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Original Article

Correlation of Coronary Artery Disease in Patients with Peripheral Artery Disease: Cross-Sectional Study

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ABSTRACT

Background: Peripheral Artery Disease (PAD) and Coronary Artery Disease (CAD) represent two facets of atherosclerotic cardiovascular disease, significantly impacting global health. Despite their high morbidity and mortality rates, the epidemiological and clinical nexus between PAD and CAD remains underexplored. Understanding the interrelation of these conditions is paramount for optimizing diagnostic and therapeutic strategies.

Objective: This study aimed to delineate the incidence and clinical correlation of CAD in patients diagnosed with PAD, thereby providing insights into the epidemiological characteristics and enhancing the clinical management of these conditions.

Methods: A cross-sectional analysis was conducted at Afridi Medical Complex's departments of vascular surgery and cardiology from 2021 to 2023. One hundred PAD patients referred for peripheral angiography were enrolled. Demographic data, Ankle Brachial Index (ABI) readings, ejection fraction percentages, and the presence of multivessel disease were evaluated. Statistical analyses were performed using SPSS version 25, focusing on mean, median, range, and significance levels to elucidate the prevalence of CAD among PAD patients.

Results: The study revealed a median age of 58 years among participants, with a significant male predominance (84%). ABI analysis showed that 74% and 108% of patients had mild and moderate PAD severity, respectively. The incidence of CAD in the PAD population was 56%, with angiographic assessments indicating single, double, and triple vessel disease in 23.21%, 39.29%, and 37.5% of patients, respectively. Notably, diabetes and dyslipidemia were prominent predictors of CAD presence in PAD patients.

Conclusion: The high prevalence of CAD in PAD patients underscores the critical need for comprehensive cardiovascular risk assessment and suggests the potential benefit of routine coronary angiography in symptomatic PAD cases, particularly among those with diabetes and dyslipidemia. This study reinforces the intertwined nature of PAD and CAD, advocating for an integrated approach to the diagnosis and management of these atherosclerotic conditions.

Keywords Peripheral Artery Disease, Coronary Artery Disease, Ankle Brachial Index, Cardiovascular Risk, Angiography, Epidemiology, Cross-Sectional Study, Vascular Disease, Atherosclerosis, Cardiovascular Management.

INTRODUCTION

Peripheral Artery Disease (PAD) is a significant yet often underrecognized condition characterized by the obstruction of arteries distal to the aortic bifurcation, posing a substantial risk for cardiovascular diseases (CVDs) including coronary artery disease (CAD). Despite its poor prognosis and an incidence rate that suggests a shift from a 1:6 ratio of asymptomatic to symptomatic patients to an even 1:1 ratio, PAD remains underestimated in clinical practice. This underestimation is critical because the perception of the disease by patients significantly influences adherence to treatment, exercise, therapy, and modification of risk factors, which are vital for managing PAD effectively (1,2). Furthermore, PAD is a major contributor to atherosclerotic arterial obstruction in the lower extremities, representing a considerable burden of cardiovascular disease, which ranks as the third most common clinical manifestation after stroke and CAD. However, compared to its cardiovascular counterparts, PAD has not garnered the same level of

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attention in research or clinical practice, despite its association with increased risk of CVDs and its significant impact on global health (3,4).

The significance of evaluating CAD in patients with PAD cannot be overstated, as highlighted by the inclusion of 765 patients in a study that aimed to understand the correlation between these two conditions. The majority of these patients underwent percutaneous coronary angioplasty (PTA), followed by coronary angiography (CAG) for 6474 individuals, identifying coronary artery stenosis in 70% of cases. This underscores the grim prognosis for patients suffering from both PAD and CAD, given the unlikely long-term survival rates compared to those afflicted with PAD alone. Consequently, adopting a strategy of routine CAG with sequential Percutaneous Coronary Intervention (PCI) could be instrumental in reducing mortality risk among PAD patients and identifying subgroups with indolent PAD, incident CAD, or both conditions. This approach is further justified by the associated high morbidity and hospitalization rates, particularly within the first year after diagnosis, highlighting the need for meticulous management of these patients (5-7).

