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FREQUENCY OF ANGIOGRAPHICALLY SIGNIFICANT DISEASE IN PATIENTS UNDERGOING VALVE REPLACEMENT SURGERY WITH OR WITHOUT RISK FACTORS FOR ATHEROSCLEROSIS

Original Research

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Acknowledgement: The authors acknowledge the support of NICVD staff throughout the study.

Conflict of Interest: None
Grant Support & Financial Support: None

ABSTRACT

Background: Coronary artery disease (CAD) often coexists with valvular heart disease, especially in regions with high prevalence of rheumatic etiology. In developing countries like Pakistan, the clinical presentation of valvular pathology differs significantly from the West, with mitral valve involvement being more common. While CAD screening is routine in developed settings, data on its prevalence in patients undergoing valve replacement surgery in low- to middle-income populations remain scarce, highlighting the need for localized evidence to guide preoperative protocols.

Objective: To determine the frequency of angiographically significant CAD in patients undergoing valve replacement surgery and compare its prevalence among patients with and without traditional atherosclerotic risk factors.

Methods: This descriptive cross-sectional study was conducted at the National Institute of Cardiovascular Diseases (NICVD), Karachi, over six months. A total of 266 patients aged 40–60 years undergoing aortic, mitral, or double valve replacement surgery were enrolled through consecutive non-probability sampling. Patients with prior CAD, valve surgery, CABG, or PCI were excluded. Detailed history, BMI, socioeconomic data, and risk factor profiles were recorded. Coronary angiography was performed in all patients to identify >70% stenosis in major arteries. Data were analyzed using SPSS v25; associations were tested using chi-square or Fisher's exact test with a p-value <0.05 as significant.

Results: Among 266 participants, 157 (59.0%) were male and 176 (66.2%) resided in urban areas. Mitral valve replacement was the most common procedure (57.5%). Risk factors for atherosclerosis were present in 176 (66.2%) patients. Angiographically significant CAD was identified in 123 (46.2%) patients, with higher prevalence among those with risk factors.

Conclusion: The study highlights a high burden of silent but significant CAD in patients undergoing valve replacement, warranting routine coronary evaluation regardless of overt risk factor presence.

Keywords: Atherosclerosis, Cardiac surgery, Coronary angiography, Coronary artery disease, Preoperative evaluation, Risk factors, Valve replacement.

INTRODUCTION

Coronary artery disease (CAD) remains the leading cause of mortality worldwide, with a notable burden observed in the Asian population where the prevalence has reached 4.9%, compared to 7.0% globally, and is projected to rise further in the coming years (1). Parallel to this global challenge, valvular heart disease continues to emerge as a major cardiovascular concern, particularly in developing countries like Pakistan. Interestingly, the underlying etiological pattern differs significantly from that seen in Western populations. While degenerative causes dominate in the West, rheumatic valvular disease is the most prevalent form in South Asian regions, reflecting both healthcare disparities and differing environmental exposures (2). Among patients diagnosed with valvular heart disease, a considerable subset also suffers from concomitant CAD. Despite this clinical overlap, there exists a notable paucity of local data exploring the coexistence and implications of CAD in patients undergoing valve replacement surgeries. This gap is critical, as evidence from developed nations suggests that up to 30% of patients scheduled for valvular interventions present with significant coronary disease (3,4). Given the increasing referral of rheumatic heart disease patients for surgical interventions in tertiary care centers across Pakistan, the question arises whether these patients are adequately evaluated for CAD prior to surgery, especially when conventional risk factors for atherosclerosis—such as smoking, hypertension, diabetes mellitus, and dyslipidemia—are also prevalent (5). Older age and a higher prevalence of these risk factors have been consistently associated with significant CAD in patients undergoing valve replacement, making their consideration essential in pre-operative planning (6).

Previous studies have reported significant CAD in 46.3% of patients undergoing valve surgeries, with smoking, hypertension, and diabetes being the most frequently observed risk factors (7). However, such studies are limited in the regional context and do not comprehensively account for patients with and without atherosclerotic risk factors, nor do they clearly stratify the frequency of CAD across different types of valve replacement procedures. Timely identification of coexisting CAD in patients with valvular heart disease is essential to reduce intraoperative risks, guide revascularization decisions, and improve long-term survival. Simultaneous coronary artery bypass grafting (CABG) during valve replacement has been shown to lower mortality in patients with significant CAD, particularly in those undergoing aortic valve replacement (6). Therefore, there is a pressing need to refine screening strategies tailored to the demographic and clinical characteristics of patients in our population.

