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Diagnostic Accuracy of Computed Tomography Angiography in Acute Chest Pain with Suspected Coronary Artery Disease

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Abstract

Hypertension, diabetes mellitus, smoking, hyperlipidemia, and familial hypercholesterolemia are major atherosclerotic risk factors and are strongly associated with cardiovascular morbidity and mortality. Coronary artery disease (CAD), most commonly caused by atherosclerotic plaque formation and luminal narrowing of the coronary arteries, remains the leading cause of death worldwide. Coronary computed tomography angiography (CCTA) provides a non-invasive method to assess the anatomic extent and severity of CAD. To determine the frequency and pattern of coronary artery disease detected on computed tomography angiography in patients presenting with chest pain and suspected CAD, and to evaluate its association with major cardiovascular risk factors. This cross-sectional study was conducted over four months at the Punjab Institute of Cardiology, Lahore, and Al-Razi Hospital, Lahore. A total of 67 patients with clinically suspected CAD were enrolled using a consecutive sampling technique. Sample size was calculated using the standard formula with an assumed incidence of CAD of 4.5%. Adults of both genders with suspected CAD, with or without traditional risk factors and/or family history of cardiac disease, were included. Patients aged <18 years and pregnant women were excluded. All patients underwent CCTA on a Toshiba Aquilion 640-slice CT scanner using a standardized contrast-enhanced retrospective ECG-gated protocol. Demographic data, major risk factors (diabetes mellitus, hypertension, hyperlipidemia, familial hypercholesterolemia, smoking), and CCTA findings (presence of CAD and number of vessels involved) were recorded. Data were analyzed using SPSS version 25. In our Study 67 patients were included in which 51 (76.5%) had CAD and 16 (23.5%) had no CAD on CCTA. The cohort comprised 52 males (78%) and 15 females (22%). Diabetes mellitus was present in 37 patients (54.5%), hypertension in 52 (77.3%), hyperlipidemia in 28 (41.7%), familial hypercholesterolemia in 28 (42%), and smoking in 15 (22.7%). Coronary vessel involvement analysis showed that 16 patients (23.5%) had normal coronary arteries, 10 (15.2%) had single-vessel disease, 10 (15.2%) had two-vessel disease, and 31 (46.2%) had three-vessel disease. The most frequent pattern was combined involvement of LAD + LCA + RCA, observed in 31 patients (46.2%). CAD was more prevalent in males (40 males vs. 11 females with CAD), in diabetics (32 with CAD vs. 5

without), in hypertensive patients (38 with CAD vs. 14 without CAD), in patients with familial hypercholesterolemia (22 with CAD), and in smokers (13 with CAD). Overall, CAD showed higher prevalence among males, diabetics, hypertensive individuals, smokers, and those with familial hypercholesterolemia. CCTA demonstrated a high burden of CAD in patients presenting with chest pain and suspected coronary disease, with most CAD patients exhibiting multivessel involvement. Male gender, hypertension, and diabetes mellitus emerged as the strongest predictors of CAD, while smoking and familial hypercholesterolemia showed weaker associations in this cohort. CCTA is a valuable non-invasive modality for evaluating coronary anatomy and risk stratification in symptomatic patients with multiple cardiovascular risk factors.

Keywords: Coronary Artery Disease; Computed Tomography Angiography; Diabetes Mellitus; Hypertension; Hyperlipidemia; Familial Hypercholesterolemia; Smoking

