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Original Article

Coronary Angiographic Profile in Acute Coronary Syndrome: A Prospective Observational Study in Southern India

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ABSTRACT

Background: Coronary angiography performed during acute coronary syndrome (ACS) reveals different morphologies of the coronary artery such as occlusion, thrombosis, and stenosis. However, in some cases of ACS, angiography shows normal coronaries. Thus, we aimed to evaluate the pattern of coronary artery disease (CAD) in various cases of ACS using coronary angiography.

Methods: In this prospective study, 100 patients of either gender, aged above 18 years, with the chief complaint of typical chest pain and electrocardiographic abnormalities consistent with ACS, who underwent coronary angiography within 48 hours of admission were studied for angiographic patterns. Statistical analysis was performed using software R, version 3.6.0.

Results: The study population was comprised of 100 patients, of whom the majority were men (60%). The mean age was 56.86 ± 12.79 years. Most of the patients had unstable angina (39%), ST-elevation myocardial infarction (31%), and non–ST-elevation myocardial infarction (30%), followed by single-vessel disease (33%), double-vessel disease (19%), and triple-vessel disease (19%). The left anterior descending (LAD) was the most common artery involved (61%) with 31% of complex and diffuse lesions. Among patients with risk factors, including diabetes and hypertension, 41% had vessel occlusions. Statistically, no significant association was found between risk factors and angiographic findings (P = 0.193). A linear positive correlation was found between total cholesterol and the percentage of the vessel occlusion of an individual epicardial artery (LAD: 0.12^{r} [P = 0.233], left circumflex: 0.104^{r} [P = 0.302], and left main coronary artery: 0.016^{r} [P = 0.869]).

Conclusions: Coronary angiography revealed a high incidence of multiple-vessel disease in our patients with hyperlipidemia, diabetes, and hypertension. However, it showed normal coronaries in a few patients with ACS. Therefore, coronary angiography may not always be useful in the detection of the etiology of myocardial ischemia in every patient. ***(Iranian Heart Journal 2021; 22(1): 42-48)***

KEYWORDS: Coronary artery disease, Diabetes, Hypertension, Hyperlipidemia

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Coronary artery disease (CAD) is a global health concern and will be the leading cause of mortality worldwide by the year 2020.[1] Cardiovascular diseases, especially CAD, account for 26% of mortality in India.[2] Although the mortality rate has been declining in Western countries for the past 3 decades, the rate has been rising in India as the pattern of acute coronary syndrome (ACS) among Indians is totally different from that of the Western population.[3] The increased incidence of CAD in Indians may be due to changes in metabolism, lifestyle, food habits, genetic, and nonconventional risk factors as well.[4, 5] Therefore, prompt and early diagnoses via accurate diagnostic procedures are essential to reduce the mortality rate associated with CAD. The primary step in diagnosing ACS is a complete clinical workup including the patient's medical history, physical examination, and diagnostic tests such as electrocardiography (ECG), chest X-ray, and serum cardiac biomarkers. If ECG findings are consistent with myocardial ischemia, the patient should be managed for ACS accordingly. Nonetheless, a high rate of mortality is encountered among patients with normal ECG not hospitalized for an acute attack as ECG has low sensitivity in detecting single-vessel disease (SVD). On the other hand, anatomical diagnostic tests such as coronary angiography have higher accuracy in detecting non-occlusive CAD.[6] This study aimed to evaluate the pattern of CAD in various cases of ACS using coronary angiography, to correlate angiographic findings with risk factors, and to determine the prevalence of non-occlusive CAD.

METHODS

After obtaining ethical clearance, we performed this prospective observational study for 2 years, between November 2012 and June 2014 in the Department of General Medicine at a tertiary care teaching hospital, Karad, Maharashtra, India. Via the non-probability (consecutive) sampling technique, a total of 100 patients aged above 18 years with the chief complaint of typical chest pain (or tightness or burning) and ECG abnormalities consistent with myocardial ischemia were included in the study. Patients with cardiomyopathy or established valvular heart disease were exempted from the study. After obtaining written informed consent, we performed coronary angiography (C-Arm Machine; Judkins Right and Judkins Left catheters for the femoral route and the Tiger Optitorque for the radial artery route) on all the patients. Other biochemical and hematological tests, including cardiac troponin I and creatine kinase-MB, were conducted on each patient as indicated.

