 to December 2024. Male and female patients aged ≥40 years requiring valve replacement for rheumatic valvular heart disease were enrolled through consecutive non-probability sampling. Valvular disease was assessed by transthoracic echocardiography. Patients with previously documented CAD, prior coronary revascularization, degenerative valvular disease, infective endocarditis, bicuspid aortic valve, or emergency surgery were excluded. All participants underwent preoperative coronary angiography. Significant CAD was defined as >50% stenosis of the left main coronary artery or >70% stenosis of other major coronary arteries. Although the minimum calculated sample size was 151, 215 eligible patients were included.

Results: Of 215 patients, 121 (56.3%) were male and 94 (43.7%) female, with a mean age of 48.84 ± 6.62 years. Significant CAD was detected in 37 (17.20%) patients. Among these, 13 (35.10%) had single-vessel, 16 (43.20%) double-vessel, and 8 (21.60%) triple-vessel disease; 24 (64.9%) had multivessel disease.

Conclusion: Significant CAD was present in 17.20% of patients undergoing valve replacement for rheumatic valvular disease, with nearly two-thirds demonstrating multivessel involvement, supporting careful preoperative coronary assessment for appropriate surgical planning.

Keywords

Coronary Artery Disease, Rheumatic Heart Disease, Rheumatic Valvular Heart Disease, Valve Replacement Surgery, Coronary Angiography.

Introduction

Valvular heart disease remains an important cause of cardiovascular morbidity and mortality worldwide, although its underlying etiology varies substantially across geographical and socioeconomic settings. Rheumatic heart disease continues to predominate as a cause of valvular disease in low- and middle-income countries, whereas degenerative and functional valvular disorders are more frequently encountered in high-income countries.[1] Consequently, countries such as Pakistan continue to experience a substantial requirement for surgical intervention for rheumatic valvular lesions.

The coexistence of coronary artery disease (CAD) in patients undergoing valve surgery is clinically important because significant coronary lesions may require coronary revascularization during the same surgical procedure. Identification of CAD before surgery therefore has direct implications for operative planning and perioperative risk assessment. The presence of concomitant CAD may also influence surgical outcomes; for example, 30-day mortality has been reported to be higher among patients undergoing combined coronary artery bypass grafting and aortic valve replacement compared with those undergoing isolated aortic valve replacement.[2] Appropriate preoperative assessment of the coronary circulation is therefore an important component of the evaluation of selected patients undergoing valvular surgery.

Current clinical recommendations emphasize evaluation for obstructive CAD before valve intervention according to patients' clinical characteristics and underlying risk of coronary disease.[3] Invasive coronary angiography provides direct anatomical assessment of the coronary arteries and enables identification of clinically significant coronary stenosis that may alter the planned surgical strategy.

The reported prevalence of concomitant CAD among patients with valvular heart disease varies considerably across studies and populations. Several investigations have examined CAD among patients undergoing surgery for valvular heart disease of different etiologies,[4-6] whereas others have specifically evaluated patients with rheumatic valvular disease.[7,8] Such distinction is important because patients with rheumatic valvular heart disease may differ substantially from those with degenerative valve disease in terms of age, cardiovascular risk profile, and underlying disease characteristics.

Narang et al. evaluated 2,188 patients with rheumatic valvular heart disease undergoing screening coronary angiography before surgery and reported significant CAD in approximately 11% of patients.[9] Other studies, however, have demonstrated considerable geographical variation. A Pakistani study reported obstructive CAD among 24.6% of patients undergoing surgery for rheumatic valvular heart disease,[10] while other local studies have also reported varying frequencies of significant CAD among patients undergoing valve replacement surgery.[11,12] These differences highlight the importance of evaluating the burden of concomitant CAD within individual populations and healthcare settings.

Despite the continuing burden of rheumatic valvular heart disease in Pakistan, evidence regarding the prevalence and angiographic extent of concomitant CAD among patients undergoing rheumatic valve surgery remains limited, particularly in our regional population. Locally generated evidence may assist clinicians and cardiac surgical teams in understanding the expected burden of significant coronary disease during preoperative evaluation and planning appropriate surgical management.

Therefore, the present study aimed to determine the prevalence of angiographically significant coronary artery disease among patients aged 40 years and above undergoing planned valve replacement surgery for rheumatic valvular heart disease at a tertiary-care center in Peshawar, Pakistan.