Introduction

Coronary computed tomography angiography (CCTA) is a non-invasive cardiac imaging modality that allows detailed visualization of the coronary arteries and assessment of atherosclerotic plaque and luminal stenosis. It is increasingly used to evaluate patients presenting with chest pain and suspected coronary artery disease (CAD), particularly in those with low to intermediate pre-test probability of CAD (1). Plaque within the coronary arteries is composed of fat, cholesterol, calcium, and other substances that accumulate along the arterial intima. Progressive plaque buildup leads to luminal narrowing, reduced coronary blood flow, myocardial ischemia, and, in advanced cases, plaque rupture and thrombotic occlusion resulting in acute myocardial infarction. Global data show that CAD remains the leading cause of mortality, accounting for a substantial proportion of cardiovascular deaths worldwide (2). Epidemiological studies indicate that the prevalence of CAD varies across populations but is consistently higher in individuals with modifiable risk factors such as hypertension, diabetes mellitus, dyslipidemia, smoking, and obesity. South Asian populations, including Pakistan, have a high burden of these risk factors and tend to develop CAD at a younger age compared to Western populations. Despite this, local data on the pattern of CAD and its association with risk factors using CCTA are limited. CCTA offers several advantages: it is non-invasive, provides high spatial resolution, allows visualization of both luminal stenosis and plaque characteristics, and can demonstrate the number and distribution of diseased vessels. It is particularly useful in triaging patients with acute or subacute chest pain, where timely and accurate diagnosis is crucial for guiding management and preventing adverse cardiac events. In the context of our setting, where invasive coronary angiography may not be readily available for all patients, CCTA can serve as an important diagnostic and risk-stratification tool.

Material and Methods:

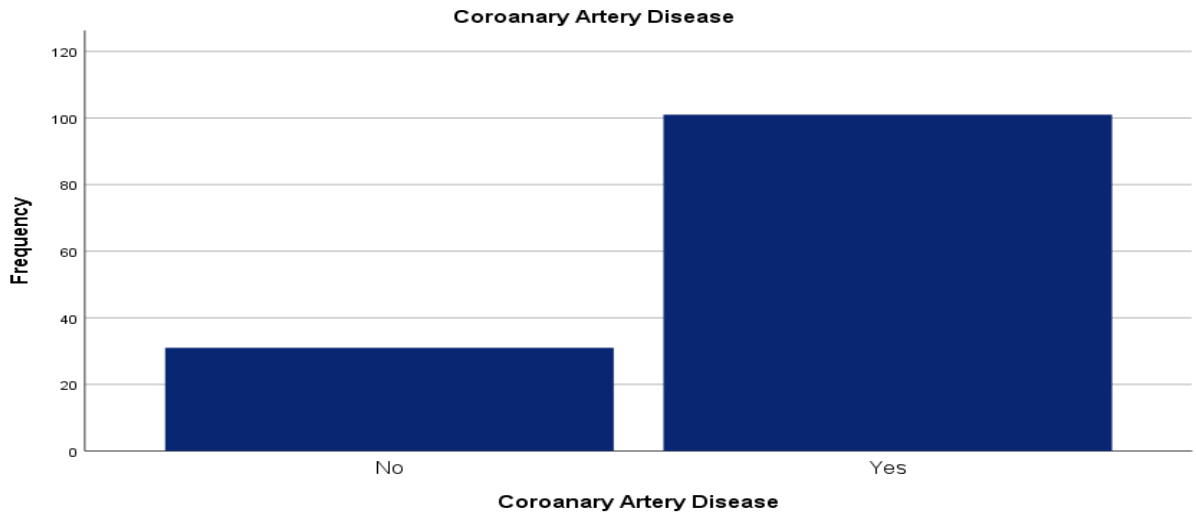
This cross-sectional study was conducted over four months at the Punjab Institute of Cardiology and Al-Razi Hospital, Lahore, using a consecutive non-probability sampling technique. The sample size was calculated using the standard formula with an assumed CAD incidence of 4.5%, yielding 67 patients. Adults aged ≥18 years with clinically suspected coronary artery disease presenting with chest pain—with or without major risk factors or positive family history—were included, while individuals aged <18 years and pregnant women were excluded. All CCTA scans were performed on a Toshiba Aquilion 640-slice CT scanner using a standardized protocol that involved supine positioning, ECG monitoring, IV contrast injection (80–100 ml at 5–7 ml/sec), saline flush, optional beta-blocker administration, 120 kVp with modulated mAs, 0.5 mm slices, retrospective ECG gating, and bolus tracking. Data were recorded using a structured proforma, documenting demographic