The data regarding age, gender, and detailed medical history including the CAD risk factor profile (tobacco addiction, alcohol, obesity, hypertension, diabetes mellitus, and dyslipidemia), familial history of CAD, ECG findings, and cardiac biomarkers (cardiac troponin I and creatine kinase-MB) were recorded in a predesigned pro forma. Coronary angiography was performed using the standard procedure within 48 hours of admission unless the patient was hemodynamically unstable, and expert opinion was obtained from a senior cardiologist on coronary angiography. CAD was taken into consideration if the stenosis was greater than 50% in major epicardial arteries, namely the left anterior descending (LAD), the right coronary artery (RCA), the left circumflex (LCX), and the left main coronary artery (LMCA). Accordingly, the patients were categorized to have occlusive or non-occlusive (normal) coronaries; SVD, double-vessel disease (DVD), or triple-vessel disease (TVD).

Statistical Analysis

The statistical analyses were conducted using software R, version 3.6.0. The normality of the data was determined using

the Shapiro–Wilk test. The continuous variables with normal distributions were presented as mean±SD and compared using the paired *t*-test, whereas the χ^2 test was employed for the dichotomous data. The Mann–Whitney *U* test was performed for variables without a normal distribution. The categorical variables were presented as frequencies and percentages. Relative risk (RR) was used to measure the risk of ACS among men and women. The correlation between different angiographic findings and risk factors was measured using the Pearson correlation test for the continuous variables and the Spearman test for the non-continuous variables. A *P* value of less than 0.05 was considered statistically significant at a 95% confidence interval.

RESULTS

The study population was comprised of 100 patients, of whom 60% were male and 40% were female at a mean age of 58.37 ± 12.21 years and 55.35 ± 13.37 years, respectively. Almost 50% of the patients were at least 60 years old, with the mean age being 57.16 ± 12.71 years. Most of the patients (82%) presented with chest sensations, including heaviness, tightness, chest pain, and retrosternal discomfort, followed by breathlessness (29%) at rest or on exertion and associated symptoms such as palpitation (5%), giddiness (11%), and sweating (29%).
Out of the 100 patients, 60% were addicted to tobacco, 8% had diabetes mellitus, 23% had hypertension, and 10% had both diabetes mellitus and hypertension. The majority of the patients (59%) had no such contributory risk factors (diabetes mellitus and hypertension). Among the patients with tobacco addiction, 44/60 (73%) were men and 16/40 (40%) were women, with those aged above 60 years accounting for the highest number of addicts (64%). Dyslipidemia was one of the risk factors for CAD. It was found that the mean levels of serum low-density lipoprotein (LDL) and serum high-density lipoprotein (HDL) were high and low, respectively, in both genders (Table 1). Younger patients had a lower serum HDL level than the middle-aged ones, whereas serum LDL remained high in the middle-aged and elderly patients. Statistically, no significant difference was found between the genders and age groups with regard to the lipid profile ($P > 0.05$) (Table 1).
At the time of presentation, ECG was recorded and interpreted: 31% had anterior wall myocardial ischemia, 23% had inferior wall myocardial ischemia, and 6% showed diffuse areas of ischemia. In 2D echocardiography, 64% of the patients showed regional wall motion abnormality (RWMA). The majority of the patients who were at least 60 years old had RWMA (74%) compared with the other age groups. A statistically significant association was found between the age groups 29 to 39 years, 40 to 59 years, and at least 60 years in regard to RWMA ($P = 0.0413$), indicating a gradual decline in the functional capacity of the heart with increasing age. Eventually, 39% of the patients were diagnosed with unstable angina (UA), 31% with ST-segment-elevation myocardial infarction (STEMI), and 30% with non–ST-segment-elevation myocardial infarction (NSTEMI). The male patients had 1.16, 0.61, and 1.31 times more risk than their female counterparts for UA, STEMI, and NSTEMI, respectively.

Coronary Angiography

The majority of the patients had SVD (33%), followed by DVD (19%) and TVD (19%). The rest of the patients (29%) had no occlusion in any vessel (normal coronaries). Among the patients in the age group of 20 to

