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Original Article

# Coronary artery disease in patients undergoing cardiac surgery for non-coronary lesions in a tertiary care centre

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ABSTRACT

*Background:* The objective of the present study was to determine the prevalence of coronary artery disease (CAD) in patients undergoing surgery for various valvular as well as non-valvular cardiac pathologies.

*Methods:* Patients with various valvular and non-valvular pathologies were selected. All patients with age ≥40 years and an indication for open heart surgery underwent pre-operative coronary angiogram and were included in the study.

*Results:* The mean age was 51.5 ± 9.02 years. 178 (59.3%) patients were males and 122 (40.7%) patients were females. Out of 300 patients, 270 (90%) patients had valvular heart disease (VHD) and 30 (10%) patients had non-valvular heart disease. Rheumatic heart disease (RHD), mitral valve prolapse (MVP), degenerative aortic valve disease (DAVD) and bicuspid aortic valve (BAV) was present in 161 (53.7%), 17 (5.7%), 60 (20%) and 32 (10.7%) patients respectively. Overall, 26 (8.7%) patients were found to have significant CAD. CAD was significantly more common in patients with VHD as compared to patients with other etiologies (1 patient, 3.3%, $p < 0.05$). In the valvular group, DAVD patients had maximum prevalence of CAD (14 patients, 23.4%, $p < 0.05$). In the group with CAD, the presence of variables such as age >60 years, male sex, typical angina, HT, dyslipidemia and smoking were significantly greater as compared to those with normal coronaries.

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*Conclusion:* The overall prevalence of CAD among patients undergoing non-coronary cardiac surgery is 8.7%. Coronary artery disease is relatively uncommon in patients with rheumatic VHD (4.9%), while its prevalence is highest in DAVD (23.4%).


## 1. Introduction

Many patients with valvular and non-valvular heart disease have concomitant coronary artery disease (CAD), but there are only limited data regarding optimal strategies for diagnosis and treatment of CAD in such patients. The decision regarding strategies for diagnosis of CAD has been driven by data from smaller published series of patients undergoing surgical treatment of valvular heart disease (VHD). The unfavorable impact of untreated CAD on perioperative and long term postoperative outcome makes preoperative identification of CAD mandatory even in asymptomatic patients.[1,2] This anticipated risk forms the basis of American College of Cardiology/American Heart Association (ACC/AHA) guidelines for coronary angiography (CAG) in VHD,[3] which states that CAG should be performed before valve surgery in men aged 35 years or older, premenopausal women aged 35 years or older who have coronary risk factors, and postmenopausal women.

The guidelines address patients with VHD. However, there are no guidelines regarding the evaluation of CAD in patients undergoing cardiac surgery for non-valvular etiologies. In India, CAG is usually performed routinely in rheumatic heart disease (RHD) patients prior to valve replacement surgery if there are symptoms of CAD or if the patient is more than 40 years of age. The present study aims to identify the prevalence of CAD among patients with valvular as well as non-valvular cardiac pathologies who are scheduled for surgery other than coronary artery bypass surgery (CABG).

## 2. Methods

This study includes Indian patients with different cardiac valvular and non-valvular etiologies admitted in department of cardiothoracic surgery in Sri Jayadeva Institute of Cardiovascular Sciences and Research, Bengaluru between October 2011 and January 2013. 300 patients, with primary cardiac lesion (valvular and non-valvular), referred with indications for heart surgery, were selected for the study and data was prospectively collected. All patients with age ≥40 years and an indication for open heart surgery underwent preoperative coronary angiogram and were included in the study. Valvular cases included RHD, mitral valve prolapse (MVP), degenerative aortic valve disease (DAVD) and bicuspid aortic valve (BAV). Non-valvular cases included atrial myxoma, constrictive pericarditis, atrial septal defect and aortic aneurysm. Patients with known case of CAD, prior CABG or percutaneous coronary intervention or age <40 years were excluded from the study.