details, cardiovascular risk factors (diabetes mellitus, hypertension, hyperlipidemia, familial hypercholesterolemia, and smoking), as well as CCTA findings, including presence of CAD, number of vessels involved, and specific artery involvement (LAD, LCA, RCA). CAD was defined as luminal narrowing due to atherosclerotic plaque and categorized as normal, single-, double-, or triple-vessel disease. Ethical approval was ensured through informed consent, strict confidentiality, and adherence to institutional safety protocols. Statistical analysis was performed using SPSS version 25, with categorical variables presented as frequencies and percentages and continuous variables as mean ± standard deviation, while associations between CAD and risk factors were assessed using cross-tabulations.

Result

A total of 67 patients were included in this study, of whom 51 (76.5%) had coronary artery disease (CAD) and 16 (23.5%) had no CAD. The study population predominantly consisted of males (78%), while females accounted for 22%. Diabetes mellitus was present in 37 patients (54.5%), whereas 30 (45.5%) were non-diabetic. Hypertension was highly prevalent, reported in 52 patients (77.3%), and 15 patients (22.7%) were normotensive. Hyperlipidemia was identified in 28 patients (41.7%), and 39 (58.3%) had no hyperlipidemia. Familial hypercholesterolemia (FH) was present in 28 patients (42%), while 39 (58%) did not report FH. Regarding smoking, 15 patients (22.7%) were smokers and 52 (77.3%) were non-smokers. Assessment of coronary vessel involvement showed that 16 patients (23.5%) had normal coronary arteries, while 10 patients (15.2%) had single-vessel disease, 10 (15.2%) had two-vessel disease, and 31 patients (46.2%) had three-vessel disease. The most frequently involved pattern was LAD + LCA + RCA, seen in 31 patients (46.2%). Gender-wise, 40 males and 11 females had CAD. Among diabetics, 32 patients had CAD compared to 19 non-diabetics, while 38 hypertensive patients had CAD versus 13 normotensives. CAD was also more frequent among those with familial hypercholesterolemia (22 with FH vs. 29 without FH) and among smokers (13 smokers with CAD vs. 38 non-smokers). Overall, CAD showed higher prevalence among males, diabetics, hypertensive individuals, smokers, and those with

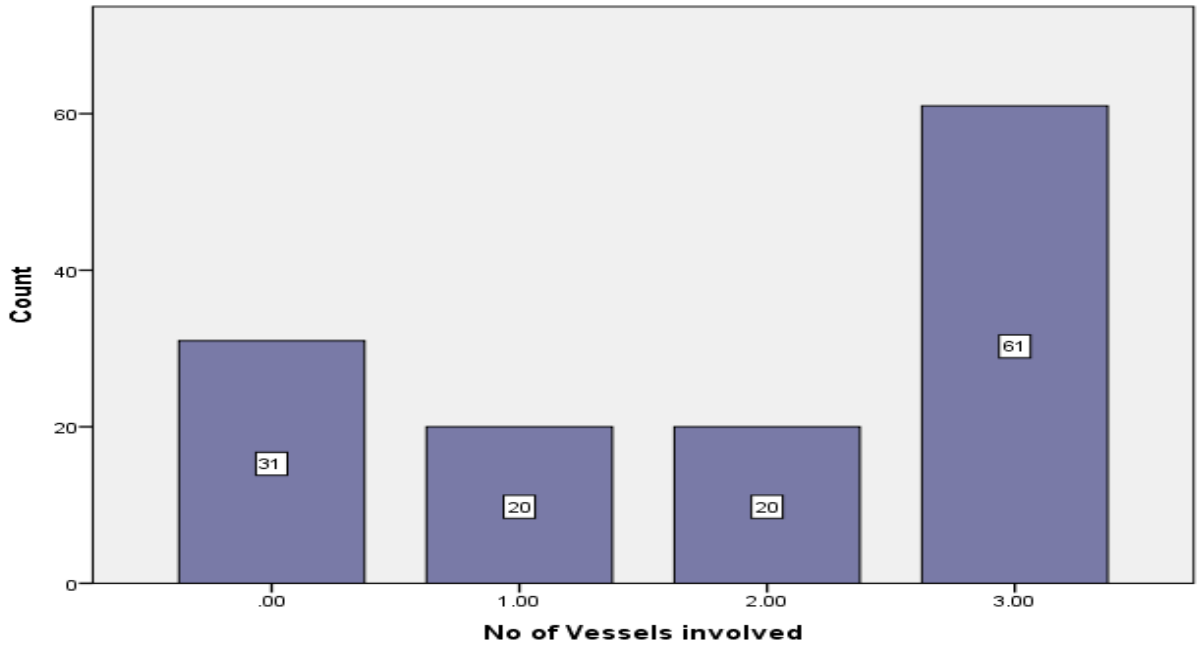
Gender		
Variable	**Frequency**	**Percent**
Female	15	22%
Male	52	78%
Total	67	100%