39 years, 66.67% had non-occlusive disease, whereas 31.7% and 39% in the age group of 40 to 59 years had SVD and non-occlusive disease, respectively. Among the patients aged at least 60 years, 36% had SVD, 26% had TVD, and only 14% had non-occlusive disease. Statistically, a significant association was found between the age group and the number of blood vessels involved (P = 0.0206). Out of the 100 patients, 31% had complex and diffuse lesions (mostly the terminal branch), 24% had plain lesions (lesion involved only in 1 area of the vessel), and 23% had normal coronaries. Among the patients with complex and diffuse lesions, 54.83% had TVD, whereas 24% of the patients with plain lesions had SVD. The data on the occlusive and non-occlusive types of an individual epicardial artery with regard to gender and age are presented in Table 2. LAD (61%) was the most common artery involved, followed by RCA (33%) and LCX (29%), with the least involvement of LMCA (3%). A significant positive correlation was found between age and the percentage of occlusion of an individual epicardial artery (LAD: 0.28^{r} [P = 0.004], LCX: 0.351^{r} [P = 0.0003], and LMCA: 0.196^{r} [P = 0.049]), indicating a gradual increment in the occlusion of the vessel with age advancement.

The number of patients with the lipid profile in the normal range with vessel involvement was comparatively higher than that of the patients with increased cholesterol levels (Table 3). In contrast, a linear positive correlation was found between total cholesterol and the percentage of occlusion in an individual epicardial artery (LAD: 0.12^{r} [P = 0.233], LCX: 0.104^{r} [P = 0.302], and LMCA: 0.016^{r} [P = 0.869]), suggesting a gradual increment in vessel occlusion with an increase in the total cholesterol.

Among the patients with risk factors (diabetes mellitus, hypertension, and both), 41% had occlusive disease (75.6%) and 24.3% had normal coronaries. No statistically significant association was found between the risk factors and angiographic findings (P = 0.193), whereas the ECG interpretation of ACS showed a significant association with occlusive and non-occlusive vessels (P < 0.0001) (Table 4).

LAD was the most common coronary artery involved in SVD (25) or TVD (19), followed by a similar involvement of RCA and LCX mostly in multiple-vessel disease (MVD) (DVD; 21 and TVD; 33) (Table 5).

Table 1: Age and gender-wise distributions of the lipid profile

Variables		Lipid profile (mg/dL [mean±SD])			
		Serum Cholesterol	Serum Triglycerides	Serum LDL	Serum HDL
Gender	♂	177.90±46.59	141.25±60.29	108.65±34.09	38.90±10.07
	♀	176.93±40.60	129.63±44.48	107.55±35.97	39.33±9.63
P value [a]		0.91	0.27	0.87	0.83
Age group	20- 39 y	158.75±43.276	117.63±62.41	91.75±38.57	33.00±6.11
	40-59 y	181.71±37.19	146.19±61.59	115.05±30.10	40.98±10.17
	≥ 60 y	176.98±49.28	131.58±46.09	105.10±36.94	38.44±9.72
P value		0.08[a]	0.02[b]	0.05[a]	0.18[b]

a, Paired *t*-test; b, Mann–Whitney *U* test; ♂, Male; ♀, Female; LDL, Low-density lipoprotein; HDL, High-density lipoprotein

Table 2: Age- and gender-wise occlusion of an individual epicardial artery

Epicardial Artery		Gender (n)		Age Group (n)		
		Male	Female	20-39 y	40-59 y	≥60 y
LAD	Occlusive	41	20	3	22	36
	Non-occlusive	19	20	6	19	14
P value [a]		0.066		0.041		
RCA	Occlusive	21	12	0	9	24
	Non- occlusive	39	28	9	32	26
P value [a]		0.027		0.002		
LCX	Occlusive	22	7	1	9	19
	Non-occlusive	38	33	8	32	31
P value [a]		0.039		0.113		
LMCA	Occlusive	3	0	0	0	3
	Non-occlusive	57	40	9	41	47
P value [a]		0.151		0.213		

a, χ2 test; LMCA, Left main coronary artery; LAD, Left anterior descending; RCA, Right coronary artery; LCX, Left circumflex

Table 3: Comparisons of the lipid profile with angiographic findings

Lipid Profile (mg/dL)		Coronary Angiography (n)				Total (n)	*P value* [a]
		SVD	DVD	TVD	Non-occlusive		
TC	>200	12	3	6	5	26	0.227
	≤200	21	16	13	24	74	
TG	>150	13	8	7	7	35	0.525
	≤150	20	11	12	22	65	
HDL	≥40	19	6	5	14	44	0.098
	<40	14	13	14	15	56	
LDL	>100	23	7	11	18	59	0.136
	≤100	10	12	8	11	41	

a, χ2 test; TC, Cholesterol; TG, Triglycerides; LDL, Low-density lipoprotein; HDL, High-density lipoprotein

Table 4: Comparisons of risk factors (DM and HTN) and ACS with angiographic findings