In light of the lack of indigenous data and the critical implications for clinical management, this study aims to determine the frequency of angiographically significant coronary artery disease in patients undergoing valve replacement surgery. Furthermore, it seeks to compare the occurrence of significant CAD in patients with and without established risk factors for atherosclerosis, thereby facilitating better surgical planning, risk stratification, and patient counseling.

METHODS

This descriptive cross-sectional study was conducted in the Department of Cardiology at the National Institute of Cardiovascular Diseases (NICVD), Karachi, over a period of six months following the approval of the research synopsis by the institutional review board and the College of Physicians and Surgeons Pakistan (CPSP). Ethical approval was obtained prior to study initiation, and written informed consent was secured from all participants after explaining the purpose, procedures, potential risks, and benefits of the study in a language they could understand (8). A total of 266 patients undergoing valve replacement surgery were enrolled using a non-probability consecutive sampling technique. The sample size was calculated using the World Health Organization sample size formula, with an anticipated prevalence of significant coronary artery disease (CAD) of 46.3%, a 95% confidence level, and a 6% margin of error. Participants included male and female patients aged 40 to 60 years, ASA II and III who were admitted for aortic valve replacement (AVR), mitral valve replacement (MVR), or double valve replacement (DVR) surgeries. Patients were excluded if they had a prior history of CAD, previous valve surgery, coronary artery bypass grafting (CABG), or percutaneous coronary intervention (PCI) (9).

Data collection was initiated after eligibility screening and informed consent. Demographic details such as age, gender, body mass index (BMI), area of residence (urban or rural), education level, profession, and socioeconomic status were recorded using a structured proforma. BMI was calculated using the formula weight in kilograms divided by height in meters squared (kg/m^2), with weight measured on a calibrated digital scale and height on a wall-mounted stadiometer, both under standardized conditions (light clothing, without shoes

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or headwear) (10). Risk factors for atherosclerosis were documented as per operational definitions. Detailed clinical history included smoking status (classified as current smoker, ex-smoker, or non-smoker based on the number of cigarettes consumed and time of cessation), and history of hypertension and diabetes mellitus. Patients were grouped based on the presence or absence of these risk factors (11).

All participants underwent coronary angiography before valve surgery. The procedure was performed under sterile conditions using either the radial or femoral artery approach. A catheter was introduced, and a radiopaque contrast dye was injected. Fluoroscopic imaging was used to visualize the three major coronary arteries—left anterior descending, right coronary, and left circumflex. A lesion was considered significant if there was >70% stenosis in any of these vessels, as per the study's operational definition. All findings were interpreted and recorded by the primary investigator. Coronary angiography was performed by a consultant interventional cardiologist with a minimum of five years of post-fellowship experience, following standard aseptic protocols under institutional guidelines (12).

Data were entered and analyzed using IBM SPSS version 25. Quantitative variables such as age, BMI, fasting blood glucose levels, and smoking pack-years were assessed for normal distribution using the Shapiro-Wilk test. Normally distributed variables were reported as mean ± standard deviation (SD), while non-normally distributed variables were presented as median with interquartile range (IQR). Categorical variables including gender, area of residence, education, profession, socioeconomic status, presence of atherosclerotic risk factors, type of valve surgery (AVR, MVR, DVR), and presence of significant CAD were expressed as frequencies and percentages (13).

The association between angiographically significant CAD and the presence of atherosclerotic risk factors was evaluated using the chi-square test or Fisher's exact test where appropriate. A p-value <0.05 was considered statistically significant. Stratification was performed for potential effect modifiers including age, gender, residence, BMI, education, profession, socioeconomic status, and type of surgery. Post-stratification chi-square or Fisher's exact test was applied to assess the significance of associations within subgroups, with the significance level set at 5% (14).

RESULTS

Out of a total of 266 patients included in the study, the mean age was 52.1 ± 5.3 years, with a range of 40 to 60 years. The majority of the participants were male (n = 157, 59.0%), while females comprised 41.0% (n = 109) of the cohort. The mean body mass index (BMI) of the study population was 26.8 ± 3.2 kg/m², with values ranging from 19.5 to 35.7 kg/m². Most participants were from urban areas (n = 176, 66.2%), while rural residents accounted for 33.8% (n = 90). In terms of educational status, 64.3% (n = 171) had completed matriculation or below, and 35.7% (n = 95) had education above matriculation. Socioeconomic status distribution showed that 42.1% (n = 112) belonged to the low-income group (<30,000 PKR/month), 45.5% (n = 121) to the middle-income group (30,000–65,000 PKR/month), and 12.4% (n = 33) to the upper-income group (>65,000 PKR/month).

