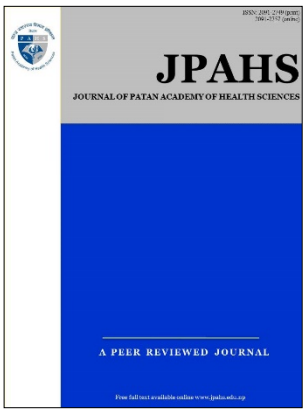

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Pattern of coronary artery occlusion in patients undergoing coronary angiography at Birat Medical College Teaching Hospital

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Abstract

Introduction: Coronary artery disease (CAD), is the leading cause of death globally. Among different diagnostic and treatment procedures, coronary angiography is considered the gold standard. Birat Medical College Teaching Hospital (BMCTH) is also providing cardiovascular services to people from eastern Nepal and from the neighboring country India. We aim to analyze the pattern of coronary artery occlusion in patients undergoing coronary angiography.

Method: A hospital based observational cross-sectional study was conducted at BMCTH from 10 Sep 2022 to 10 Jan 2023. A total of 220 patients were enrolled by consecutive sampling techniques. Ethical approval was obtained from the Institutional Review Committee of BMCTH. Data was collected on baseline characteristics, risk factors, clinical presentation and degree of coronary artery occlusion. Collected data was entered in Microsoft Excel and analyzed by Statistical Package for Social Sciences version 23. Frequency, mean, percentage were calculated.

Result: Nearly half (49.1%) patients had significant, 6(2.7%) had intermittent CAD and 14(6.4%) had non critical CAD. Three patients (1.4%) had left main coronary artery disease. Left anterior descending artery 66(30%) was the most commonly involved. Single vessel disease was present in most patients 49(22.27%). Double vessel disease 15(46.8%) and triple vessel disease was more common 14(51.8%) in above 65 y of age.

Conclusion: The coronary angiography revealed presence of significant coronary artery disease and multiple vessel involvement with increasing age.

Keywords: coronary angiography, coronary artery disease, coronary vessel disease, left main disease.

Introduction

Coronary artery disease (CAD) is characterized by the presence of atherosclerosis resulting in impaired blood circulation in the heart. It is clinically presented as stable angina and acute coronary syndrome (unstable angina and myocardial infarction).[1] It is the foremost single cause of cardiovascular death (CVD) globally contributing to 43% of all CVDs.[2] In developed countries, the age adjusted death rates due to CAD are declining while in developing countries, there is an increasing trend as a result of an increasing prevalence of risk factors and a lack of access to interventional measures.[3]

A population based survey in eastern Nepal found 5.7% prevalence of coronary heart disease.[4] The alarming pervasiveness of CAD is driven by the significant risk factors such as smoking, alcohol, poor nutrition and physical inactivity.[5] Along with the rise in CAD, diagnostic facilities and treatment modalities are available in the country. Among several diagnostic interventions, coronary angiography is considered the gold standard for the diagnosis of CAD.[6]

Birat Medical College Teaching hospital is continuously providing specialty services in cardiovascular disease recently. Hence in its initial phase of expanding the cath-lab services, we aimed to study the pattern of coronary artery occlusion in patients undergoing coronary angiography.

Method

A hospital-based observational cross-sectional study was conducted among 220 patients in Birat Medical College Teaching Hospital from 10 Sep 2023 to 10 Jan 2023. Ethical approval was obtained from the Institutional review committee (IRC PA -221/2078-79) of Birat Medical College Teaching Hospital prior to data collection and informed written consent was obtained from patients. All patients undergoing coronary angiography in the department of cardiology diagnosed with acute coronary syndrome (unstable angina, myocardial infarction), stable angina and treadmill test positive for angiography were included in the study. Patients with failed coronary angiography procedures were excluded from the study.

All consecutive patients meeting the inclusion criteria were included during the study period. Data was collected using specifically designed proforma by the first and second author. At first patient baseline characteristics such as age, sex, risk factors like smoking, hypertension, diabetes mellitus, dyslipidemia, coronary artery disease profile, treadmill test positive or negative status were collected. Then in the second part, findings of the coronary angiography were recorded. The collected data was entered in Microsoft Excel 16 and transferred to Statistical Package for Social Sciences (SPSS) version 23 for statistical analysis. Frequency, mean percentage were calculated.