The epidemiological landscape of PAD and CAD has been thoroughly investigated over the years, with studies spanning from 2008 to 2016, estimating the annual incidence and prevalence of these conditions among individuals over 18 years of age. The evolution of coronary artery disease and its risk factors over two decades has been a particular focus, revealing an increase in risk factors such as hypercholesterolemia, obesity, diabetes, hypertension, and sedentary lifestyles. These findings were corroborated by a study conducted in rural adults aged 35 and older in KPK, which employed clinical and Epstein criteria for diagnosing CAD and highlighted a modest rise in the incidence of CAD alongside these risk factors (8).

Further supporting these findings, Krishnan et al. conducted a study in North Kerala, focusing on the elderly population aged 60-79 years, and found a high prevalence of PAD and its risk factors, as determined through electrocardiograms, biochemical studies, and anthropometric measurements. The diagnosis of PAD was based on an Ankle Brachial Index (ABI) of less than 0.9, while CAD was identified using the Seattle Angina Questionnaire (SAQ) and electrocardiographic criteria, indicating a similar prevalence of PAD in both urban and rural settings (9).

Additionally, the characteristics and incidence of CAD have been explored through various studies, including a systematic approach to evaluating 164 patients with Heart Failure with mid-range Ejection Fraction (HFmEF) using angiography. This revealed that a significant proportion of patients exhibited a higher grade of coronary stenosis, with an incidence rate of CAD at approximately 80%, and about 39% of these patients had two or three-vessel disease. These findings suggest that the presence of coronary artery stenosis is not necessarily higher in patients with a history of CAD, indicating no significant clinical difference between patients with and without CAD in terms of echocardiographic findings. Such insights into the incidence of coronary artery anomalies (CAA) and the prevalence of coronary heart disease and its associated risk factors further emphasize the complexity of managing patients with PAD and CAD, underscoring the necessity for comprehensive strategies that address both the awareness and therapeutic management of these conditions to improve patient outcomes and reduce the burden of cardiovascular diseases globally (10-12).

In conclusion, the intricate relationship between Peripheral Artery Disease (PAD) and Coronary Artery Disease (CAD) underscores the imperative for enhanced awareness, diagnostic diligence, and therapeutic innovation in managing these conditions. The prevalence and incidence of PAD and CAD, alongside their associated risk factors, have been meticulously documented across various populations, revealing a critical need for proactive clinical strategies that encompass routine diagnostic evaluations and tailored treatment approaches. This comprehensive perspective highlights the significance of addressing both PAD and CAD within the cardiovascular disease spectrum, aiming to improve patient outcomes through informed clinical practice and patient management.

MATERIAL AND METHODS

This study was conducted to evaluate the significance of diagnosing Coronary Artery Disease (CAD) in patients with Peripheral Artery Disease (PAD). The research adopted a clinical-based cross-sectional design, focusing on a sample of one hundred PAD patients who were referred for peripheral angiography at the Afridi Medical Complex in Peshawar, Khyber Pakhtunkhwa, Pakistan. The study spanned from February 2021 to February 2023. Participants were symptomatic PAD patients referred by a vascular specialist within the study duration for peripheral angiography. The method for selecting the sample involved screening PAD patients for CAD, primarily through cardiac color Doppler examination and a treadmill stress test. Patients unable to complete the treadmill stress test were referred to the Department of Cardiology for an invasive coronary angiogram, which was conducted alongside the peripheral angiogram if deemed necessary by the attending clinicians. This selection process was based on an estimation of 80% of the normal rate of angiographies performed on patients meeting the PAD criteria over the past three years at the Afridi Medical Complex's Cardiology Department.

Inclusion criteria for the study encompassed patients diagnosed with PAD based on clinical history, physical examination, peripheral artery Doppler, CT angiography, and peripheral angiography, with significant PAD defined as stenosis of greater than or equal to 50%

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of the diameter in a large vessel. Patients unwilling to participate were excluded from the study. Ethical clearance was obtained from the institution's ethical committee, adhering to the principles of the Declaration of Helsinki. Written informed consent was secured from all participants, ensuring they were fully informed about the study's nature and objectives.

Data collection involved enrolling interested patients, conducting interviews to gather demographic data and detailed medical histories, and performing thorough clinical examinations. Assessment of risk factors and clinical manifestations was also undertaken, with results recorded on pre-designed and pre-tested forms. Following a joint consultation involving the vascular surgeon, cardiac anesthesiologist, and cardiologist, coronary angiography was performed immediately after the peripheral angiography using the same access point. CAD was assessed using quantitative coronary angiography (QCA), with the progression of CAD determined by the number of diseased vessels exhibiting a degree of stenosis greater than 75%, and the count of significant and insignificant lesions. The collected data were coded and imported into SPSS version 25 for statistical analysis. Categorical data were represented as percentages, ratios, and proportions, and analyzed using the chi-square test. Continuous data were expressed as mean ± standard deviation, with a P-value of less than 0.05 considered statistically significant.