Detailed assessment of symptoms such as chest pain, dyspnea, syncope, and fatigue and of risk factors like hypertension (HT; systolic arterial pressure ≥140 mmHg or diastolic arterial pressure ≥90 mmHg or use of anti-hypertensive medication), diabetes mellitus (DM; fasting glucose ≥126 mg/dl, post-prandial glucose ≥200 mg/dl or on medications for DM), smoking, dyslipidemia (total cholesterol ≥200 mg/dl, triglycerides ≥150 mg/dl, and/or LDL ≥130 mg/dl), overweight or obesity, family history of cardiovascular disease was done in all patients. Etiology of cardiac disease was evaluated by transthoracic and if required, transesophageal echocardiogram with two dimensional and color flow imaging. All selected patients underwent CAG with informed written consent prior to surgery. Angiographic data was collected including the presence and absence of significant coronary artery stenosis (defined as ≥50% luminal narrowing) and number of coronaries involved.

### 2.1. Statistical analysis

The data was entered and managed on an Excel spreadsheet, and analyzed systematically using SPSS 16 statistical software (SPSS Inc., Chicago, USA). All data were presented as frequency distribution and simple percentages. Descriptive statistics were presented in the form of mean ± SD for all continuous variables. Categorical variables were expressed as percentages and analyzed using the chi-square test. A $p$-value <0.05 was considered to be statistically significant.

## 3. Results

A total of 300 patients were included in the study. Table 1 shows the baseline demographic and clinical characteristics of the study cohort. The mean age of the patients was 51.5 ± 9.02 years and mean BMI was 21.26 ± 4.2. 178 (59.3%) patients were males and 122 (40.7%) patients were females. The overall prevalence of major risk factors, DM, HT, dyslipidemia and smoking was 10.3%, 10.7%, 45% and 31.7% respectively. Out of 300 patients, 270 (90%) patients had VHD and 30 (10%) patients had non-valvular heart disease. Majority (161 patients, 53.7%) of patients of VHD had rheumatic etiology while DAVD (60 patients, 20%) was the second most common etiology.

Baseline characteristics were also defined in the individual diagnosis group (Table 2). Patients with DAVD were significantly older (mean age 61.7 ± 7.04 years, $p < 0.001$) and more males (42 patients, 70%, $p < 0.05$) than patients in other groups. Prevalence of DM, HT, dyslipidemia, smoking and family history of cardiovascular disease (CVD) was not significantly different between all the groups ($p$ = NS).

**Table 1 – Baseline characteristics of patients.**

| Characteristics | | |
|---|---|---|
| Age, mean (SD) | 51.5 (9.02) | |
| BMI, mean (SD) | 21.26 (4.2) | |
| | Number | Percentage |
| Males | 178 | 59.3% |
| Females | 122 | 40.7% |
| Atypical angina | 61 | 20.3% |
| Typical angina | 87 | 29.0% |
| No chest pain | 152 | 50.7% |
| Overweight or obese | 56 | 18.7% |
| Diabetes | 31 | 10.3% |
| Hypertension | 32 | 10.7% |
| Dyslipidemia | 135 | 45.0% |
| Smoking | 95 | 31.7% |
| Family history of CAD | 14 | 4.7% |
| Valvular ($n = 270$) | 270 | 90.0% |
| • RHD | 161 | 53.7% |
| • MVP | 17 | 5.7% |
| • BAV | 32 | 10.7% |
| • Degenerative AV disease | 60 | 20.0% |
| Non-valvular ($n = 30$) | 30 | 10.0% |
| CAD | 26 | 8.7% |

CAD, coronary artery disease; RHD, rheumatic heart disease; MVP, mitral valve prolapse; BAV, bicuspid aortic valve; SD, standard deviation.