No of Vessels involved		
Variables	**Frequency**	**Percent**
0	16	23.5%
1	10	15.2%
2	10	15.2%
3	31	46.2%
Total	67	100%

Total number of 67 patients in which, 16 patients had no plaque in coronary artery vessels, 10 patients had plaque in single vessels, 10 patients had plaque in two vessels and 31 patients had plaque in three vessels of their coronary arteries showing in the table number 1

Figure 08:

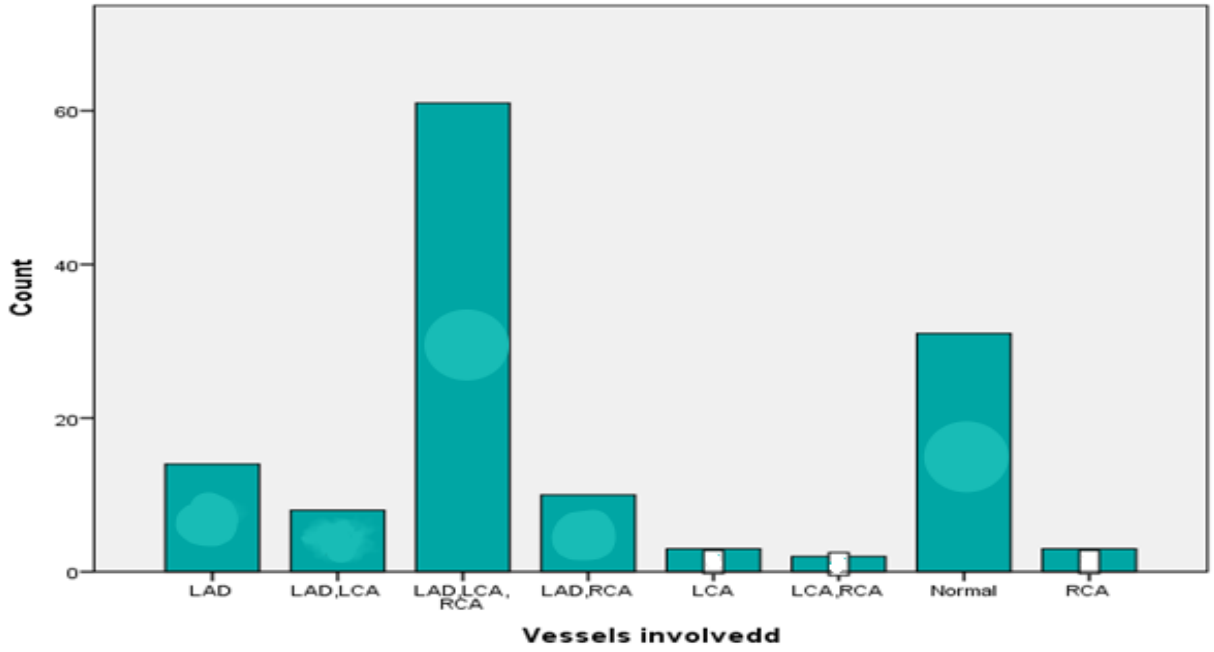


Vessels involved		
	Frequency	**Percent**

LAD	7	10.6%
LAD+LCA	4	6.1%
LAD+LCA+RCA	31	46.2%
LAD+RCA	5	7.6%
LCA	2	2.3%
LCA+RCA	1	1.5%
Normal	16	23.5%
RCA	2	2.3%
Total	67	100%

Table 09: Total number of 67 patients, in which 7 patients had involved LAD branch of coronary artery, 2 patients had involved LAC branch of coronary artery, 2 patients had involved RCA branch of coronary artery considered single vessels disease. 4 patients had involved two vessels LAD & LCA branch of coronary artery, 5 patients had involved LAD & RCA branch of coronary artery, 1 patients had involved LCA & RCA branch of coronary artery considered two vessels disease. 31 patients had involved LAD, LCA & RCA branch of coronary artery considered three vessels disease. 16 patients had not involved vessels of coronary artery that considered normal.

Figure 09:



Coronary Artery Disease	Gender	Female	Male	Total
No	Count	**4**	**12**	**16**
	% within CAD	25.8%	74.2%	100%
Yes	Count	**11**	**40**	**51**
	% within CAD	20.8%	79.2%	100%
Total	Count	**15**	**52**	**67**
	% of total	22%	78%	100%

Total number of 67 patients, in which 4 female patients and 12 male patients had no coronary artery disease. 211 female patients and 40 male patients had coronary artery disease, as shown in table 10

Coronary Artery Disease	Diabetes Mellitus	No	Yes	Total
No CAD	Count	**11**	**5**	**16**
	% within CAD	71.0%	29.0%	100%
