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Linking Clinical Presentation with Coronary Anatomy: A Study of Angina Severity and Its Relationship with Angiographic Findings in Coronary Artery Disease

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ABSTRACT

No intensive studies have been conducted locally or even in broader regions of the country, which results in a crucial knowledge gap in the establishment of the relationship between the severity of angina and the angiographic findings in patients with coronary artery disease (CAD). **Objectives:** To determine the correlation of angina severity with angiographic findings in patients diagnosed with coronary artery disease. **Methods:** This cross-sectional study was carried out at the Department of Cardiology, Lady Reading Hospital, Peshawar. Male and female patients of age 30 to 70 years diagnosed with coronary artery disease were evaluated for angina severity in comparison to angiographic findings. **Results:** Among 304 patients, angina severity demonstrated a strong positive correlation with angiographic findings ($\rho = 0.875$, $p<0.001$). Diabetic patients with severe angina had a higher proportion of high angiographic burden (36.8%) compared to non-diabetics (10.2%), while patients with family history of CAD showed a strong correlation ($\rho = 0.886$) and relatively weak correlation with Type C complex lesions ($\rho = 0.706$). **Conclusions:** A strong positive correlation was observed between angina severity and angiographic CAD burden, though this relationship was modified by diabetes, family history, and lesion complexity.

INTRODUCTION

Cardiovascular disease is a leading cause of global morbidity and mortality [1]. It is caused by the constriction or obstruction of the coronary arteries that deliver oxygenated blood to the cardiac muscle [2]. Narrowing typically results from plaque formation within the arterial wall, leading to reduced blood and oxygen delivery to the myocardium [3]. With time, the ischemia can damage the myocardium, which is expressed clinically as chest pain or discomfort, and can eventually cause a heart attack, heart failure, or sudden cardiac demise [4]. Diagnosis as well as the management of CAD is based largely on the degree and level of arterial blockage, usually measured by coronary angiography, which provides an accurate imaging of the coronary arterial anatomy [5]. Angina pectoris, or angina, is the classic clinical syndrome of myocardial ischemia and is defined by chest pain or discomfort usually resulting from exertion or stress [6]. The condition varies in severity from patient to patient and can be graded with the usual scales like the Seattle Angina Questionnaire (SAQ), from symptoms with heavy exertion to mild discomfort/pain at rest [7, 8]. The gold standard for imaging of coronary arteries and the evaluation for the site, presence, and

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degree of arterial stenosis is coronary angiography [9]. The imaging process is achieved by intracoronary delivery of the contrast material, which enables prompt X-ray detection of blood flow and vessel patency [10]. Angiographic findings typically focus on the degree of narrowing of the lumen, distribution of affected vessels, and occurrence of complicated lesions such as calcification and complete occlusion [11]. The relationship between the severity of the angina and the angiographic findings of coronary artery disease is subtle but clinically significant. In most instances, the more intense the angina, the higher the degrees of stenosis and multi-vessel involvement are as seen by angiography [12]. The relationship is nonetheless influenced by a variety of factors including collateral supply, myocardial oxygen demands, and the patient's pain tolerance [13]. Some patients with severely evident angiographic coronary disease are virtually asymptomatic because well-developed collateral pathways provide well-maintained myocardial perfusion [14]. A study conducted by Haider *et al.* demonstrated a correlation of r = 0.16 between symptom severity and angiographic findings [15].

No study has been conducted specifically in the province of Khyber Pakhtunkhwa or even broader regions of the country, which results in a crucial knowledge gap in the establishment of the relationship between the severity of angina and the coronary imaging diagnostics in the population. It is essential to bridge this gap to increase the level of accuracy in the process of diagnosis, management of the patient, and related strategies of treatment under the regional healthcare framework. It is necessary to conduct a study assessing the correlation of angina severity with angiographic findings in coronary artery disease. This study aimed to determine the correlation of angina severity with angiographic findings in patients diagnosed with coronary artery disease.