The study variables were operationalized. Hypertension was defined as systolic blood pressure ≥140 mmHg and/or the diastolic blood pressure readings on both days is ≥90 mmHg or patients having antihypertensive medicine under physician's prescription.[7] Dyslipidemia was defined as presence of increased levels of serum total cholesterol (TC)>240 mg/dl, low-density lipoprotein cholesterol (LDL-C)>130 mg/dl, triglycerides (TG)>150 mg/dl, or a decreased serum high-density lipoprotein cholesterol (HDL-C)<50 mg/dl concentration or patients undertaking lipid lowering drug.[8] Diabetes Mellitus (DM) was defined as patients having symptoms of diabetes, fasting blood sugar>126 mg/dl(7.0 mmol/L) or glycated hemoglobin (HbA1C) level >6.5 or undertaking oral hypoglycemic agents as per American Diabetes Association (ADA) guidelines-2020.[9] Treadmill stress testing was considered positive when patients had angina or significant ST depression >2 mm as defined by Bruce protocol; and/or failure of blood pressure and heart rate to increase appropriately to a graded exercise aimed for 6 to 12 minutes of exercise duration.[10] Chronic stable angina is defined as having complete reversibility of the symptoms and

repetitiveness of the angina attacks over time, typically months to years, is provoked by a exertion or emotional stress, and is relieved by rest or short-acting nitrates.[11] Acute coronary syndrome (ACS) patients presented with new or recent onset chest pain, unrelieved by pain relieving medications and provoked even in rest. It includes ST-segment elevation myocardial infarction (STEMI), Non ST-segment elevation myocardial infarction (NSTEMI) and unstable angina.[12] Significant CAD was defined by invasive coronary angiography as >50% stenosis of the left main stem, ≥70% stenosis in a major coronary vessel.[13] Non critical CAD was defined as stenosis grading of <50% and intermittent CAD was defined as stenosis grading of 50-70%. The coronary artery stenosis was graded as normal/no luminal stenosis, minimal (<25%), mild (25-49%), moderate (50-69%), severe (70-99%) and complete total occlusion (100%).[14] Depending on the number of major epicardial arteries (right coronary artery, left anterior descending artery and left circumflex artery) and degree of stenosis ≥70% involved, they are classified as single vessel disease (SVD), double-vessel disease (DVD) and triple vessel disease (TVD).

Significant stenosis of >50% in the left main coronary artery was considered left main disease (LMD).[15,16] Normal vessels were defined as the complete absence of any disease in the left main coronary artery (LMCA), left anterior descending (LAD), right coronary artery (RCA), and left circumflex (LCX) as well as in their main branches.[17]

Result

The mean age of the patients was 59.76±11.55 y where the majority of the patients 67(30.5%) were in the age group of 61-70 y. Among them 125(56.7%) were male, 189(86%) of patients had hypertension, Table 1.

The number of patients with chronic stable angina was 113(51.3%), 75(34.1%) were screened by TMT and 32(14.5%) were patients with acute coronary syndrome, Table 2.

Coronary angiography procedure was performed through the right radial route in all patients. In angiography, significant CAD of the left main artery was found in 3(1.4%), LAD in 66(30%), LCX in 59(26.7%) and RCA in 58(26.3%). There was mild in-stent restenosis in one patient in the LAD and two patients in the LCX, Table 3; 108(49.1%) patients had significant CAD, 6(2.7%) had intermittent CAD and 14(6.4%) had non critical CAD; 49(22.27%) had SVD, 14.54% had DVD and 10.9% had TVD, Table 4.

Table 1. Baseline characteristics of patients (N=220)

Age group in years	N(%)	Sex	N(%)
30-40	83(2.3%)	Male	125(56.8%)
41-50	48(21.8%)	Female	95(43.2%)
51-60	61(27.7%)	**Risk factors**	
61-70	67(30.5%)	Hypertension	189(85.9%)
71-80	30(13.6%)	Dyslipidemia	93(42.2%)
81-90	6(2.7%)	Diabetes Mellitus	83(37.7%)
		Smoking	68(30.9%)

Table 2. Clinical presentation of coronary artery disease (N=220)

Classification	N(%)
Chronic stable angina	113(51.3%)
TMT positive	75(34.1%)
Acute coronary syndrome	32(14.5%)

Note: TMT: Treadmill Test

Table 3. Pattern of coronary artery occlusion in coronary angiography*(multiple responses)

Coronary arteries stenosis grading in each arteries		LMA N(%)	LAD N(%)	LCA N(%)	RCA N(%)
Normal coronary arteries	No visible stenosis	215(97.7%)	67(30.5%)	122(55.5%)	115(52.3%)
Non critical CAD (<50%)	Minimal stenosis <25%	0	0	2(0.9%)	0
	Mild stenosis 25-49%	2(0.9%)	64[a] (29.1%)	34[b] (15.4%)	37(16.8%)
Intermittent CAD (except in left main artery)	Moderate stenosis 50-69%	3(1.4%)	19(8.6%)	3(1.4%)	10(4.5%)
Significant CAD	Severe stenosis 70-99%	0	62(28.2%)	49(22.3%)	42(19.1%)
	Complete occlusion 100%	0	4(1.8%)	10(4.5%)	16(7.2%)
Significant CAD (50% in Left main and ≥70% in LAD, LCX and RCA)		3(1.4%)	66(30.0%)	59(26.7%)	58(26.3%)