**Table 3 – Prevalence and severity of CAD in relation to different etiologies*.**

| Lesion | Patients with CAD (%) | SVD (%) | DVD (%) | TVD (%) | LMD |
|---|---|---|---|---|---|
| **Valvular ($n = 270$)** | **25 (9.3)** | **20 (80)** | **3 (12)** | **1 (4)** | **1 (4)** |
| RHD ($n = 161$) | 8 (4.9) | 7 (4.3) | 0 | 0 | 1 (0.6) |
| MVP ($n = 17$) | 1 (5.9) | 1 (5.9) | 0 | 0 | 0 |
| DAVD ($n = 60$) | 14 (23.4) | 10 (16.7) | 3 (5) | 1 (1.7) | 0 |
| BAV ($n = 32$) | 2 (6.2) | 2 (6.2) | 0 | 0 | 0 |
| **Non-valvular ($n = 30$)** | **1 (3.3)** | **0** | **0** | **1 (3.3)** | **0** |

*$p$ value <0.05 for comparison between valvular and non-valvular group and DAVD vs other valvular group. CAD, coronary artery disease; RHD, rheumatic heart disease; MVP, mitral valve prolapse; BAV, bicuspid aortic valve; SVD, single vessel disease; DVD, double vessel disease; TVD, triple vessel disease; LMD, left main disease.

However, incidence of typical angina was most common in DAVD group (63.3%, $p < 0.05$).

Out of 300 patients, 26 (8.7%) patients were found to have significant CAD (Table 3). CAD was significantly more common in VHD patients (25 patients, 9.3%) as compared to non-valvular etiologies (1 patient, 3.3%, $p < 0.05$). In the valvular group, DAVD patients had maximum prevalence of CAD (14 patients, 23.4%, $p < 0.05$). There was no significant difference in the prevalence of CAD in patients with RHD (4.9%), MVP (5.9%), BAV (6.2%) and non-valvular etiologies (3.3%). Triple vessel disease (TVD) was found in only one patient with infrarenal aortic aneurysm. The patient was 72 years old, smoker and had typical angina on exertion. Only one patient of RHD with severe AR had ostial left main artery 80% stenosis. On further classifying the valvular group in rheumatic and non-rheumatic etiologies, CAD was found in 8 (4.9%) patients and 17 (15.6%, $p < 0.05$) patients respectively. Majority of the patients had single vessel disease.

The frequency of the disease was higher in males as compared to females. In the group with CAD, the presence of variables such as age >60 years, male sex, typical angina, HT, dyslipidemia and smoking was significantly greater as compared to those with normal coronaries (Table 4). There was no significant difference between the group regarding BMI, DM and family history of CAD. On subgroup analysis, in all patients with AS irrespective of etiology (120 patients), CAD was significantly more in patients having typical angina in comparison to patients without angina. 14 out of 61 patients (22.9%) with typical angina had CAD while 3 out of 59 patients (5.1%) without angina had CAD. All patients less than 50 years of age had ≥2 major coronary risk factors.