Regarding the type of valve surgery, mitral valve replacement (MVR) was the most common procedure performed (n = 153, 57.5%), followed by aortic valve replacement (AVR) in 25.2% (n = 67) and double valve replacement (DVR) in 17.3% (n = 46). Among risk factors for atherosclerosis, 45.9% (n = 122) of the participants were smokers, 42.1% (n = 112) had hypertension, and 29.3% (n = 78) had diabetes mellitus. Based on the presence of these risk factors, 66.2% (n = 176) of patients were categorized as having at least one risk factor for atherosclerosis, while 33.8% (n = 90) had none. Coronary angiography revealed angiographically significant coronary artery disease (CAD) in 46.2% of the patients (n = 123), whereas 53.8% (n = 143) had no significant CAD. The distribution of CAD was further analyzed in relation to the presence of atherosclerotic risk factors, gender, type of surgery, and other demographic characteristics in subsequent analyses.

Table 1: Mean and standard deviation (SD) for **age** and **BMI**

Variable	Mean ± SD	Minimum	Maximum
Age (years)	52.1 ± 5.3	40.0	60.0
BMI (kg/m²)	26.8 ± 3.2	19.5	35.7

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Table 2Frequency Table

Variable	Frequency (n)	Percentage (%)
Gender		
Male	157	59.0
Female	109	41.0
Residence		
Urban	176	66.2
Rural	90	33.8
Education		
Matric or below	171	64.3
Above matric	95	35.7
Socioeconomic Status		
Low class (<30,000 Rs/month)	112	42.1
Middle class (30,000–65,000 Rs/month)	121	45.5
Upper class (>65,000 Rs/month)	33	12.4
Type of Surgery		
AVR	67	25.2
MVR	153	57.5
DVR	46	17.3
Smoking		
Yes	122	45.9
No	144	54.1
Hypertension		
Yes	112	42.1
No	154	57.9
Diabetes Mellitus		
Yes	78	29.3
No	188	70.7
Risk Factors for Atherosclerosis		
Present	176	66.2
Absent	90	33.8
Angiographically Significant CAD		
Yes	123	46.2
No	143	53.8