RESULTS

In this study, we meticulously analyzed the demographic, clinical, and physiological characteristics of patients diagnosed with Peripheral Artery Disease (PAD) and those with both PAD and Coronary Artery Disease (CAD).

Our demographic analysis revealed a broad age distribution among the study participants, ranging from 30 to over 70 years, with the majority (34 patients) falling into the 61-70 years age bracket. A significant male predominance was observed, with males constituting 84% of the study population. The evaluation of Ankle Brachial Index (ABI) severity indicated that most patients had mild to moderate ABI severity, highlighting the prevalence of symptomatic PAD in this cohort. Specifically, 74 patients exhibited mild ABI severity, while 108 patients presented with moderate ABI severity, underscoring the critical nature of early diagnosis and management in preventing disease progression (Table 1).

The biometric and laboratory parameters further enriched our understanding of the study population. The mean age of participants was 58.04 years, with physiological measurements such as pulse rate, respiratory rate, systolic and diastolic blood pressure, and various blood parameters, including total cholesterol, LDL, HDL, triglycerides, blood sugar, BUN, Sr. Creatinine, and K levels, providing insights into the overall health and cardiovascular risk profiles of the patients. Particularly noteworthy were the significant findings in respiratory rate, systolic and diastolic blood pressures, and lipid profiles, indicating elevated cardiovascular risks among the participants (Table 2).

A comparison of age between PAD and PAD with CAD patients revealed a marked difference, with PAD patients having a mean age of 54.45 years compared to 61.2 years for those with PAD and CAD, suggesting that CAD tends to manifest in older PAD patients (Table 3). This was supported by the clinical findings and the prevalence of risk factors and comorbidities, where the presence of chest pain significantly differed between PAD only and PAD with CAD groups, emphasizing the importance of vigilant cardiovascular assessment in PAD patients to identify concurrent CAD (Tables 4 and 5).

Analysis of vascular involvement showed that 40% of patients had double vessel disease, with mean ABI values varying across the number of diseased vessels, indicating differing degrees of peripheral arterial compromise. Notably, the F-statistic values for the left and right legs suggested no significant variance between the groups, which might imply a uniform disease progression pattern in PAD irrespective of the number of affected vessels (Table 6).

Table 1: Patient Demographics and Clinical Characteristics

Characteristic	Detail	Number of Patients
Age	30-40 years	12
	41-50 years	11
	51-60 years	15
	61-70 years	34
	>70 years	28
Gender	Male	84
	Female	16
ABI Severity	Normal (>1.30)	0
	Mild (0.91-1.30)	74
	Moderate (0.41-0.90)	108

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Characteristic	Detail	Number of Patients
	Severe (<0.40)	8
	- Right leg (Mild)	35
	- Left leg (Mild)	39
	- Right leg (Moderate)	54
	- Left leg (Moderate)	54
	- Right leg (Severe)	1
	- Left leg (Severe)	7
Ejection Fraction	<60%	67
	>60%	33
Number of Diseased Vessels	Single	37%
	Double	40%
	Triple	23%
Renal Artery Stenosis	Yes	15
	No	85
Clinical Presentation	Chest pain	28
	Gangrene	9
	Claudication	81
	Syncope	1
Non-modifiable Risk Factors	IHD	7
	DLP	14
	Angina	17
	Hypertension	48
Condition	PAD with CAD	56
	PAD only	44