**Table 2 – Characteristics of patients with valvular and non-valvular heart disease.**

| Variable | | Valvular ($n = 270$) | | | | Non-valvular ($n = 30$) | $p$ value |
|---|---|---|---|---|---|---|---|
| | | RHD ($n = 161$) | MVP ($n = 17$) | DAVD ($n = 60$) | BAV ($n = 32$) | | |
| Mean age (SD) | | 48.96 (7.27) | 51.94 (7.6) | 61.7 (7.04) | 47.84 (7.54) | 48.37 (8.74) | <0.001 |
| Sex | Males (%) | 85 (52.8) | 11 (64.7) | 42 (70) | 24 (75) | 16 (53.3) | <0.05 |
| | Females (%) | 76 (47.2) | 6 (35.3) | 18 (30) | 8 (25) | 14 (46.7) | |
| Mean BMI (SD) | | 20.8 (4.5) | 20.8 (3.4) | 22.6 (3.6) | 21.18 (4.1) | 21.42 (3.28) | 0.080 |
| Diabetes (%) | | 15 (9.3) | 1 (5.9) | 8 (13.3) | 5 (15.6) | 2 (6.7) | 0.640 |
| Hypertension (%) | | 11 (6.8) | 3 (17.6) | 11 (18.3) | 5 (15.6) | 2 (6.7) | 0.078 |
| Dyslipidemia (%) | | 70 (43.5) | 9 (52.9) | 27 (45) | 18 (56.2) | 11 (36.7) | 0.548 |
| Smoking (%) | | 45 (28) | 5 (29.4) | 25 (41.7) | 14 (43.8) | 6 (20) | 0.096 |
| Family history of CAD (%) | | 6 (3.7) | 2 (11.8) | 2 (3.3) | 2 (6.2) | 2 (6.7) | 0.569 |
| Chest pain | Absent (%) | 100 (62.1) | 6 (35.3) | 17 (28.3) | 12 (37.5) | 17 (56.7) | <0.05 |
| | Atypical (%) | 29 (18) | 10 (58.8) | 5 (8.3) | 7 (21.9) | 10 (33.3) | |
| | Typical (%) | 32 (19.9) | 1 (5.9) | 38 (63.3) | 13 (40.6) | 3 (10) | |

CAD, coronary artery disease; RHD, rheumatic heart disease; MVP, mitral valve prolapse; BAV, bicuspid aortic valve; BMI, body mass index; SD, standard deviation.

**Table 4 – Clinical characteristics of patients with and without CAD.**

| Variables | With CAD ($n = 26$) | | Without CAD ($n = 274$) | | $p$ value |
|---|---|---|---|---|---|
| | $n$ | % | $n$ | % | |
| Age <50 years | 7 | 26.9 | 138 | 50.4 | 0.009 |
| Age 50–60 years | 7 | 26.9 | 79 | 28.8 | |
| Age >60 years | 12 | 46.2 | 57 | 20.8 | |
| Males | 19 | 73.1 | 159 | 58 | <0.05 |
| Females | 7 | 26.9 | 115 | 42 | |
| Typical chest pain | 21 | 80.8 | 66 | 24.1 | <0.001 |
| Atypical chest pain | 2 | 7.7 | 59 | 21.5 | |
| No chest pain | 3 | 11.5 | 149 | 54.4 | |
| BMI <25 | 22 | 84.6 | 222 | 81 | 0.653 |
| BMI ≥25 | 4 | 15.4 | 52 | 19 | |
| Diabetes | 3 | 11.5 | 28 | 10.2 | 0.833 |
| Hypertension | 11 | 42.3 | 21 | 7.6 | <0.001 |
| Dyslipidemia | 22 | 84.6 | 113 | 41.2 | <0.001 |
| Smokers | 16 | 61.5 | 79 | 28.8 | 0.001 |
| Family history of CAD | 1 | 3.8 | 13 | 4.7 | 0.836 |
| Valvular | 25 | 96.1 | 245 | 89.4 | <0.05 |
| • RHD | 8 | 30.8 | 153 | 55.8 | |
| • MVP | 1 | 3.8 | 16 | 5.8 | |
| • DAVD | 14 | 53.8 | 46 | 16.8 | |
| • BAV | 2 | 7.7 | 30 | 10.9 | |
| Non-valvular | 1 | 3.8 | 29 | 10.6 | |

CAD, coronary artery disease; RHD, rheumatic heart disease; MVP, mitral valve prolapse; BAV, bicuspid aortic valve; BMI, body mass index.