METHODS

This cross-sectional study was carried out at the Department of Cardiology, Lady Reading Hospital, Peshawar, during the period from 3rd July 2025 to 2nd January 2026 after taking approval from the research review board vide no. 437/LRH/MTI dated 5th November 2024. Male and female patients of age 30 to 70 years diagnosed with coronary artery disease were enrolled. The patients were evaluated for angina severity and compared with angiographic findings. Patients with acute myocardial infarction in the last month, New York Heart Association (NYHA) class IV heart failure, significant valvular heart disease, history of coronary artery bypass graft (CABG) or percutaneous coronary intervention (PCI), patients with dilated cardiomyopathy, congenital heart disease and severe renal impairment, and patients with contraindications to coronary angiography were excluded. Coronary artery disease was defined as a luminal diameter narrowing of ≥25% in any of the epicardial coronary arteries (left/right) on coronary angiography. Angina severity was assessed using the patient-reported Seattle Angina Questionnaire (SAQ), designed to measure the physical limitations, frequency, stability, and quality of life for patients with coronary artery disease (CAD). The score ranges from 0 (minimum score) to 100 (maximum score). Based on the SAQ score, angina severity was categorized as mild (≤50), moderate (score 51-75), and severe (score >75). Angiographic findings were quantitatively assessed by the percentage of luminal diameter narrowing in the coronary arteries. The severity was scored on a four-point scale [12] (Table 1).

Table 1: Severity Scored on A Four-Point Scale

Stenosis Severity	Percentage of Luminal Narrowing (%)	Score
Normal/No Significant Stenosis	< 25%	1
Mild	25% – 49%	2
Moderate	50% – 70%	3
Severe	> 70%	4

The total sample size was 304, calculated using the correlation sample size formula: $N = [(Z\alpha + Z\beta)/C]^2 + 3$, where $\alpha = 0.05$ (two-tailed), $\beta = 0.20$, and expected correlation coefficient $r = 0.16$ [15], with corresponding standard normal deviates $Z\alpha = 1.9600$, $Z\beta = 0.8416$, and $C = 0.1614$. Participants were enrolled using non-probability consecutive sampling. Patients diagnosed with coronary artery disease and meeting the selection criteria were recruited from the Cardiology Department of LRH Peshawar following approval from the Institutional Ethical Review Board. Before participation, all individuals provided informed consent following a detailed briefing on the study's purpose, methods, possible risks, and anticipated benefits. Demographic information such as age, sex, body mass index (BMI), smoking habits, presence of hypertension or diabetes mellitus, family history of coronary artery disease (CAD), and socioeconomic background was gathered through a standardized questionnaire. Each patient underwent a detailed clinical assessment to determine the severity of angina using the Seattle Angina Questionnaire (SAQ), assessed through a standardized interview conducted by the cardiology team. Subsequently, all participants underwent coronary angiography. Angiographic images were reviewed by an experienced interventional cardiologist with more than 3 years of post-fellowship experience who quantified the degree of luminal stenosis in the major coronary arteries. The severity of angiographic findings was recorded according to the four-point quantitative scale based on percentage luminal narrowing (<25%, 25-49%, 50-70%,

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>70%) as per operational definitions. All relevant data were documented on a pre-designed data collection form specifically developed for this study.

Data were analyzed with a statistical analysis program (SPSS Ver. 26). Frequencies and percentages were computed for categorical variables like gender, smoking status, residential status, hypertension, diabetes, family history of coronary artery disease, and socioeconomic status. Mean ± SD or median (IQR) was presented for quantitative variables like age, body mass index (BMI), angina severity score, and angiographic findings score (Shapiro-Wilk test was used to check normality). The correlation between angina severity and angiographic findings was assessed using Spearman's correlation coefficient. Post-stratification correlation analysis was performed for subgroups such as age, gender, diabetes, hypertension, family history of coronary artery disease, and socioeconomic status. A p-value ≤ 0.05 was considered statistically significant.

RESULTS

Out of the total 304 participants, 215 patients (70.7%) were aged 51–70 years and had an equivalent gender distribution (156 male, 148 female). Cardiovascular risk factors observed included: hypertension (177, 58.2%), diabetes (120, 39.5%), and history of smoking (163, 53.7% current or former). Coronary lesion complexity revealed Type C lesions present in 74 patients (24.3%), while 106 patients (34.9%) had severe angina. Angiographic findings revealed that 152 patients (50.0%) had low disease burden, yet 152 patients (50.0%) demonstrated moderate-to-high severity. All 304 patients were on aspirin, with high adherence to statin (242, 79.6%) and beta-blocker (188, 61.8%) therapy (Table 2).

