ORIGINAL ARTICLE

Correlation of Coronary Angiography Findings with Cardiovascular Risk Factors in a Tertiary Center in Nepal

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ABSTRACT

Introduction: Coronary artery disease is one of the most common heart problems and a major cause of illness and death around the world. It occurs when the coronary arteries become narrower due to atherosclerosis. Risk factors contributing to atherosclerosis include high blood pressure, diabetes, smoking, high cholesterol, being overweight, and physical inactivity. Coronary angiography is a highly effective method for diagnosing coronary disease. Having more than one cardiovascular risk factor at the same time has been linked to more serious and widespread forms of coronary artery disease. **Aims:** To correlate coronary angiographic findings of coronary artery disease with cardiovascular disease risk factors. **Methods:** A hospital-based cross-sectional descriptive study was conducted among 170 patients who had undergone coronary angiograms in a Semi-urban tertiary care center. Participants were enrolled prospectively after taking ethical approval from the Institutional Review Committee, Kathmandu University School of Medical Sciences. Various risk factors and coronary angiogram findings were noted. Data were collected in Microsoft Excel and analyzed in SPSS version 21. **Results:** The mean age of the patients in the study was 60.81±10.70 years, and 35.88% of them were female. The most prevalent risk factor for coronary artery disease was hypertension (73.53%), and the most common symptom was chest pain, seen in 83.50% of cases. ECG changes were seen in 87.65%, and 69.41% of cases had coronary artery disease findings on coronary angiogram. The most common coronary angiogram finding was single-vessel disease, seen in 28.24% of cases. Significant CAD findings correlated well with hypertension, diabetes, smoking, and dyslipidemia, but no correlation was found with obesity and family history of CAD. The risk of having multivessel disease was higher among those who had multiple risk factors. **Conclusion:** This study highlights hypertension as a key modifiable risk factor for CAD. The risk of significant CAD increases in the presence of modifiable cardiovascular risk factors, and the risk of having multivessel disease, i.e., diffuse disease or significant disease burden, is high in the presence of multiple risk factors as compared to single risk factors.

Keywords: Cardiovascular Risk Factors, Coronary Angiography, Coronary Artery Diseases

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INTRODUCTION

Cardiovascular disease (CVD) is the leading cause of death globally, claiming an estimated 17.9 million lives in 2015.[1] Age, gender, smoking, obesity, dyslipidemia, physical inactivity, hypertension and diabetes mellitus (DM) are established risk factors for CVD.[2-5] Coronary artery disease (CAD), one of the major causes of morbidity and mortality worldwide, is characterized by the presence of atherosclerosis in the coronary arteries. CAD still accounts for approximately one-third of all deaths in individuals over 35 years old.[6-7] Mortality from CVD results from CAD, with ACS almost always presenting with symptoms including unstable angina and myocardial infarction.[8] Coronary angiography is an invasive diagnostic procedure used to visualize the coronary circulation and diagnose intracoronary

lesions.[9] Due to its low risk of major complications and the ability to perform interventions, if necessary, hemodynamic data can also be obtained during the procedure.[9] Various studies have examined the effect of multiple risk factors, such as diabetes, hypertension, hyperlipidemia, sex and smoking, on the pattern and severity of CAD, but there is very limited data based on Nepal. This study aims to correlate the findings of coronary artery disease confirmed by coronary angiogram with cardiovascular disease risk factors.

METHODS

This prospective cross-sectional study was conducted in a semi-urban tertiary care center of Nepal from October 2022, to July 2024. The study was conducted after getting ethical approval from the Institutional Review Committee, Kathmandu University School of Medical Sciences (IRC, KUSMS), with an approval number IRC/KUSMS 11/17. Clinical and demographic variables, including age, sex, Body Mass Index (BMI), smoking history, hypertension, diabetes mellitus, dyslipidemia, family history and alcohol consumption were noted. Electrocardiography (ECG), Echocardiography, and Coronary angiography were done, and their findings were also noted. Two cardiologists independently evaluated angiograms. Lesions ≥50% were defined as significant. CAD was categorized as Single-vessel disease (SVD), Double-vessel disease (DVD), and Triple-vessel disease (TVD). Consecutive sampling was done.

Inclusion Criteria: All patients who underwent coronary angiography (CAG) for coronary artery disease and were presented to the Emergency or Cardiology Outpatient Departments were included in the study.