CAD	Count	**19**	**32**	**51**
	% within CAD	37.6%	62.4%	100%
Total	Count	**30**	**37**	**67**
	% of total	45.5%	54.5%	100%

Total number of 67 patients, in which 11 patients with no history of diabetes mellitus and 5 patients with history of diabetes mellitus but they had no coronary artery disease. Patients with history of diabetes mellitus that had CAD were 30 and the patients with no history of diabetes mellitus that had CAD were 37.

Coronary Artery Disease	Hypertension	No	Yes	Total
No CAD	Count	**2**	**14**	**16**
	% within CAD	12.9%	87.1%	100%
CAD	Count	**13**	**38**	**51**
	% within CAD	25.7%	74.3%	100%
Total	Count	**15**	**52**	**67**
	% of total	22.7%	77.3%	100%

Total number of 67 patients, in which 2 patients with no history of hypertension and 14 patients with history of hypertension but they had no coronary artery disease. Patients with history of hypertension that had CAD were 15 and patients with no history of smoking that had CAD were 52 As shown in table 12

Coronary Artery Disease	FH Status	No	Yes	Total
No CAD	Count	**10**	**6**	**16**
	% within CAD	61.3%	38.7%	100%
CAD	Count	**29**	**22**	**51**
	% within CAD	56.4%	43.6%	100%
Total	Count	**39**	**28**	**67**
	% of total	57.6%	42.4%	100%

Total number of 67 patients in which, 10 patients with no history of familial hypercholesterolemia and 6 patients with history of hypercholesterolemia but they had no coronary artery disease. Patients with history of familial Hypercholesterolemia that had CAD

were 29 and patients with no history of familial hypercholesterolemia that had CAD were 22. As shown in table 13

Coronary Artery Disease	Smoking Status	No	Yes	Total
No CAD	Count	**14**	**2**	**16**
	% within CAD	83.9%	16.1%	100%
CAD	Count	**38**	**13**	**51**
	% within CAD	75.2%	24.8%	100%
Total	Count	**52**	**15**	**67**
	% of total	77.3%	22.7%	100%