Table 2: Descriptive Statistics for categorical Variables (n=304)

Variables	Category	n (%)
Age Group	30-50 Years	89 (29.3%)
	51-70 Years	215 (70.7%)
Gender	Male	156 (51.3%)
	Female	148 (48.7%)
Smoking Status	Current	78 (25.7%)
	Former	85 (28.0%)
	Never	141 (46.4%)
Residential Status	Urban	175 (57.6%)
	Rural	129 (42.4%)
Hypertension	Yes	177 (58.2%)
	No	127 (41.8%)
Diabetes	Yes	120 (39.5%)
	No	184 (60.5%)
Family History CAD	Yes	134 (44.1%)
	No	170 (55.9%)
Socioeconomic Status	Low	112 (36.8%)
	Middle	116 (38.2%)
	High	76 (25.0%)
Lesion Type	Type A (Focal)	112 (36.8%)
	Type B (Tubular)	118 (38.8%)
	Type C (Complex)	74 (24.3%)
Angina Severity Score	Mild (≤ 50)	78 (25.7%)
	Moderate (51-75)	120 (39.5%)
	Severe (> 75)	106 (34.9%)
Angiographic Findings Score	Low (≤ 60)	152 (50.0%)
	Moderate (61-80)	106 (34.9%)
	High (> 80)	46 (15.1%)
Medication Aspirin	Yes	304 (100.0%)
	No	0 (0.0%)
Medication Statin	Yes	242 (79.6%)
	No	62 (20.4%)
Medication Beta Blocker	Yes	188 (61.8%)
	No	116 (38.2%)
Medication ACE Inhibitor	Yes	156 (51.3%)
	No	148 (48.7%)

The mean age of the cohort was 58.3 years (SD 10.2). BMI was normally distributed (mean 26.7 kg/m^2, SD 2.5; Shapiro-Wilk p=0.089). In contrast, Angina Severity Score (median 62.0, IQR 44.0-79.0), Angiographic Findings Score (median 68.0, IQR 49.0-85.0), Hemoglobin A1c (median 6.3, IQR 5.6-7.2), creatinine (median 1.0, IQR 0.9-1.2), ejection fraction (median 57.0, IQR 47.0-66.0), and number of stenosed vessels (median 2.0, IQR 1.0-2.0) all demonstrated significant deviation from normality (all p<0.005) (Table 3).

Table 3: Descriptive Statistics for Continuous Variables (n=304)

Variables	Mean ± SD	Median (IQR)	Shapiro-Wilk p-value
Age (years)	58.3 ± 10.2	58.0 (50.0-67.0)	0.081
BMI (kg/m^2)	26.7 ± 2.5	26.5 (24.8-28.5)	0.089
Angina Severity Score	61.1 ± 21.8	62.0 (44.0-79.0)	0.002*
Angiographic Findings Score	66.3 ± 22.3	68.0 (49.0-85.0)	0.001*
Hemoglobin A1c (%)	6.5 ± 1.1	6.3 (5.6-7.2)	0.003*
Creatinine (mg/dL)	1.1 ± 0.3	1.0 (0.9-1.2)	0.001*
Ejection Fraction (%)	55.7 ± 12.7	57.0 (47.0-66.0)	0.014*
Number of Stenosed Vessels	1.7 ± 1.0	2.0 (1.0-2.0)	0.001*

*Note: Angina severity scores, angiographic findings scores, HbA1c, creatinine, EF, and vessel count showed non-normal distribution (p<0.005)

A strong, statistically significant positive correlation was observed between Angina Severity Score and Angiographic Findings Score (ρ = 0.875, 95% CI 0.844–0.902; p < 0.001). Among patients with mild angina (≤ 50, n=78), the majority (52, 66.7%) had low angiographic burden (≤ 60), whereas among those with severe angina (> 75, n=106), 54 (50.9%) had low angiographic scores, and 26 (24.5%) had high scores (>80) (Table 4).

