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PREVALENCE OF CAROTID ARTERY STENOSIS IN PATIENTS WITH PERIPHERAL VASCULAR DISEASE

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Abstract

Introduction: *Peripheral vascular disease (PVD) is significantly linked to systemic atherosclerosis, which elevates the risk of carotid artery stenosis (CAS) and subsequent cerebrovascular incidents. Timely intervention through early detection of significant CAS in patients with PVD can enhance outcomes.*

Objectives: *To determine the frequency of significant carotid artery stenosis in patients presenting with symptomatic peripheral vascular disease.*

Subjects & Methods: *This cross-sectional study was conducted at the Department of Surgery, Division of Vascular Surgery, Foundation University School of Health Sciences, Rawalpindi from January-April, 2025. 170 symptomatic PVD patients of both genders having age between 18 to 80 years were enrolled for this study. Following clinical assessment and Doppler confirmation, a bilateral carotid ultrasound was conducted to identify severe stenosis on the basis of MCA-PSV. Significant CAS labelled as positive if there is ≥50% of stenosis as per SRUCC criteria. Data was analyzed using SPSS 23.0, with results presented as frequencies, percentages, and means ± SD. Stratification was performed for study confounders, and a post-stratification Chi-square test was utilized, with a p-value of ≤ 0.05 deemed significant.*

Results. *Study was female dominant 117 (68.8%) and most patients were aged 50–60 years (n=76; 44.7%). Cumulative mean age of the study population was 55.64±10.20 years. Significant carotid artery stenosis was found in 27 (15.9%) patients, while 143 (84.1%) had no significant stenosis. We found no statistically significant association among significant carotid artery stenosis and gender, age,*

BMI, duration of symptoms, or clinical presentation (p-values > 0.05).
***Conclusions**: A significant proportion of individuals with PVD demonstrated notable CAS. Although the stratified analysis did not reveal statistically significant relationships, trends suggest an increased risk among females, those with obesity, and patients with advanced limb ischemia.*

INTRODUCTION

Peripheral artery disease (PAD) is a leading cause of disability worldwide with atherosclerosis as the primary factor driving its development.J It generally manifests as intermittent claudication and critical limb ischemia; however, additional life-threatening conditions such as MI and stroke may also arise.[i] It impacts almost 230 million adults globally, including 64 million in high-income nations and 172 million in low- and middle-income nations.[ii]

Stroke is a leading cause of death with a high mortality rate and it has been reported that 10-50% of ischemic strokes are caused by carotid artery stenosis (CAS).[iii] Despite advancement in diagnostic modalities and management as well as carrying a high morbidity and mortality, these patients are often left undertreated and underdiagnosed. Lower extremity peripheral arterial disease (PAD) and CAS are both localized manifestations of systemic atherosclerosis and commonly share the same risk factors.[iv] PAD and CAS are both localized manifestations of systemic atherosclerosis and commonly share the same risk factors. Cardiovascular and cerebrovascular accidents are the most common cause of death in patients with PAD.[v]

The aim of this study is to detect significant carotid artery stenosis in patients with PAD. The logic is that atherosclerosis is a generalized process; thus, disease in one vascular bed warrants screening in other important vascular beds like the carotids and coronary arteries.[2] Despite the recognized clinical implications, data on the prevalence of significant CAS among PVD patients is sparse on our local population. This is crucial because early diagnosis and prompt treatment of these vital vascular areas can save lives by preventing strokes. This study will emphasize the importance of considering a patient with peripheral vascular disease as having poly vascular disease, where detecting issues in other critical vascular regions can reduce mortality and morbidity-shifting the focus from merely saving a limb to improving overall patient outcomes.

MATERIALS AND METHODS

This descriptive cross-sectional study was performed in the Department of Surgery, Division of Vascular Surgery, at Foundation University School of Health Sciences (FUSH), Fauji Foundation Hospital, Rawalpindi, over a three-month period (from 22 Jan 2025 to 30 April 2025) subsequent to IRB approval. A consecutive (non-probability) sampling method was utilized, and the sample size was determined using the WHO sample size calculator, resulting in 170 participants with a 95% confidence level and a 6% margin of error, based on a reference prevalence of 19.6% for critical carotid artery stenosis from a study by Li Z et al. The study encompassed patients aged 18 to 80 years of both sexes with a verified diagnosis of symptomatic peripheral vascular disease (PVD), excluding individuals with normal peripheral pulses, absence of ischemic symptoms, previous carotid artery interventions, or a history of ischemic stroke, coronary artery disease, or other carotid artery conditions. Following ethical permission, data collection occurred at Surgical Unit 3 of FFH, Rawalpindi where comprehensive clinical histories and physical examinations were conducted by the trainee researcher. Suspected PVD cases received Doppler ultrasonography for verification, and eligible patients who provided informed consent were enrolled. Bilateral carotid grayscale and Doppler ultrasound were employed to diagnose severe carotid artery stenosis (CAS). Data analysis was performed using SPSS version 23.0, with qualitative components expressed as frequencies and percentages, and quantitative variables provided as mean ± standard deviation. Effect modifiers such as age, gender, BMI, and symptom duration were addressed through stratification, followed by post-stratification Chi-square analysis, with a p-value of ≤ 0.05 considered statistically significant.

OPERATIONAL DEFINITIONS:

Peripheral vascular disease (PVD): was diagnosed clinically at the time of presentation to the hospital by the consultant surgeon and was suspected if any two of the following sign/symptoms are present:

Intermittent claudication (pain or cramping in the legs during exertion, relieved by rest)

Rest pain

Ulcer or Gangrene (loss of tissue may include skin and muscles)

PVD was confirmed through the doppler ultrasonography by determining the Ankle Brachial Index ≤0.9.