Total number of 67 patients, in which 14 patients with no history of smoking and 2 patients with history of smoking had no coronary artery disease. Patients with history smoking that CAD were 38 and patients with no history of smoking that had CAD were 13. As shown in table 14

Discussion:

Our study was designed to diagnostic accuracy of computed tomography angiography in acute chest pain with suspected coronary artery disease. On the basis of diagnostic performance for exclusion of CAD and detecting plaque in vessels of coronary artery, CTA is considered a reliable method for assessing patients with suspected CAD. [55]

In current study, attempt was made to correlate coronary artery disease with risk factors. Data were collected according to the age, gender and risk factors such as hypertension, diabetes mellitus, smoking, hyperlipidemia and familial hypercholesterolemia, vessels involved and extent of vessels involvement. The study population predominantly consisted of males (78%), while females accounted for 22%. Diabetes mellitus was present in 37 patients (54.5%), whereas 30 (45.5%) were non-diabetic. Hypertension was highly prevalent, reported in 52 patients (77.3%), and 15 patients (22.7%) were normotensive. Hyperlipidemia was identified in 28 patients (41.7%), and 39 (58.3%) had no hyperlipidemia. Familial hypercholesterolemia (FH) was present in 28 patients (42%), while 39 (58%) did not report FH. Regarding smoking, 15 patients (22.7%) were smokers and 52 (77.3%) were non-smokers.[56]

Xi Yang et al., 2015 purposed that hypertension, smoking, diabetes mellitus, dyslipidemia, overweight, and obesity are all major risk factors of coronary heart disease. The incidence of coronary artery lesions in the high-risk population with multiple risk factors is significantly higher than in the control population. Findings of their study support our results where CAD was more in males (78.0%) than females (22.0%). In our study, The study population predominantly consisted of males (78%), while females accounted for 22%. Diabetes mellitus was present in 37 patients (54.5%), whereas 30 (45.5%) were non-diabetic. Hypertension was highly prevalent, reported in 52 patients (77.3%), and 15 patients (22.7%) were normotensive. Hyperlipidemia was identified in 28 patients (41.7%), and 39 (58.3%) had no hyperlipidemia. Familial hypercholesterolemia (FH) was present in 28 patients (42%), while 39 (58%) did not report FH. Regarding smoking, 15 patients (22.7%) were smokers and 52 (77.3%) were non-smokers.[57]

According to John W. McEvoy et al, 2015 study conducted that 14% were smokers, 39% were former smokers and 47% were non-smokers and in our study 77.3% participants were non-smokers which implies that in our population, smoking is not a major contributing factor toward CAD as in our study 22.7% smokers were contributing in CAD. Extensive epidemiological data have also established that smoking is an independent risk factor for coronary atherosclerosis and for future cardiac events but that it is less strong predictor than hypertension and diabetes mellitus.[58]