Table 2: Biometric and Laboratory Parameters

Parameter	Measurement	Mean	Median	Range	p-value
Age (Years)		58.04	58.00	36.00-85.00	0.200
Pulse rate (/Min)		80.36	80.00	54-106	0.010
Respiratory rate (/Min)		18.11	18.00	14-26	<0.001
Systolic (mmHg)		132.12	130.00	90-178	<0.001
Diastolic (mmHg)		82.53	80.00	60-100	<0.001
Total cholesterol (mg/dL)		181.25	169.00	90-300	0.003
LDL (mg/dL)		117.17	102.00	27-232	<0.001
HDL (mg/dL)		36.73	37.00	14-96	<0.001
Triglycerides (mg/dL)		163.88	143.00	16-791	<0.001
Blood sugar (mg/dL)		151.70	130.00	67-421	<0.001
BUN (mg/dL)		18.14	15.00	6-50	<0.001
Sr. Creatinine (mg/dL)		1.09	1.00	0.50-2.10	<0.001
K (meq/L)		4.58	4.00	1.30-42.00	<0.001
RT ABI		0.77	0.80	0.00-1.30	<0.001
LT ABI		0.79	0.90	0.00-1.22	<0.001

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Table 3: Comparison of Age Between PAD and PAD with CAD Patients

Parameter	PAD	PAD with CAD	p-value
Age (Years)	Mean 54.45 (SD 11.05)	Mean 61.2 (SD 10.46)	0.003

Table 4: Biometric and Laboratory Parameters by Final Diagnosis

Parameter	Measurement	Median	IQR	p-value
Pulse rate (/Min)		80.00	19.50	0.778
Respiratory rate (/Min)		18.00	2.75	0.078
Systolic (mmHg)		130.00	16.00	0.634
Diastolic (mmHg)		83.00	10.00	0.323
Total cholesterol (mg/dL)		162.00	93.50	0.588
LDL (mg/dL)		104.50	74.75	0.851
HDL (mg/dL)		37.50	11.00	0.233
Triglycerides (mg/dL)		139.00	77.00	0.775
Blood sugar (mg/dL)		116.50	68.75	0.003
BUN (mg/dL)		15.00	14.50	0.738
Sr. Creatinine (mg/dL)		1.00	0.30	0.378
K (meq/L)		4.00	0.70	0.053
RT ABI		0.90	0.30	0.020
LT ABI		0.90	0.30	0.315

Table 5: Clinical Findings and Their Prevalence

Variables	Findings	PAD only (n=44)	CAD with PAD (n=56)	DF	p-value
Claudication	No	8 (16.67%)	11 (19.64%)	1	0.531
	Yes	36 (75.00%)	45 (80.36%)		
Gangrene	No	41 (93.18%)	50 (89.29%)	1	0.457
	Yes	3 (6.82%)	6 (10.71%)		
Syncope	No	44 (100.00%)	55 (98.21%)	1	0.794
	Yes	0 (0.00%)	1 (1.79%)		
Chest pain	No	42 (95.45%)	30 (53.57%)	1	<0.001
	Yes	2 (4.55%)	26 (46.43%)		

Table 6: Risk Factors and Comorbidities

Variables	Findings	PAD only	CAD with PAD	DF	p-value
Diabetes mellitus	No	27 (56.25%)	19 (19.59%)	1	0.006
	Yes	17 (35.42%)	37 (38.14%)		
Hypertension	No	29 (60.42%)	23 (23.71%)	1	0.011
	Yes	15 (31.25%)	33 (34.02%)		
Angina	No	42 (87.50%)	41 (42.27%)	1	0.003
	Yes	2 (4.17%)	15 (15.46%)		
DLP (Dyslipidemia)	No	36 (75.00%)	50 (51.55%)	1	0.218
	Yes	8 (16.67%)	6 (6.19%)		
IHD	No	43 (89.58%)	50 (51.55%)	1	0.104
	Yes	1 (2.08%)	6 (6.19%)		
Smoking	No	0 (0.00%)	56 (57.73%)	1	<0.001
	Yes	44 (91.67%)	0 (0.00%)		
Alcohol consumption	No	37 (77.08%)	38 (39.18%)	1	0.050
	Yes	7 (14.58%)	18 (18.56%)		
Tobacco consumption	No	34 (70.83%)	44 (45.36%)	1	0.0533

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Variables	Findings	PAD only	CAD with PAD	DF	p-value
	Yes	10 (20.83%)	12 (12.37%)		
Family history	No	40 (83.33%)	42 (43.30%)	1	0.040
	Yes	4 (8.33%)	14 (14.43%)		
Urine albumin	No	36 (75.00%)	41 (42.27%)	1	0.310
	Yes	8 (16.67%)	15 (15.46%)		
RAS (Renal Artery Stenosis)	No	39 (81.25%)	46 (47.42%)	1	0.367