Methodology

Study Design

This descriptive cross-sectional study was conducted to determine the frequency of angiographically significant coronary artery disease (CAD) among patients aged 40 years and above undergoing planned valve replacement surgery for rheumatic

valvular heart disease. A consecutive non-probability sampling technique was used, whereby all eligible patients presenting during the defined study period and fulfilling the predefined selection criteria were considered for inclusion. The primary outcome of interest was the presence of angiographically significant CAD on preoperative coronary angiography.

Ethics

Ethical approval for the study was obtained from the Ethical Review Committee of Lady Reading Hospital, Peshawar (Ref. No. 1031/LRH/MTI, dated 23/12/2022). Eligible patients were included after obtaining informed consent. Patient information collected for the study was used for research purposes in accordance with institutional ethical requirements.

Setting

The study was conducted jointly in the Departments of Cardiology and Cardiovascular Surgery, Medical Teaching Institution (MTI), Lady Reading Hospital, Peshawar, Pakistan. Patients undergoing evaluation for valve replacement surgery due to rheumatic valvular heart disease between January 2020 and December 2024 constituted the study population. The institutional setting provided facilities for transthoracic echocardiography, invasive coronary angiography, and cardiovascular surgical evaluation.

Participants

All consecutive male and female patients aged ≥40 years who had an indication for valve replacement surgery due to rheumatic valvular heart disease were eligible for inclusion. Rheumatic valvular disease and the severity of the underlying valve lesion were assessed using transthoracic echocardiography (TTE). Echocardiographic parameters recommended by the American Society of Echocardiography were used to diagnose and quantify valvular stenosis and regurgitation. Morphological features considered suggestive of rheumatic etiology included thickening of the free borders of the valve leaflets, with or without commissural fusion, reduced leaflet mobility, and posterior leaflet fixation.

Patients with previously documented coronary artery disease, previous coronary revascularization, degenerative valvular disease, infective endocarditis, bicuspid aortic valve, or those undergoing emergency surgery were excluded. These criteria were applied to obtain a study population undergoing elective surgical management primarily for rheumatic valvular heart disease without previously established CAD or major non-rheumatic valvular pathology.

Variables

The principal outcome variable was the presence or absence of angiographically significant CAD. Significant coronary stenosis was defined as >50% luminal stenosis of the left main coronary artery and >70% stenosis of other major epicardial coronary arteries. Among patients identified as having significant CAD, the angiographic extent of disease was further categorized as single-vessel, double-vessel, or triple-vessel disease according to the number of major coronary vessels showing significant stenosis.

Other variables recorded for characterization of the study population included age, sex, type of rheumatic valvular involvement, and planned valve surgery. Valvular disease was categorized according to the operative requirement as mitral valve disease requiring mitral valve replacement, aortic valve disease requiring aortic valve replacement, or combined mitral and aortic valve disease requiring double valve replacement. Age was treated as a continuous quantitative variable, whereas sex, type of valve disease/planned surgery, presence of significant CAD, and extent of CAD were treated as categorical variables.

Data Sources / Measurement

Clinical and diagnostic information was obtained during the patients' preoperative evaluation. The diagnosis, type, and severity of rheumatic valvular heart disease were established using TTE. Standard echocardiographic parameters were used to assess valvular stenosis and/or regurgitation, while characteristic valve morphology was considered when determining rheumatic etiology.

All patients included in the study underwent preoperative invasive coronary angiography,

preferably through the right radial approach, using standard angiographic views. Coronary artery stenosis was evaluated visually by a consultant cardiologist. Angiographically significant CAD was defined using the prespecified thresholds of >50% stenosis for the left main coronary artery and >70% stenosis for other coronary vessels. The same operational thresholds were applied when classifying patients as having significant CAD and when determining the number of significantly diseased vessels.

Bias

Several measures were incorporated into the study design to reduce potential selection and measurement bias. Consecutive recruitment of all eligible patients during the study period was used to reduce selective enrollment. Uniform inclusion and exclusion criteria were applied to define the study population. Restricting inclusion to patients with rheumatic valvular disease and excluding patients with degenerative valve disease, bicuspid aortic valve, infective endocarditis, previously documented CAD, previous coronary revascularization, and emergency surgery helped create a more clinically defined study population. Echocardiographic assessment was based on standardized parameters, while predefined angiographic stenosis thresholds were applied consistently for the classification of significant CAD. Nevertheless, because coronary stenosis was determined by visual angiographic assessment rather than quantitative coronary angiography, some degree of observer-related measurement variability may remain.