Exclusion Criteria: Patients who did not give consent were excluded from the study. 170 samples were collected randomly from October 2022 to July 2024. The sample size was calculated using the formula for estimating proportions, $N = Z^2p\ (1-p) / e^2$

Where the N is the required sample size, Z = 1.96 at 95% confidence interval, P is the prevalence of coronary artery disease taken from a study[10] and d = margin of error(5%).

According to the Global Burden of Disease, the prevalence of coronary artery disease in Nepal(p) is 12.2%.[10] Using the above formula, the sample size was calculated to be 170. Therefore, a total of 170 samples were collected.

Statistical analysis

The data were entered in Microsoft Excel, and subsequent statistical analysis was conducted using Statistical Package for the Social Sciences (SPSS) version 21.0 software.

RESULTS

The study enrolled 170 patients with suspected coronary artery disease (CAD) who met the inclusion criteria.

Baseline Characteristics

The mean age of the study population was 60.81±10.70, with the youngest age being 30 years. In our study, Males were higher in number (64.12%) compared to females (35.88%).

The following demographic features and risk factor profile were observed as shown in Table I.

Characteristics	Frequency n(%)
(A) Risk Factors	
Mean age	**60.81 ± 10.70years**
Male	109 (64.12)
Female	61 (35.88)
Hypertension	125 (73.53)
Smoking	83 (48.82)
Alcohol	117 (68.82)
Diabetes Mellitus	61 (35.88)
Obesity (BMI >=30)	64 (37.65)
Dyslipidemia	45 (26.47)
Family History of CAD	16 (9.41)
Past myocardial infarction	16 (9.41)
Stroke	8 (4.71)
Peripheral Arterial Diseases	12 (7.06)
(B) Clinical Features	**n (%)**
Chest pain	142 (83.50)
Shortness of breath	99 (58.20)
Palpitation	58 (34.10)
S3 heart sound	5 (2.90)
S4 heart sound	5 (2.90)
Murmur	38 (22.40)
Asymptomatic	5 (2.94)

Table I: Baseline Characteristics of Study Participants

ECG findings	Frequency n(%)
ST depression	120 (70.64)
ST elevation	50 (29.36)
T wave inversion	57 (33.55)
Q wave	19 (11.18)
LBBB	30 (17.65)
RBBB	12 (7.06)
Atrial fibrillation	15 (8.82)

Table II: Electrocardiography (ECG) findings

Echocardiographic Findings		Frequency n(%)
Dilated Left Ventricle	≤ 50%	118 (69.40)
	>50%	52 (30.50)
Left ventricular ejection fraction	>50%	113 (66.47%)
	40-50%	37 (21.70)
	<40%	20 (11.70)
Regional wall motion abnormalities	Present	62 (36.40)
	Absent	108 (63.50)

Table III: Echocardiographic Findings

Coronary Angiographic Findings

Out of a total of 170 patients undergoing coronary angiography, 118 (69.40%) had significant CAD (defined as ≥50% luminal stenosis). SVD was the most common (28.2%), followed by DVD (14.7%) and TVD (12.9%), as shown in Table IV. Left main disease was identified in 4.1%.

Coronary Angiographic Features	Frequency (%)
No significant CAD	52 (30.60)
Single Vessel Disease(SVD)	48 (28.24)
Double Vessel Disease (DVD)	25 (14.71)
Triple Vessel Disease (TVD)	22 (12.94)
Left Main Disease	7 (4.11)
Non-critical CAD	18 (10.59)

Table IV: Coronary Angiographic Findings

Correlation with Risk Factors

In our study, we found that significant coronary artery disease (defined as ≥50% luminal stenosis) was more common in patients with hypertension (OR=4.25), diabetes (OR=0.46), smoking (OR=2.75), and dyslipidemia (OR=2.76), as shown in Table V. Obesity and family history showed no significant correlation. Patients with >= 2 risk factors were significantly more likely to have multivessel disease (OR 4.78, 95% CI 2.17–10.56). Percentages of individual risk factors among CAD patients are shown in Table Va. Those with only one risk factor had lower odds of having multivessel disease (OR 0.29, 95% CI 0.13–0.69).