Note: LMA-Left main artery, LAD=Left anterior descending artery, LCA= Left circumflex artery, RCA= Right coronary artery *right radial route. [a]one in stent restenosis in LAD. [b]two in stent restenosis in LCX

Table 4. Angiographic findings (N=220)

Vessels Involved	N(%)
Normal coronary arteries	82(37.3%)
Significant CAD 108(49.1%)	
Single vessel disease	49(22.3%)
Double vessel disease	32(14.5%)
Triple vessel disease	24(10.9%)
Left main disease	3(1.4%)
Non critical CAD	14(6.4%)
Intermittent CAD	6(2.7%)
Myocardial bridge	6(2.7%)
Negative remodelling	4(1.8%)

Note: CAD=Coronary artery diseases

Table 5. Distribution of coronary angiographic findings in relation to age and sex

Characteristics	Sex		Age in Years		
	Males N(%)	Females N(%)	<50 y N(%)	50-65 y N(%)	>65 y N(%)
Normal coronary arteries N(%)	37(45.1%)	45(54.9%)	27(32.9%)	30(36.6%)	25(30.5%)
SVD	31(63.2%)	18(36.7%)	3(6.2%)	24(48.9%)	22(44.9%)
DVD	23(71.9%)	9(28.1%)	8(25%)	9(28.1%)	15(46.9%)
TVD	13(54.2%)	11(45.8%)	2(8.3%)	11(45.8%)	11(45.8)
Left Main Disease	2(66.7%)	1(33.3%)	0	0	3(100%)
Intermittent CAD	4(66.6%)	2(33.3%)	1(16.6%)	3((50%)	2(33.3%)
Non critical CAD	8(57.1%)	6(42.8%)	2(14.3%)	8(57.1%)	4(28.6%)
Myocardial bridging	5(83.3%)	1(16.6%)	0	4(66.6%)	2(33.3%)
Negative remodelling	2(50%)	2(50%)	1(25%)	2(50%)	1(25%)

Patients age >65 y had the least normal coronary arteries 25(30.5%) compared to other age group. The majority of patients had single vessel disease in the age of 50-65 y. Double vessel disease and triple vessel disease was more common in ages above 65 y, i.e., 15(46.8%) and 14(51.8%) respectively. Triple vessel disease was 2(8.3%), females 45(54.9%) had normal coronary arteries compared to males 37(45.1%), Table 5.

Discussion

In this study, among 220 patients, nearly half (49.1%), patients had significant CAD, 6(2.7%) had intermittent CAD and 14(6.4%) had non critical CAD. Three patients had left the main

CAD. Normal coronary arteries were seen in 82(37.3%) patients. Females 45(54.9%) had normal coronary arteries compared to male patients 37(45.1%).