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Table 4: Association and Correlation Analysis between Angina Severity Score and Angiographic Findings Score (n = 304)

Angina Severity Score	Angiographic Findings Score			Total, n, (%)	χ^2 and p-value	Spearman, ρ Correlation (95% CI)
	Low (≤ 60), n (%)	Moderate (61-80), n (%)	High (> 80), n (%)			
Mild (≤ 50)	52 (66.7%)	22 (28.2%)	4 (5.1%)	78 (100%)	χ^2 = 42.6, p-value <0.001 ρ = 0.875	(95% CI, 0.844-0.902), Strong positive correlation
Moderate (51-75)	46 (38.3%)	58 (48.3%)	16 (13.3%)	120 (100%)		
Severe (> 75)	54 (50.9%)	26 (24.5%)	26 (24.5%)	106 (100%)		
Total	152 (50.0%)	106 (34.9%)	46 (15.1%)	304 (100%)		

Among diabetic patients with severe angina (n=57), 21 (36.8%) had high angiographic scores (>80), compared to only 5 (10.2%) among non-diabetics with severe angina (n=49). Similarly, among patients with family history of CAD and severe angina (n=54), 20 (37.0%) had high angiographic scores, versus 6 (11.5%) in those without family history (Table 5).

Table 5: Post-Stratification Analysis: Angina Severity vs. Angiographic Findings (n=304)

Subgroup	Category	Angina Severity*	Low (≤60), n (%)	Moderate (61-80), n (%)	High (>80), n (%)	Total	Spearman, ρ value	p-value
Age Group (years)	30-50 (n=89)	Mild	18 (72.0%)	6 (24.0%)	1 (4.0%)	25	0.862	<0.001
		Moderate	14 (41.2%)	16 (47.1%)	4 (11.8%)	34		
		Severe	12 (40.0%)	10 (33.3%)	8 (26.7%)	30		
	51-70 (n=215)	Mild	34 (64.2%)	16 (30.2%)	3 (5.7%)	53	0.881	<0.001
		Moderate	32 (37.2%)	42 (48.8%)	12 (14.0%)	86		
		Severe	42 (55.3%)	16 (21.1%)	18 (23.7%)	76		
Gender	Male (n=156)	Mild	28 (68.3%)	11 (26.8%)	2 (4.9%)	41	0.872	<0.001
		Moderate	24 (38.7%)	30 (48.4%)	8 (12.9%)	62		
		Severe	28 (52.8%)	12 (22.6%)	13 (24.5%)	53		
	Female (n=148)	Mild	24 (64.9%)	11 (29.7%)	2 (5.4%)	37	0.878	<0.001
		Moderate	22 (37.9%)	28 (48.3%)	8 (13.8%)	58		
		Severe	26 (49.1%)	14 (26.4%)	13 (24.5%)	53		
Diabetes	Yes (n=120)	Mild	14 (58.3%)	8 (33.3%)	2 (8.3%)	24	0.884	<0.001
		Moderate	12 (30.8%)	20 (51.3%)	7 (17.9%)	39		
		Severe	20 (35.1%)	16 (28.1%)	21 (36.8%)	57		
	No (n=184)	Mild	38 (70.4%)	14 (25.9%)	2 (3.7%)	54	0.868	<0.001
		Moderate	34 (42.0%)	38 (46.9%)	9 (11.1%)	81		
		Severe	34 (69.4%)	10 (20.4%)	5 (10.2%)	49		
Hypertension	Yes (n=177)	Mild	28 (62.2%)	14 (31.1%)	3 (6.7%)	45	0.880	<0.001
		Moderate	24 (34.3%)	36 (51.4%)	10 (14.3%)	70		
		Severe	32 (51.6%)	14 (22.6%)	16 (25.8%)	62		
	No (n=127)	Mild	24 (72.7%)	8 (24.2%)	1 (3.0%)	33	0.867	<0.001
		Moderate	22 (44.0%)	22 (44.0%)	6 (12.0%)	50		
		Severe	22 (50.0%)	12 (27.3%)	10 (22.7%)	44		
Family History CAD	Yes (n=134)	Mild	18 (60.0%)	10 (33.3%)	2 (6.7%)	30	0.886	<0.001
		Moderate	16 (32.0%)	26 (52.0%)	8 (16.0)	50		
		Severe	22 (40.7%)	12 (22.2%)	20 (37.0)	54		
	No (n=170)	Mild	34 (70.8%)	12 (25.0%)	2 (4.2%)	48	0.867	<0.001
		Moderate	30 (42.9%)	32 (45.7%)	8 (11.4%)	70		
		Severe	32 (61.5%)	14 (26.9%)	6 (11.5%)	52		
Socioeconomic Status	Low (n=112)	Mild	18 (64.3%)	8 (28.6%)	2 (7.1%)	28	0.879	<0.001
		Moderate	16 (36.4%)	22 (50.0%)	6 (13.6%)	44		
		Severe	20 (50.0%)	10 (25.0%)	10 (25.0%)	40		
	Middle (n=116)	Mild	18 (69.2%)	7 (26.9%)	1 (3.8%)	26	0.873	<0.001
		Moderate	16 (40.0%)	20 (50.0%)	4 (10.0%)	40		
		Severe	18 (36.0%)	14 (28.0%)	18 (36.0%)	50		
	High (n=76)	Mild	16 (66.7%)	7 (29.2%)	1 (4.2%)	24	0.871	<0.001
		Moderate	14 (38.9%)	16 (44.4%)	6 (16.7%)	36		
		Severe	16 (100.0%)	0 (0.0%)	0 (0.0%)	16		