Study Size

The required sample size was calculated using the single-population proportion formula based on an expected prevalence of angiographically significant CAD of 11%, as reported by Narang et al.[9] A 95% confidence level and an absolute precision of 5% were used. The sample size was calculated according to the following formula: $n = Z^2P(1-P)/d^2$, where n represents the required sample size, Z = 1.96 for a 95% confidence level, P = 0.11 representing the anticipated prevalence of significant CAD, and d = 0.05 representing the desired absolute precision.

Accordingly:

$$n = (1.96)^2 \times (0.11) \times (0.89)/(0.05)^2 = 150.4$$

The minimum required sample size was therefore approximately 151 patients. However, consecutive recruitment was continued throughout the study period, resulting in a final sample of 215 eligible patients, thereby exceeding the minimum calculated sample size.

Quantitative variables

Age was analyzed as a continuous variable and summarized using the mean and standard deviation. Categorical variables, including sex, type of planned valve surgery, presence or absence of angiographically significant CAD, and number of diseased coronary vessels, were summarized using frequencies and percentages. Coronary stenosis was converted into a clinically defined categorical outcome according to the prespecified angiographic thresholds: >50% stenosis for the left main coronary artery and >70% stenosis for other major coronary arteries.

Statistical Methods

Data were entered and analyzed using IBM SPSS Statistics version 22. Descriptive statistical analysis was performed to characterize the study population and determine the frequency of angiographically significant CAD. Continuous variables were summarized as mean ± standard deviation, while categorical variables were presented as frequencies and percentages.

The proportion of patients with angiographically significant CAD was calculated using the total number of included patients as the denominator. Among patients with significant CAD, the distribution of single-, double-, and triple-vessel disease was calculated and reported as frequencies and percentages. As the primary objective of the study was descriptive estimation of the frequency of angiographically significant CAD rather than hypothesis testing or identification of independent predictors, no multivariable inferential model was reported.

Results

Participants

A total of 215 patients aged 40 years and above with rheumatic valvular heart disease who were being evaluated for valve replacement surgery were included in the study. All included patients fulfilled the predefined eligibility criteria and underwent preoperative coronary angiography for assessment of concomitant coronary artery disease (CAD). The study population comprised patients planned for mitral valve replacement, aortic valve replacement, or double valve replacement. The distribution of participants according to the type of planned valve surgery is presented in Table 1.

Descriptive Data

Of the 215 patients included in the analysis, 121 (56.3%) were male and 94 (43.7%) were female, corresponding to a male-to-female ratio of approximately 1.29:1. The participants ranged in age from 40 to 64 years, with a mean age of 48.84 ± 6.62 years.

Mitral valve disease requiring mitral valve replacement represented the most frequent surgical category, accounting for 122 (56.70%) patients. Aortic valve disease requiring aortic valve replacement was present in 67 (31.20%) patients, while 26 (12.10%) patients had combined valvular disease requiring double valve replacement. Thus, more than half of the study population was undergoing evaluation for mitral valve replacement, while approximately one-third was planned for aortic valve replacement. The detailed distribution of the planned surgical procedures is shown in Table 1.

Outcome Data

The primary outcome was the presence of angiographically significant CAD on preoperative coronary angiography. Of the 215 patients, 37 (17.20%) were found to have significant CAD according to the predefined angiographic criteria. Consequently, 178 (82.80%) patients did not meet the criteria for significant CAD.

Among the 37 patients with significant CAD, 13 (35.10%) had single-vessel disease, 16 (43.20%) had double-vessel disease, and 8 (21.60%) had triple-vessel disease. Double-vessel disease was therefore the most frequently observed pattern among patients with significant CAD. The angiographic distribution according to the number of affected vessels is presented in Table 2.

Main Results

The principal finding of the study was that 17.20% (37/215) of patients aged ≥40 years undergoing planned valve replacement surgery for rheumatic valvular heart disease had concomitant angiographically significant CAD. Therefore, approximately one in six patients in this surgical population had significant coronary disease identified during preoperative angiographic assessment.

Furthermore, the angiographic burden among CAD-positive patients was notable. Of the 37 patients with significant CAD, 24 (64.9%) had multivessel disease, comprising 16 patients with double-vessel and 8 with triple-vessel disease (Table 2). In comparison, 13 (35.10%) had disease confined to a single coronary vessel. These findings demonstrate that, among patients in whom significant CAD was detected, multivessel involvement was more frequent than isolated single-vessel disease.

The findings show a measurable burden of concomitant significant CAD in patients aged 40 years and above undergoing surgical treatment for rheumatic valvular heart disease, with mitral valve replacement representing the most frequent planned valve procedure (Table 1) and double-vessel disease representing the most frequent angiographic pattern among CAD-positive patients (Table 2).