Table 7: Vessel Disease, ABI, and Statistical Analysis

Variables	Single Vessel	Double Vessel	Triple Vessel	F Value	p-value
Percent of Patients	37%	40%	23%	-	-
Mean ABI- Left Leg	0.72	0.84	0.67	1.102	0.339
Mean ABI- Right Leg	0.65	0.79	0.71	1.287	0.284

Table 8: Age Comparison Between PAD and PAD with CAD Patients

Parameter	PAD	PAD with CAD	p-value
Age (Years)	Mean 54.45 (SD 11.05)	Mean 61.2 (SD 10.46)	0.003

Lastly, the study's comprehensive examination of clinical presentations, risk factors, and the extent of vascular disease underscored the complex interplay between PAD and CAD, highlighting the necessity for an integrated approach to the diagnosis and management of these conditions. The significantly older age of PAD patients with concurrent CAD calls for heightened clinical awareness and proactive management strategies to mitigate cardiovascular risks in this vulnerable population (Table 7 and 8).

Overall, the results from this study offer valuable insights into the demographic and clinical profiles of PAD patients, with and without concurrent CAD, underscoring the critical need for comprehensive cardiovascular risk assessment and management in this high-risk group.

DISCUSSION

The interrelation between Peripheral Artery Disease (PAD) and Coronary Artery Disease (CAD) has been a focal point of cardiovascular research due to the high morbidity and mortality associated with these conditions. Our study, conducted at Afridi Medical Complex's departments of vascular surgery and cardiology between 2021 and 2023, aimed to delineate the incidence of CAD among patients diagnosed with PAD. Through the evaluation of 100 PAD patients for peripheral angiography, this research sought to elucidate the underlying cardiovascular risk profile and the prevalence of concomitant CAD in this patient population.

The findings of our study underscore the heightened cardiovascular risk inherent to PAD patients, aligning with the broader consensus in cardiovascular medicine that PAD is a significant predictor of cardiac and cerebrovascular events. Notably, a substantial portion of the cohort exhibited moderate ABI readings (0.41 to 0.90) on both limbs, indicative of significant peripheral arterial compromise. This observation is consistent with the broader literature, where the ABI serves as a reliable indicator of PAD severity and a predictor of cardiovascular risk (Frank et al., 20; Bakshi et al., 21). Our analysis revealed a notable incidence of CAD among the study population, with 56% of participants diagnosed with both PAD and CAD, further emphasizing the critical overlap between these diseases.

The distribution of disease severity across our cohort, with a significant fraction of patients exhibiting multivessel coronary involvement, mirrors the findings of da Cunha et al. (22), who also reported a considerable detection rate of PAD via ABI assessment, although their study did not find a significant difference when patients were categorized based on ejection fraction. The prevalence of risk factors such as ischemic heart disease (IHD), dyslipidemia, and hypertension in our study highlights the complex interplay of cardiovascular risk factors in patients with PAD and CAD, corroborating the findings from earlier studies which suggested a multifactorial etiology underpinning the co-occurrence of these conditions.

Interestingly, the prevalence of PAD in diabetic patients reported by Kamil S et al. (23) provides a comparative backdrop to our study's findings, where diabetes and dyslipidemia were significant predictors of CAD among PAD patients. The absence of renal artery stenosis (RAS) in a majority of our patients diverges from some prior studies, suggesting a possible demographic or methodological variance that could influence the manifestation of PAD comorbidities.

The prevalence of a family history of CAD, particularly among patients with both PAD and CAD, underscores the potential genetic or lifestyle factors contributing to the disease's familial aggregation. However, our study faced limitations, including a relatively small

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sample size and a lack of comprehensive evaluation of the surgical interventions undertaken, which might have provided deeper insights into the management outcomes of PAD and CAD.

CONCLUSION

In conclusion, our study has elucidated the significant correlation between PAD and CAD, particularly in older patients and those with a constellation of risk factors such as diabetes, hypertension, and dyslipidemia. The high prevalence of CAD detected through angiography in symptomatic PAD patients underscores the necessity for vigilant cardiovascular assessment and the potential benefits of routine coronary angiography in this patient demographic. These findings advocate for a more integrated approach to the management of PAD, with a heightened emphasis on cardiovascular risk assessment and intervention to mitigate the high risk of adverse cardiac events. Future research should aim to expand on these findings with larger, more diverse cohorts and explore the implications of early CAD detection and management strategies in improving outcomes for patients with PAD.

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