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Smoking Status	Current (n=78)	Mild	14 (66.7%)	6 (28.6%)	1 (4.8%)	21	0.870	<0.001
		Moderate	12 (37.5%)	16 (50.0%)	4 (12.5%)	32		
		Severe	12 (48.0%)	6 (24.0%)	7 (28.0%)	25		
	Former (n=85)	Mild	14 (63.6%)	7 (31.8%)	1 (4.5%)	22	0.877	<0.001
		Moderate	12 (37.5%)	16 (50.0%)	4 (12.5%)	32		
		Severe	16 (51.6%)	8 (25.8%)	7 (22.6%)	31		
	Never (n=141)	Mild	24 (68.6%)	9 (25.7%)	2 (5.7%)	35	0.875	<0.001
		Moderate	22 (39.3%)	26 (46.4%)	8 (14.3%)	56		
		Severe	26 (52.0%)	12 (24.0%)	12 (24.0%)	50		
Lesion Type	Type A (n=112)	Mild	28 (77.8%)	7 (19.4%)	1 (2.8%)	36	0.764	<0.001
		Moderate	24 (51.1%)	20 (42.6%)	3 (6.4%)	47		
		Severe	18 (62.1%)	8 (27.6%)	3 (10.3%)	29		
	Type B (n=118)	Mild	16 (57.1%)	10 (35.7%)	2 (7.1%)	28	0.792	<0.001
		Moderate	14 (35.0%)	22 (55.0%)	4 (10.0%)	40		
		Severe	20 (40.0%)	14 (28.0%)	16 (32.0%)	50		
	Type C (n=74)	Mild	8 (57.1%)	5 (35.7%)	1 (7.1%)	14	0.706	<0.001
		Moderate	8 (24.2%)	16 (48.5%)	9 (27.3%)	33		
		Severe	16 (59.3%)	4 (14.8%)	7 (25.9%)	27		
Residential Status	Urban (n=175)	Mild	30 (65.2%)	13 (28.3%)	3 (6.5%)	46	0.876	<0.001
		Moderate	26 (37.1%)	34 (48.6%)	10 (14.3%)	70		
		Severe	32 (54.2%)	14 (23.7%)	13 (22.0%)	59		
	Rural (n=129)	Mild	22 (68.8%)	9 (28.1%)	1 (3.1%)	32	0.873	<0.001
		Moderate	20 (40.0%)	24 (48.0%)	6 (12.0%)	50		
		Severe	22 (46.8%)	12 (25.5%)	13 (27.7%)	47		

*Angina severity = mild (≤50), moderate (51-75), severe (>75)