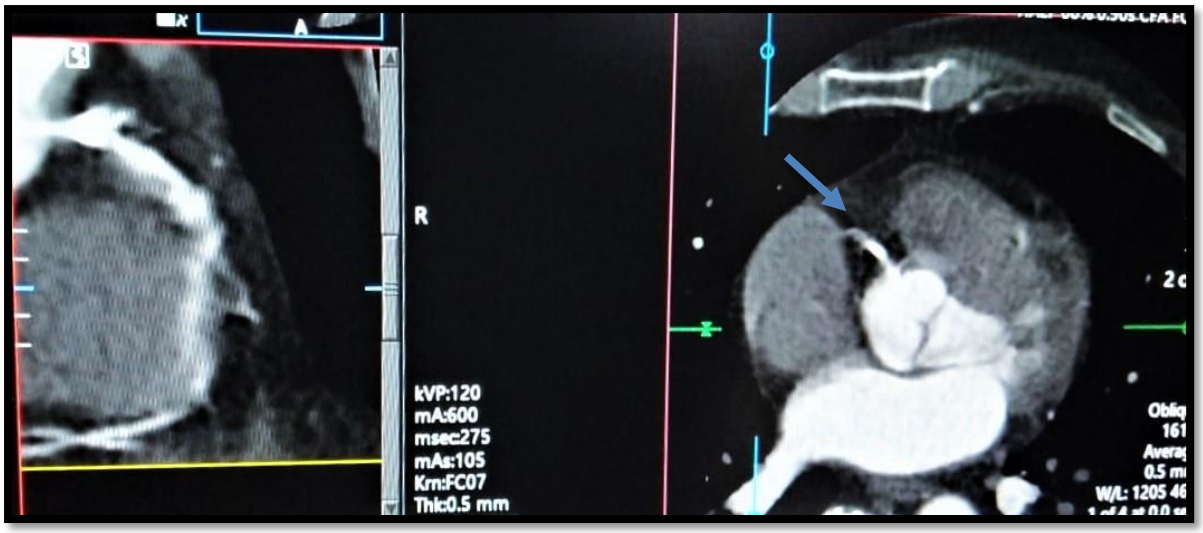
According to the Tilea et al, 2018 the prevalence of CAD is more in hypertensive patients with multiple associated cardiovascular risk factors.27Their sample size was large compared to ours. They divided 283 hypertensive patients in three grades according to number of coronary arteries involved: single, double, triple vessel CAD. With regard to hypertension grades correlated with CAD. Out of 190 male and 93 female hypertensive patients, 61.13% (173) had significant CAD. Single vessel disease was identified in 88.8% of grade 1 hypertensive patients, and triple vessel disease was identified in 29.3% of patients presenting hypertension grade 2 compared to 24.0% in grade 3 hypertensive patients. According to our study, 77.3% of patients had hypertension,The study of J.P.S. Sawhney et al., 2018 conducted the high prevalence of familial hypercholesterolemia in premature coronary artery disease. They also had a large sample size as compared to us (635). A total of 635 patients with premature CAD were assessed for FH based on scores, patients were diagnosed as definite, probable, possible, or no FH, 4% were diagnosed as definite, 11% as probable, 37% as possible and 48% without FH. In our study 42.4% of patients had familial hypercholesterolemia.[59]

The association of HLP with atherosclerotic cardiovascular disease is largely based on epidemiological studies. Elevated levels of blood lipids are well documented risk factors for cardiovascular disease as our results showed that 41.7% of patients had hyperlipidemia with CAD. However, HLP remained a predictor of lower mortality in several studies. Another study was conducted by A Marie N Boggan et al., 2015 studied that hyperlipidemia in early adulthood increases long term risk of coronary heart disease. Adults with prolonged exposure to even moderate elevations in non–high-density lipoprotein cholesterol have elevated risk for future CHD.[60]

From our study, it is concluded that male patients are more affected than females. Research makes it clear that both diabetes mellitus and hypertension were found to be stronger predictors of coronary atherosclerosis than smoking.

Conclusion:

We concluded from this study that individuals with hypertension and diabetes mellitus are more likely to develop coronary artery disease compared to those without these conditions. CAD was found to be more common in males than females. Although smoking and familial hypercholesterolemia were present in some patients, they showed a weaker association with CAD compared to hypertension and diabetes. Most patients with CAD also showed involvement of multiple coronary vessels, indicating more advanced disease. Overall, male gender, hypertension, and diabetes emerged as the strongest predictors of coronary artery disease in this study.



A 30 year old patient Shows three vessels disease. RCA show diffuse Shows severe diffuse disease in proximal segment due to calcified plaque. LAD and LCA shows total occlusion.

Fig No 2 A 42 year patients **s**hows **t**hree Vessels disease. LAD Shows total ostio-proximal occlusion. Diagonal branch shows tight proximal stenosis and is normal after SVG insertion. LCA and RCA shows tight proximal stenotic occlusion.

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