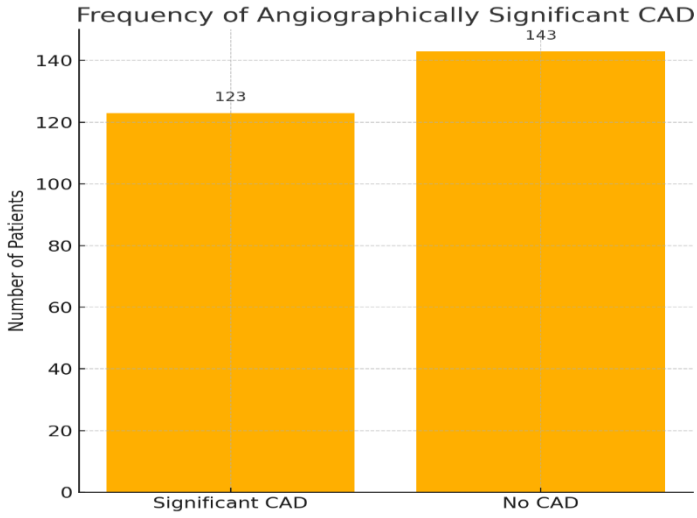

Figure 1 Frequency of Angiographically Significant CAD

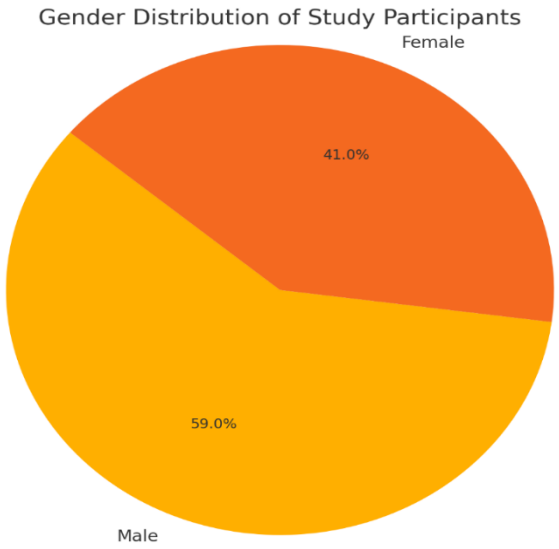

Figure 2 Gender Distribution of Study Participants

DISCUSSION

The present study aimed to determine the frequency of angiographically significant coronary artery disease (CAD) in patients undergoing valve replacement surgery and to compare its prevalence among those with and without traditional atherosclerotic risk factors. The findings revealed that 46.2% of the patients exhibited significant CAD, aligning closely with the results reported by Shabeer et al., where the prevalence was noted at 46.3%. This consistency with prior literature underscores the clinical importance of evaluating for concomitant CAD in patients scheduled for valvular interventions, especially in populations with a high burden of rheumatic heart disease and undiagnosed cardiovascular risk profiles (15,16). In the current sample, two-thirds of the patients had at least one risk factor for atherosclerosis, with smoking, hypertension, and diabetes being the most prevalent. These trends are in keeping with known epidemiologic patterns in South Asian countries, particularly Pakistan, where a growing urban population, limited access to preventive care, and lifestyle-related factors have contributed to a rise in non-communicable diseases. The predominance of MVR procedures in the cohort further reflects the rheumatic etiology that remains common in developing regions, diverging from Western populations where degenerative aortic stenosis predominates (17,18).

The high frequency of significant CAD observed even among patients without traditional risk factors highlights the limitations of risk factor-based screening alone and supports the need for universal coronary angiographic evaluation in this subgroup. This approach becomes particularly important in regions like Pakistan, where risk factors such as hypertension and diabetes are often underdiagnosed or poorly controlled, and where atherosclerosis may progress silently in the presence of chronic inflammatory states such as rheumatic fever. Additionally, the fact that a significant proportion of patients with no documented comorbidities were still found to have CAD underscores the silent nature of the disease and the risk of intraoperative complications if not appropriately screened (19,20). This study contributes valuable data to a relatively under-researched clinical intersection in South Asia—namely, the coexistence of CAD in patients with rheumatic valvular disease. The strengths of the study include its standardized data collection, well-defined inclusion criteria, and real-world representation of a tertiary cardiac care center's population. The systematic use of coronary angiography allowed for an objective diagnosis of CAD, strengthening the reliability of the findings (8,21).

Nonetheless, several limitations warrant discussion. The single-center design may limit the generalizability of the results to broader or more diverse populations. The use of non-probability consecutive sampling introduces selection bias, and the cross-sectional nature of the study precludes causal inferences. Furthermore, the operational definition of risk factors relied on self-reported history and existing diagnoses, which may not capture subclinical or undiagnosed cases. The lack of functional assessments or follow-up data also restricts insight into long-term outcomes or the impact of concomitant CAD on surgical prognosis (12,19). Future studies should consider multicenter designs with larger, stratified samples that encompass different geographic and ethnic backgrounds. Incorporating non-invasive screening modalities, cardiac biomarkers, and follow-up for postoperative outcomes would enrich the understanding of how

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undiagnosed CAD influences morbidity and mortality in this population. Moreover, exploring genetic and inflammatory markers may uncover latent risk profiles not evident through traditional screening (8,20). The findings affirm the high prevalence of significant CAD in patients undergoing valve replacement surgery, particularly those with atherosclerotic risk factors, but not exclusively. These results advocate for a more comprehensive preoperative assessment strategy in such patients, which could substantially enhance perioperative planning, reduce surgical risk, and improve overall outcomes in a resource-limited yet high-risk population.

CONCLUSION

This study concluded that a substantial proportion of patients undergoing valve replacement surgery have coexisting angiographically significant coronary artery disease, with a notably higher occurrence among those presenting with traditional atherosclerotic risk factors. However, the presence of CAD was not limited to this group alone, underscoring the inadequacy of relying solely on clinical risk profiles for preoperative screening. These findings emphasize the practical need for routine coronary assessment in all such patients prior to surgery, as timely identification and management of CAD can significantly enhance surgical planning and patient safety. The study offers important insight for cardiac surgical teams in settings where rheumatic heart disease remains prevalent, supporting a shift toward more proactive and inclusive cardiovascular evaluation protocols.

AUTHOR CONTRIBUTION

Author	Contribution
Yasmeen Soomar*	Substantial Contribution to study design, analysis, acquisition of Data Manuscript Writing Has given Final Approval of the version to be published
Zakir Ullah	Substantial Contribution to study design, acquisition and interpretation of Data Critical Review and Manuscript Writing Has given Final Approval of the version to be published
Elham Yousufzai	Substantial Contribution to acquisition and interpretation of Data Has given Final Approval of the version to be published
Kiran Shah	Contributed to Data Collection and Analysis Has given Final Approval of the version to be published
Saeeda Bhehlar	Contributed to Data Collection and Analysis Has given Final Approval of the version to be published
Ibad Ullah	Substantial Contribution to study design and Data Analysis Has given Final Approval of the version to be published
Qaiser Ahmed	Contributed to study concept and Data collection Has given Final Approval of the version to be published
Asad Ullah	Writing - Review & Editing, Assistance with Data Curation

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