Variables		Coronary Angiography (n)				*P value* [a]
		SVD	DVD	TVD	Non-occlusive	
Risk factors	DM	2	2	2	2	0.193
	HTN	6	5	6	6	
	DM+HTN	1	2	5	2	
	Nil	24	10	6	19	
ACS	UA	6	4	4	25	<0.0001
	STEMI	14	11	6	0	
	NSTEMI	13	4	9	4	

a, χ2 test; SVD, Single-vessel disease; DVD, Double-vessel disease; TVD, Triple-vessel disease; ACS, Acute coronary syndrome; UA, Unstable angina; STEMI, ST-elevation myocardial infarction; NSTEMI, Non–ST-elevation myocardial infarction

Table 5: Comparisons of angiographic findings with individual epicardial arteries

Epicardial Artery		Coronary Angiography (n)				*P value* [a]
		SVD	DVD	TVD	Non-occlusive	
LAD	Occlusive	25	17	19	0	<0.0001
	Non-occlusive	8	2	0	29	
RCA	Occlusive	5	11	17	0	<0.0001
	Non-occlusive	28	8	2	29	
LCX	Occlusive	3	10	16	0	<0.0001
	Non-occlusive	30	9	3	29	
LMCA	Occlusive	0	0	3	0	0.004
	Non-occlusive	33	19	16	29	

a, χ2 test; LMCA, Left main coronary artery; LAD, Left anterior descending; RCA, Right coronary artery; LCX, Left circumflex

DISCUSSION

This observational descriptive research studied the pattern of CAD in suspected cases of ACS using coronary angiography. All the patients with ACS had a mean age of 56.86 ± 12.79 years, which is consistent with a prospective analysis (CREATE registry) conducted on 20 937 patients by Xavier et al[7] (57.5 ± 12.1 y). A clear preponderance of males (60%) was observed in our study, indicating that our male patients were prone to CAD. Ranjith et al[8] conducted a study on African Asian Indians (4418) with ACS and reported 67% of male preponderance with high a prevalence of STEMI (75%) in all the patients. In contrast, a high prevalence of UA (39%) was observed in this study, suggesting that UA was the most common occurrence. The majority of the patients had anterior wall myocardial ischemia and infarction (31%), which is in accordance with a study conducted by Wadkar et al.[9] Histopathological studies have revealed that plaques in younger patients are highly unstable and more likely to rupture, suggesting increased susceptibility of young adults to STEMI.[10] The prevalence of MVD was relatively high in our patients with hypertension and diabetes mellitus (9.7 and 27.8, respectively) when compared with our patients without these 2 risk factors (5.6% and 16.02%, correspondingly). Tewari et al[10] also reported that diabetes mellitus was a good predictor of MVD. Still, no significant correlation was found between the lipid profile and the percentage of vessel occlusion on angiography. Hughes et al[11] reported an increased RR of myocardial infarction directly with triglycerides and inversely with HDL in Asian Indians.

We observed a high prevalence of SVD with a male preponderance in all of our patients with ACS, followed by DVD and TVD. Tewari et al[10] and Kumar et al[12] also reported SVD with male dominance in ACS with statistical significance ($P < 0.05$). UA was more commonly associated with normal coronaries (15.6%) than NSTEMI (11.4%) and STEMI (9.72%). Almost 30% of the patients with UA were overdiagnosed, suggesting more false positivity of ACS, especially in females. Mohammad et al[13] reported a 9.42% rate of normal coronaries angiographically in patients with STEMI who had been subjected to complete recanalization (spontaneous/post-thrombolysis). A high incidence of MVD was associated with hypercholesterolemia, hypertriglyceridemia, high LDL, low HDL, hypertension, and diabetes mellitus in this study.

One of the major limitations of our study is that none of our patients had a history of severe familial hyperlipidemia. In other words, family history was not accorded due emphasis. Secondly, the treatment (other than thrombolysis) received upon admission and before angiography was not taken into

consideration along with the complications of treatment and disease as well.

CONCLUSIONS

Coronary angiography revealed a high incidence of MVD in patients with hyperlipidemia, diabetes, and hypertension. However, it showed normal coronaries in a few patients with ACS. Therefore, coronary angiography may not always be useful in determining the etiology of myocardial ischemia in every patient. Furthermore, comparative studies on coronary angiography with other diagnostic procedures such as intravascular ultrasound are required, which probably may increase the diagnostic accuracy of angiography.

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