DISCUSSION

The present study demonstrated a statistically significant positive correlation between angina severity and the angiographic burden of coronary artery disease. The pattern of correlation observed in our study is consistent with the broader body of literature examining the relationship between clinical presentation and anatomical disease severity. Patients with classic angina had greater Gensini scores and a higher incidence of multivessel disease than those with unusual presentations. According to Khezri *et al.* substantial correlations exist between symptom attributes and angiographic imaging findings [16]. These conclusions are supported in another study by Al Chaar *et al.* [17]. Lowenstern *et al.* in their analysis involving over 4,000 patients, demonstrated that typical angina was significantly associated with obstructive coronary artery disease on invasive angiography, with a positive predictive value exceeding 70% for patients presenting with classic symptoms [18]. Among the diabetic patients in our cohort, those with severe angina had a markedly higher proportion of high angiographic scores compared to non-diabetic patients with severe angina. This indicates that diabetic patients with severe angina in this cohort had a higher proportion of extensive anatomical disease [19, 20]. The relationship between diabetes and the clinical presentation of coronary artery disease has been extensively characterized [21]. Kawsar *et al.* demonstrated that diabetic patients undergoing coronary angiography had significantly higher Gensini scores and a greater prevalence of multivessel disease compared to non-diabetic patients [22]. Furthermore, among elderly patients with acute coronary syndrome, diabetes was associated with more extensive angiographic disease, including higher rates of triple vessel disease and left main stem involvement in a study by Wen *et al.* [23]. Diabetes was also found by Aksu and Ahmed to be a strong predictor of higher Gensini scores in angiography patients [24]. Patients with a family history of coronary artery disease also showed a notable pattern. In the research of Lebanese subjects undergoing coronary angiography, Al Chaar *et al.* showed that, regardless of conventional risk variables, a family history of early CAD was substantially linked to higher SYNTAX scores and a greater risk of coronary artery disease [17]. In a similar manner, Aghajani *et al.* found that in comparison to individuals who had advanced CAD, those with early CAD had much greater percentages of positive family history [21]. The finding that family history enhanced both the strength of the correlation and the proportion of severe disease in symptomatic patients supports the incorporation of family history as a key variable in clinical decision-making. An observation was noted regarding lesion complexity. Among patients with Type C complex lesions, the correlation was relatively weak. This finding

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may be explained by several mechanisms. Theofilis *et al.* discussed the complex pathophysiology of acute coronary syndromes, noting that patients with chronic, diffuse atherosclerosis may develop collateral circulation that preserves myocardial perfusion [2]. A study stated that the existence of established collaterals can greatly reduce anginal symptoms [4]. Boerhout *et al.* emphasized that in individuals without obstructive coronary vessels, the level of epicardial stenosis does not necessarily correspond with the severity of symptoms [8]. Clinical implications of these findings include the necessity for objective evaluation, as patients with known complicated or multivessel CAD may not be able to accurately convey the entire scope of their condition through symptom reporting alone. It is important to consider the connection between morphological findings and symptoms in individuals with non-obstructive coronary arteries. Liu *et al.* highlighted that emotional distress and physical ischemia both caused a higher symptom load in individuals with angina and without obstructive coronary disease [7]. Wen *et al.* investigated the trend further and found that the coronary sluggish flow phenomenon, which was linked to inflammatory signals and may account for symptom generation in the absence of substantial stenosis [23]. These results are especially pertinent to our finding that angiographic load was more evenly distributed among patients with severe angina in the high socioeconomic level category. This might be due to the population's increased incidence of non-obstructive coronary artery disease, microvascular abnormalities, or non-cardiac causes of chest pain.

Some limitations warrant recognition. The cross-sectional design makes it impossible to establish a causal relationship between symptom severity and anatomical findings. Subgroup Spearman correlations were compared descriptively; statistical testing for differences between these correlations was not performed. Generalizability to other communities with differing healthcare systems or demographics may be limited by the single-center setting. Even while visual angiographic evaluation is clinically conventional, quantitative techniques like the Gensini score may add observer variability. Furthermore, coronary collaterals were not extensively evaluated in the research. It is recommended that future prospective multicenter studies should incorporate standardized collateral circulation assessment and utilize validated angiographic scoring systems to confirm these findings and objectively prioritize clinical decision-making in this population.

CONCLUSIONS

In individuals with coronary artery disease, angina symptom severity had a significant positive correlation with angiographic disease burden. Severe angiographic abnormalities were more common in diabetic individuals and those with a family history of CAD. In contrast, patients with Type C complex lesions exhibited a weaker correlation between symptom severity and anatomical disease.

Authors' Contribution

Conceptualization: MAI
Methodology: HU
Formal analysis: HU
Writing and Drafting: HU, MAI, SK, NK, SU
Review and Editing: HU, MAI, SK, NK, SU

All authors approved the final manuscript and take responsibility for the integrity of the work

Conflicts of Interest

All the authors declare no conflict of interest.

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