Table 1: Type of planned valve surgery among the study participants (n = 215).

Variables	N (%)
Mitral valve replacement	122 (56.70%)
Aortic valve replacement	67 (31.20%)
Double valve replacement	26 (12.10%)

Table 2: Distribution of coronary artery disease among patients with significant CAD (n = 37).

Variables	N (%)
Single-vessel disease	13 (35.10%)
Double-vessel disease	16 (43.20%)
Triple-vessel disease	8 (21.60%)
Total	37 (100%)

Discussion

The present study evaluated the prevalence of angiographically significant coronary artery disease (CAD) among patients aged 40 years and above undergoing planned valve replacement surgery for rheumatic valvular heart disease. The principal finding was that 37 of 215 patients (17.20%) had significant CAD on preoperative coronary angiography. Importantly, among patients with significant CAD, 64.9% had multivessel involvement, including 43.20% with double-vessel disease and 21.60% with triple-vessel disease. These findings indicate that concomitant CAD represents a clinically relevant consideration during the preoperative assessment of patients with rheumatic valvular heart disease in this population. Rheumatic heart disease remains an important cause of valvular morbidity, particularly in low- and middle-income countries. Globally, the burden of rheumatic valvular heart disease has been estimated to exceed that of calcific aortic stenosis and degenerative mitral valve disease.[1] Rheumatic involvement commonly affects the mitral valve, either alone or in combination with other valves. This pattern was also evident in the present study, in which mitral valve replacement represented the most frequent planned surgical procedure, accounting for 56.70% of patients, compared with 31.20% undergoing aortic valve replacement and 12.10% undergoing double valve replacement. A predominance of mitral valve involvement among patients undergoing surgery for rheumatic valvular disease has also been reported previously.[6]

The prevalence of significant CAD observed in the present study was higher than that reported in some earlier investigations of rheumatic valvular heart disease. Kruczan et al. compared patients with rheumatic and non-rheumatic valvular disease referred for surgery and reported significant CAD in approximately 4% of patients with rheumatic valve disease compared with 33.61% of patients with non-rheumatic valve disease.[5] However, differences in age and cardiovascular risk factors, including diabetes mellitus and dyslipidemia, between rheumatic and non-rheumatic groups may partly explain this difference. Such findings emphasize that the prevalence of concomitant CAD cannot necessarily be extrapolated directly across populations with different demographic and cardiovascular risk profiles.

The prevalence observed in our study is closer to that reported by Cazelli et al., who found obstructive CAD in approximately 20% of 712 patients undergoing primary surgery for acquired valvular heart disease.[4] However, their study included patients aged 18 years and above with valvular disease of both rheumatic and non-rheumatic etiologies. Differences in patient selection and underlying valve pathology therefore need to be considered when comparing their findings with the present study, which was

restricted to patients aged ≥40 years with rheumatic valvular heart disease.

A particularly relevant comparison is the large study by Narang et al., which included 2,188 patients with rheumatic valvular heart disease undergoing screening coronary angiography before surgery.[9] Significant CAD was reported in approximately 11% of patients, with a greater prevalence among males and an increasing frequency with advancing age, reaching approximately 20% among patients older than 60 years.[9] The 17.20% prevalence identified in the present study is therefore higher than the overall prevalence reported in that Indian population. Differences in the demographic characteristics, cardiovascular risk profiles, referral patterns, and population-specific burden of atherosclerotic disease may contribute to variation between studies.

Available evidence from Pakistan has similarly demonstrated substantial variability in the prevalence of concomitant CAD among patients undergoing surgery for valvular heart disease. Ullah et al. reported obstructive CAD in approximately 24.6% of patients undergoing surgery for rheumatic valvular heart disease.[10] Other Pakistani studies have reported frequencies of 27.6% and 46.3%.[11,12] Although these estimates are higher than the 17.20% observed in our study, collectively they indicate that significant coronary disease is not uncommon among patients undergoing valve surgery in local clinical settings. Differences in inclusion criteria, age distributions, cardiovascular risk profiles, definitions of significant CAD, and underlying valvular etiologies may account for some of the observed variation across studies.

In contrast, substantially lower frequencies have been reported in some other populations. Garba and Leta evaluated 108 patients aged 40 years and above undergoing valve surgery for rheumatic heart disease in Kenya and identified only two patients with mild CAD.[13] On this basis, the authors questioned the need for routine preoperative coronary angiography in lower-risk patients with rheumatic valve disease.[13] Similarly, a study from Thailand evaluating patients with rheumatic valvular disease suggested a comparatively low burden of coronary stenosis and examined clinical factors associated with its occurrence.[14] These findings demonstrate considerable geographical heterogeneity in the coexistence of rheumatic valvular heart disease and coronary atherosclerosis.