Risk Factor	Non-Critical CAD/ Normal (N=70)	Significant CAD (N=100)	OR/CI	p-value
1. Hypertension				
Yes	40	85	4.25(2.06-8.77)	<0.001
No	30	15		
2. Diabetes				
Yes	18	43	0.46(0.24-0.89)	0.023
No	52	57		
3. Smoking				
Yes	24	59	2.75(1.46-5.2)	0.002
No	46	41		
4. Dyslipidemia				
Yes	11	34	2.76(1.28-5.94)	0.009
No	59	66		
5. Obesity				
Yes	28	36	0.84(0.45-1.58)	0.59
No	42	64		
6. Family History				
Yes	38	53	1.053(0.57-1.94)	0.87
No	32	47		

Table Va: Correlation of Risk Factors with Normal/Non-Significant CAD Vs Significant CAD

Risk Factor	SVD (N=48)	MVD (N=52)	Odd's Ratio	95% Confidence Interval
1. Hypertension				
Yes	38	47	0.819	(0.31-2.04)
No	10	5		
2. Diabetes				
Yes	19	24	1.30	(0.59-2.89)
No	29	28		
3. Smoking				
Yes	30	29	0.75	(0.34-1.68)
No	18	23		
4. Dyslipidemia				
Yes	13	21	1.26	(0.57-2.77)
No	35	31		
5. Obesity				
Yes	16	20	0.54	(0.23-1.27)
No	32	32		
6. Family History				
Yes	24	29	1.25	(0.5-2.83)
No	24	23		

Table Vb: Correlation of Risk Factors Among Significant CAD Patients with CAD Pattern SVD vs MVD

Risk Factors	Normal/ Nonsignificant CAD with risk factors (N=63)	Significant CAD with risk factors (N=99)	OR/(CI)
Single risk factor	19	10	0.298 (0.129-0.69)
Multiple risk factors	44	89	4.78 (2.165-10.557)

Table Vc: Correlation of Risk Factors Burden with CAD Pattern SVD Vs MVD

DISCUSSION

The age distribution of patients in this study had a mean age of 60.81 years, with the minimum age being 30 years and the maximum age of 87 years. There was a male predominance comprising 64.12% of our total study population. This finding of age and gender is consistent with the findings of Chandramani et al, conducted at a tertiary hospital in Nepal.[11] Based on the Women's Ischemia Syndrome Evaluation (WISE) study, symptoms of coronary artery disease are not typical in females, and present with atypical symptoms and decreased seeking for medical attention, which may suggest a male predominance of CAD.[12] Patients with angina, ACS or those undergoing coronary angiography may present with a variety of symptoms and signs.[13] The most common symptom was chest pain, followed by dyspnea and other symptoms, which is similar to our findings, where chest pain was the predominant symptom seen in 83% of cases, followed by dyspnea in 58% of cases. In a study by June-Sung Kim et al, about 10% of patients undergoing coronary angiography were asymptomatic.[14] In our study, the population of asymptomatic patients was 2.94%, although they had abnormal ECG or echocardiographic findings.

Among the study population, the most common risk factor was hypertension (73.53%), followed by smoking (48.82%), diabetes (35.88%), dyslipidemia (26.47%), and obesity (37.65%). Among smokers, 30.59% were active smokers and 18.24% were past smokers. Regarding the family history of risk factors, a family history of CAD is present in 9.4% of cases. Similarly, the study by Poudel et al (48). showed the prevalence of hypertension (63.6%), smoking (58.6%), diabetes (18.2%), alcohol intake (30.7%), dyslipidemia (7.6%), and the presence of angina/CAD in family members (11.3%) as risk factors, which is nearly consistent with our study.

CAD remains a leading cause of mortality in both type 1 and type 2 diabetes mellitus, and DM is associated with a 2 to 4-fold increased mortality risk from heart disease.[15] In our study, around 36% of patients were diabetic, a finding consistent with the study done by Einarson TR et al, which states that based on analyzing data from articles with 4,549,481 persons having T2DM, approximately 32.2% of all people with T2DM had cardiovascular disease.[16-17] The combination of hyperglycemia, hypercholesterolemia, inflammation, and endothelial dysfunction is the key mechanism involved in the initiation and progression of atherosclerotic coronary artery disease.[18] Elevated blood pressure (BP) is associated with a significant global burden of cardiovascular disease (CVD) and premature death. Among the patients with pre-existing coronary artery disease (CAD), the prevalence of hypertension ranged from 30% to 70%.[17] This result is somewhat consistent with our study, which found a prevalence of hypertension of 73%.