In comparison to this, a study from Dhulikhel hospital had a significantly lower percentage of patients with CAD, however the stenosis in the left main artery was (four out of 36 patients) more as compared to this study.[18] The differences in the number of study populations show the increment of disease burden in the current context. A study conducted among young patients (≤40 years) in Kathmandu found higher (55.96%) patients having significant CAD, which is greater than our study.[17] The percentage of patients with normal coronary arteries is relatively less (32.8% and 33.5% respectively) in a study from Dharan and Kathmandu compared to this study.[19,20] One possible reason for differences in the percentage of significant CAD is due to the differences in classification system. The cut off value of significant CAD in our study is 50% in the left main artery and ≥70% in other major arteries while from other studies, the cut off value of >50% in all the major coronary arteries. Contrast to our study, a study done in a tertiary hospital Kathmandu, reported a higher percentage of patients having normal coronary angiographic findings (40%).[6,21] This shows us the increasing trend of patients with CAD in our setting. The relatively less percentage of patients with normal coronary angiography is caused by an increase in the number of patients with CAD which is also due to the increased prevalence of cardiovascular risk factors like hypertension, smoking, diabetes, dyslipidemia and lifestyle pattern. Among the major coronary arteries involved, the majority had significant stenosis in LAD artery 66(30%) followed by LCX 59(26.7%) and RCA 58(26.3%) in our study. The findings of our study is similar to the study done in Norvic International hospital which reported that the LAD artery (56.0%) was most frequently affected followed by LCX artery (34.2%) and RCA (31.4%).[6] We found other similar studies which stated that the first major vessel being affected was the LAD artery. However, the succeeding artery involved was the RCA which is different from our study.[17-19,20] Several other studies demonstrated the LAD artery and LCX artery is most commonly affected compared to RCA.[22,23] LAD artery is the most important and largest blood vessel that carries almost 50% of the blood of the coronary circulation. Blockage of LAD artery may cause myocardial infarction involving large areas of the anterior, septal and apical portions of the heart muscle and lead to serious impairment of cardiac performance.[24,25] In our study, total (100%) occlusion was mostly present in RCA 16(7.2%) followed by LAD artery 10(4.5%) and LCX artery 4(1.8%). Complete occlusion in the major arteries requires immediate medical intervention as there is an increased risk of infarction and sudden cardiac death associated with the obstruction in blood flow. Also infarction in the LAD artery and LCX artery had a relatively higher adjusted mortality rate. There is increased risk of heart failure, stroke and death with LAD infarctions.[26] In regards to the number of vessels involved, maximum patients had SVD (22.27%) followed by DVD (14.5%) and TVD (12.3%). Contrast to our study, a study among female patients with DVD was commonest.[20] Similar findings were obtained in a study done among 109 young patients (SVD-30.27%, DVD-13.76% and TVD-11.9%).[17] Another study done in Shahid Gangalal National Heart Center and Norvic International Hospital also had the same findings.[6,21] In our study the number of vessel involvement increased with increasing age. SVD was common in the age group 50-65 years, DVD and TVD was more common in ages above 65 years. Left main disease was found in age above 65 years. This finding was similar to the study conducted among female patients in Kathmandu.[20] The survival rate and prognosis of patients decreases with the increase in vessel involvement and other risk factors present. SVD has better survival rate compared to DVD and TVD.[27] Patients aged below 40 years did not have disease in the left main stem which is similar to our study.[17] Another study conducted in tertiary hospital in Kathmandu identified 102(3.1%) patients who had left main stem stenosis. Mean age of the patients was 60.6±10.1 years and most (80.3%) of them

were male which is almost similar to the findings of our study.

Myocardial bridging of the LAD artery was seen most in the 50-65 years' age group and majority were male (five patients) in this study. Myocardial bridge is a congenital anomaly that remains silent in majority but is associated with exertional angina, myocardial ischemia, acute coronary syndromes, ventricular arrhythmias, stress cardiomyopathy, and sudden cardiac death. The bridging of the middle segment of the LAD is the commonest presentation which is similar to our study.[28] The mean age of the patients was 59.76±11.55 years comprising the majority in 61-70 years (30.5%). More than half (56.8%) were male in this study. A study from Dhulikhel and Kathmandu, had findings similar to our study.[18,21] A study among young age groups also reported the male (81.65%) patients being significantly higher than females.[17] This is an acceptable clinical presentation similar to the evidence from the literature. CAD is common in male compared to females before postmenopause.[29]

Every four in five patients had hypertension in our study followed by dyslipidemia and diabetes. A study from Dhulikhel hospital reported the same findings where the majority had hypertension and diabetes. Contrast to our study, smoking was the most common risk factor present in a study done among young age groups.[17] This difference in our setting is due to the difference in age group. Hypertension, dyslipidemia and diabetes increases with increasing age.[30] More than half (51.3%) undergoing coronary angiography had chronic stable angina, more than one third (34.1%) were positive for the treadmill test and 32(14.5%) were presented with ACS in our study. Similar to our finding, maximum patients had stable angina (19 out of 32) reported.[18] Contrast to our study, nearly half had STEMI (46.3%) in a study from Dharan and more than half females (52.5%) had ACS.[19,20] The differences in the mode of presentation among patients across different hospitals shows the severity of disease among patients. Patients positive for treadmill test and in presence of risk factors can be confirmed by the gold standard coronary angiography which has been done in our study. Our study has some limitations too. We studied only the pattern of coronary angiography and did not follow up patients for their outcome.

Conclusion

The coronary angiography revealed presence of significant coronary artery disease and multiple vessel involvement with increasing age.

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Conflict of Interest

None

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None

Author Contribution

Concept, design, planning: PS, MB, HKC; Literature review- PS, MB, HKC; Data collection/analysis PS, MB, PS, HKC; Draft manuscript: PS, MB, HKC; Revision of draft: PS, MB, HKC; Final manuscript: PS, MB, HKC; Accountability of the work: PS, MB, HKC.

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