The clinical relevance of our findings extends beyond the overall prevalence of CAD. Among the 37 patients with significant coronary disease, only 13 (35.10%) had single-vessel involvement, whereas 24 (64.9%) had double- or triple-vessel disease. Therefore, when significant CAD was present, multivessel involvement was more common than isolated single-vessel disease. Identification of such coronary disease before valve surgery is important because the angiographic findings may influence operative planning, including consideration of concomitant coronary artery bypass grafting where clinically indicated. Previous evidence has demonstrated that combined coronary and valvular procedures have different perioperative risk profiles compared with isolated valve surgery,[2] emphasizing the importance of appropriate preoperative assessment and surgical planning.

The findings are particularly relevant to cardiac surgical practice in Pakistan and other healthcare settings where rheumatic heart disease remains a major indication for valve replacement surgery. In the present population, approximately one in six patients aged ≥40 years undergoing surgery for rheumatic valvular disease had angiographically significant CAD. Furthermore, the predominance of multivessel involvement among CAD-positive patients indicates that the coronary findings may have meaningful implications for surgical decision-making. Preoperative coronary evaluation should therefore remain an important component of assessment in appropriately selected patients undergoing valve surgery, consistent with contemporary guideline-based evaluation.[3]

Nevertheless, the present findings should not be interpreted as demonstrating that invasive

coronary angiography is necessary for every patient with rheumatic valvular heart disease irrespective of individual clinical characteristics. The study was designed to estimate the prevalence of significant CAD in the included surgical population and was not designed to compare alternative coronary screening strategies or determine the diagnostic or outcome benefit of routine invasive angiography. Decisions regarding the method of preoperative coronary assessment should therefore continue to consider patient characteristics, cardiovascular risk, clinical presentation, planned intervention, and applicable recommendations.[3]

This study adds regional evidence regarding the coexistence of CAD and rheumatic valvular heart disease. The observed prevalence of 17.20%, together with the high proportion of multivessel disease among affected patients, highlights the importance of careful coronary assessment as part of preoperative planning in this population. Larger multicenter studies incorporating detailed cardiovascular risk profiles and comparative analyses are required to better identify patients at greatest risk of concomitant CAD and to determine the most appropriate coronary assessment strategy in patients undergoing surgery for rheumatic valvular heart disease.

Limitations

Several limitations should be considered when interpreting the findings of this study. First, this was a single-center study conducted at a tertiary-care institution; consequently, the study population may reflect local referral and surgical practices, and the findings may not be fully generalizable to other regions of Pakistan or other healthcare settings. Second, although the final sample of 215 patients exceeded the calculated minimum sample size, it remains relatively modest compared with larger multicenter studies, which may limit the precision of prevalence estimates and the ability to examine clinically important subgroups. Third, potentially important cardiovascular risk factors and confounding variables, including diabetes mellitus, hypertension, dyslipidemia, smoking status, family history of premature CAD, and socioeconomic characteristics, were not analyzed in the final study. Consequently, the present analysis cannot determine which patient characteristics were associated with the presence of significant CAD or explain differences in CAD prevalence compared with other populations. Fourth, coronary stenosis was assessed visually by a consultant cardiologist rather than by quantitative coronary angiography or physiological assessment. Visual estimation may be subject to observer-related variability, particularly for intermediate coronary lesions. Furthermore, the study was primarily descriptive and did not include multivariable analyses to identify independent predictors of significant CAD. The study also did not compare CAD prevalence according to age groups, sex, type of rheumatic valve disease, or planned surgical procedure. Finally, postoperative outcomes were not evaluated; therefore, the study cannot determine whether detection of CAD, subsequent coronary revascularization, or combined valve and coronary surgery influenced perioperative morbidity, mortality, or longer-term clinical outcomes. Future prospective, multicenter studies incorporating comprehensive cardiovascular risk-factor assessment, standardized angiographic evaluation, subgroup analyses, and postoperative follow-up would provide more robust evidence.

Conclusion

Angiographically significant coronary artery disease was identified in 17.20% of patients aged 40 years and above undergoing planned valve replacement surgery for rheumatic valvular heart disease at our tertiary-care center. Among patients with significant CAD, 64.9% had multivessel disease, indicating a clinically important burden of coronary atherosclerosis in affected patients.

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