Although LDL cholesterol, total cholesterol and total triglyceride levels are directly related to the prevalence of coronary artery disease, HDL cholesterol is more closely associated. An inverse association between HDL cholesterol and coronary artery disease persists even when adjusted for LDL cholesterol and triglyceride levels.[19] In our study, dyslipidemia was seen in 26.47% of cases, which is not consistent with the study done by Dhungana et al, where dyslipidemia was seen in around 48% of cases.[20] This discrepancy may be due to the limited sample size in our study population. However, the pattern of dyslipidemia was similar to the study where hypercholesterolemia, hypertriglyceridemia, and low HDL were present in 35.3%, 63.0%, and 28.6% of the total study population, respectively.[21] In our study, the most common pattern of dyslipidemia was low HDL, seen in 56% of cases, followed by hypercholesterolemia and hypertriglyceridemia, seen in 38% and 32% of cases, respectively.

In our study, almost 38% of patients were obese, a finding similar to the study done by Powell-Wiley TM et al, where obesity-associated cardiovascular disease was seen in nearly 38% of cases.[22] Visceral adiposity promotes systemic and vascular inflammation, which is fundamental to all aspects of the ath-

erosclerotic process, from fatty streak development to atherothrombosis.[23] Obesity represents one of the overlooked risks for CAD and will likely escalate the global burden of CAD in the coming decades, given its ongoing epidemic worldwide. A family history of coronary artery disease (CAD) is also a major risk factor for CAD. In our study, 9.4% of the total patients recruited for coronary angiography had a family history of CAD, which is consistent with the study done by Wahrenberg et al, where approximately 9% of the study population had a family history of CAD.[24]

The most common ECG finding was ST depression, seen in 70% of cases, followed by T-wave inversion in 33.55% of cases. These patterns of changes are quite similar to those reported in a study by Liu Y et al, where significant ST-T changes in ECG were observed in 66% of patients undergoing coronary angiography for suspected CAD.[25] Additionally, echocardiographic evaluation of our study population revealed normal left ventricular ejection fraction (LVEF) in 66.4% of cases, while reduced EF (LVEF <40%) was only found in 11.7%, and regional wall motion abnormalities (RWMA) were found in 36% of cases. A study on routine echocardiographic assessment in patients undergoing coronary angiography reported reduced left ventricular systolic function in 21.1% and segmental wall motion abnormalities in 32.9% of cases.[26] Though RWMA findings are consistent with our study, the finding of reduced LVEF is not similar, possibly due to selection bias or a smaller sample size of patients with reduced LVEF included in our study.

In a study by Beig Jr et al in Srinagar, single vessel disease was the most common finding, and the most common risk factor was hypertension, followed by smoking, which is consistent with our study.[27] Also, a study by Dhungana et al showed a majority of SVD followed by DVD in 21.1%, and TVD in 31.6% of cases, which also aligns with our study.[28] Among the patients with CAD on angiography, 98.2% had at least one type of risk factor. Among the various risk factors, the most common was hypertension, seen in 58.82% of cases, followed by smoking in 38.82%, diabetes in 28.24%, obesity in 25.88%, dyslipidemia in 22.94%, and family history in 6.4% of cases. The pattern of risk factors is quite similar to a study done at Sahid Gangalal National Heart Centre in a tertiary center, where hypertension (65%), smoking (57.8%) and dyslipidemia (45.5%) were the most common risk factors.[11]

In our study, we found a significant correlation between coronary artery findings on angiograms with coronary risk factors such as hypertension, diabetes, smoking and dyslipidemia. However, there was no significant correlation between family history and obesity, which may be due to the small sample size study single-center study as a study by Dung NJ et al found a significant correlation between angiographic findings of CAD, dyslipidemia and obesity.[22] Studies showed a significant correlation between risk burden and significant CAD patterns, i.e., MVD is more common among patients with multiple risk factors than SVD, based on the Odds ratio and confidence interval. The odds of single risk factor and multiple risk factors with single vessel disease versus multivessel disease are 0.298(0.129-0.69) and 4.78(2.165-10.557), respectively. This is consistent with the study done by Zeinali-Nezhad et al, who also found that with an increase in multiple risk factors, the prevalence of multivessel disease increased significantly with a p-value of <0.00529.

There are a few limitations in our study. The sample size was relatively small, and the study was done in a single center, which limits its generalizability. So the study provides valuable insights into CAD burden and risk stratification in resource-limited settings like Nepal and urges for larger, multicenter research.

CONCLUSION

Hypertension, Diabetes, Dyslipidemia, and Smoking were strongly associated with coronary arterial disease. Also, multivessel disease was strongly correlated with these risk factors. This study highlights the importance of modifying these possible risk factors and focusing public health interventions to halt the growing burden of coronary artery disease in South Asian countries like Nepal.

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