## 4. Discussion

Guidelines for CAG in patients with VHD are primarily based on studies wherein majority of the patients had degenerative etiology for VHD.[3] The overall prevalence of CAD in patients undergoing valve replacement has been shown to vary widely from 9% to 41%.[4–9] It must be kept in mind that majority of these patients are elderly, have degenerative valve disease and have multiple coronary risk factors. However, in India and other developing countries where the major etiology of VHD is rheumatic, the prevalence of coexistent CAD is much lower as compared to western patients.[10–12]

In the present study, the overall prevalence of CAD in all groups was 8.7%, which is much lower than in the western population. It has been postulated that rheumatic fever may lead to arteritis in intramyocardial coronaries. However, it has not been proven and the actual prevalence of CAD in RHD patients is not more than in general population. In the present study, CAD was found in 4.9% patients of RHD patients. The prevalence is much lower as compared to previous studies. Marchant et al[13] analyzed CAG of 100 patients with rheumatic valvular disease and reported the prevalence of significant CAD to be 14%. In that study coronary angiography was performed in patients over the age of 50 years, those having angina or ECG signs of ischemia, which can explain the higher prevalence. Shaikh et al[14] reviewed medical records of 144 patients and found CAD in 25% patients of RHD. This may be related to very high frequency of DM, HT and dyslipidemia in the study population. Two studies from India by Jose et al[10] and Narang et al[15] have reported prevalence of CAD to be 12.2% and 11% respectively in patients with RHD undergoing valve replacement. However, the baseline characteristics of patients with regards to CAD risk factors were not mentioned in study by Narang et al.[15] Also the symptoms were not assessed in the study.

Kruczan et al,[12] in his study of 294 patients with rheumatic and non-rheumatic VHD reported that patients with rheumatic VHD had lower prevalence of CAD (4%) when compared to those with non-rheumatic VHD (33.61%). The prevalence of CAD (4%) in this study is similar to that of our study (4.9%) in patients with rheumatic VHD. The prevalence of CAD in non-rheumatic etiology was still higher (33.61%) as compared to the present study (15.6%). This higher prevalence has been attributed to more frequency of male sex, older age and major coronary risk factors in non-rheumatic group. The prevalence of CAD in patients of DAVD in this study was 23.4%, which is higher as compared to other groups. This is related to the fact that this population was characterized by predominance of male sex and older age, in opposition of what was observed in other groups. Typical angina was also significantly higher in the DAVD group. In isolated degenerative aortic stenosis, the prevalence of CAD is reported to be as high as 37% in patients aged between 40 and 59 and 64% in those aged between 60 and 82 years,[16] which was also much higher as compared to our study (23.4%). It is likely to be related to the genetic, racial and environmental factors. Also, most patients in our study were from a lower socioeconomic status, where the prevalence of CAD would likely to be lower.

Patients with non-valvular heart diseases are not enrolled in previous studies. In present study, out of 30 patients with non-valvular etiologies, only one patient was found to have CAD (TVD). However, the patient was 72 years old, smoker and had typical angina on exertion. Hence, it can be concluded that preoperative angiography in this subset of patients can be restricted to those patients who are older, symptomatic and/or have other major risk factors for CAD. However, larger studies, focusing on this issue, are required to further enlighten the exact prevalence and need for CAG in these patients.

The demographic and clinical characteristics that characterized the patients from CAD group were of age >50 years, male sex, typical chest pain, hypertension, dyslipidemia, smoking and DAVD. Of note, CAD was present in only 4.8% of patients <50 years of age as compared to 12.2% of patients with ≥50 years of age. In patients with age <50 years, CAD was found only in patients with ≥2 major coronary risk factors. It can be concluded that in this subset of patients, CAG can be considered only in the presence of multiple coronary risk factors or symptoms suggestive of CAD, or if there is high clinical likelihood of CAD.

## 5. Study limitations

Although this study included relatively large number of patients with valvular heart disease, the number of patients in

the non-valvular group was low. A large study specifically involving this subset of patients is required to give more realistic prevalence in these patients.

## 6. Conclusion

The study provides data on prevalence of CAD in Indian patients with valvular and non-valvular heart diseases undergoing surgical treatment. The overall prevalence of significant CAD in this group of patients was 8.7%. The prevalence of CAD in patients with rheumatic valve disease was low whereas it was highest in those with DAVD. In patients under the age of 50 years, significant CAD was low and was present only in those with more than 2 coronary risk factors.

## Conflicts of interest

All authors have none to declare.

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