Significant Carotid artery stenosis (CAS): was diagnosed among all the patients with PVD by the consultant surgeon with at least three years of teaching experience using the grey scale and doppler ultrasound and as per criteria defined by the Society of Radiologists in Ultrasound Consensus Conference (SRUCC) attached as Annexure B. Significant CAS labelled as positive if there is ≥50% of stenosis as per SRUCC criteria.

RESULTS

The study included 170 patients with peripheral vascular disease (PVD). The mean age, BMI and duration of symptoms were 55.64 ± 10.20 years, 28.11 ± 5.43 kg/m² and 5.36 ± 2.22 weeks respectively. Study was female dominant 117 (68.8%) and most patients were aged 50–60 years (n=76; 44.7%). Patients were categorized in different groups on the basis of age, BMI and duration of symptoms which is reflected in table 1. In terms of clinical presentation, ulcer/gangrene was the most common, seen in 137 (80.6%) patients, while moderate ABI (0.4–0.9) in 100 (58.8%) was most frequently observed in our study population (figure 1 and figure 2). Significant carotid artery stenosis was found in 27 (15.9%) patients, while 143 (84.1%) had no significant stenosis. We found no statistically significant association among significant carotid artery stenosis and gender, age, BMI, duration of symptoms, or clinical presentation (*p*-values > 0.05). However, among genders, females had a higher proportion of significant stenosis (19 patients; 70.4%), the patients of age groups <50 years and >60 years each contributed equally to significant stenosis (10 patients each; 37.0%), while the 50–60 years group showed a lower rate. The group with BMI >29 kg/m² had the highest frequency of significant stenosis, followed by the BMI 25–29 kg/m² group. Regarding symptom duration, stenosis was almost equally distributed between patients of both groups i.e. ≤4 weeks and >4 weeks. Among clinical presentations, patients presenting with ulcer/gangrene exhibited the highest number of significant stenosis cases, compared to rest pain and intermittent claudication. Detailed stratification analysis is illustrated in table 2.

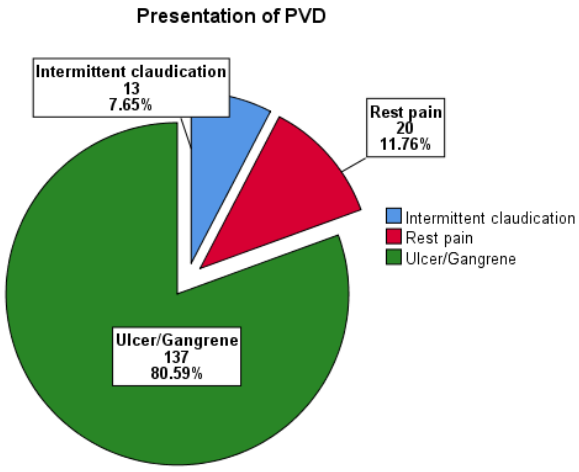

Figure 1: Distribution of patients based on presentation of peripheral vascular disease

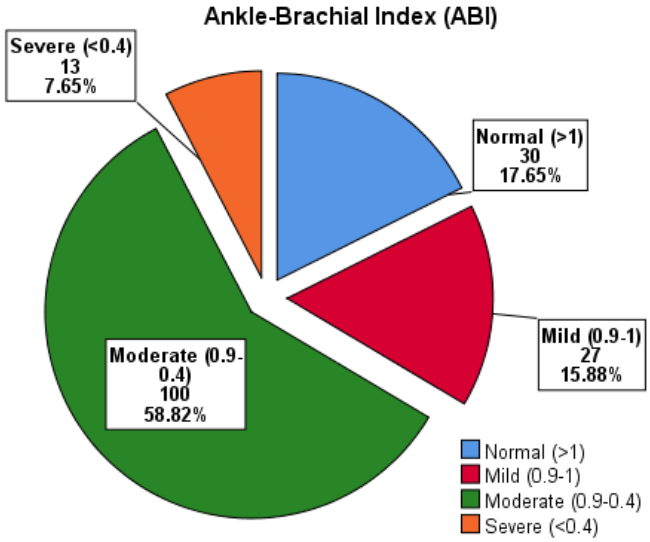

Figure 2: Distribution of patients based on ankle-brachial index severity

Table 1: Clinical, demographic and comorbid details of study subjects (n=170)

Variables		Frequency	Percentage (%)
Gender	Male	53	31.2
	Female	117	68.8
Age Groups	<50 Years	35	17.5
	50-60 Years	121	60.5
	>60 Years	44	22.0
BMI Groups	<25 kg/m^2	52	26.0
	25 – 29 kg/m^2	148	74.0
	>29 kg/m^2	57	28.5
Duration of Disease Groups	Upto 4 weeks	82	41.0
	> 4 weeks	37	18.5

Table 2: Findings of post stratification X^2 test for association between CAS and study confounders

Variables		Stenosis		p-Value (x2-test)
		Significant	Non-Significant	
Gender	Male	8 (29.6%)	45 (31.5%)	0.850
	Female	19 (70.4%)	98 (68.5%)	
Age Groups	<50 Years	10 (37.0%)	35 (24.5%)	0.098
	50-60 Years	7 (25.9%)	69 (48.3%)	
	>60 Years	10 (37.0%)	39 (27.3%)	
BMI	<25 kg/m^2	7 (25.9%)	40 (28.0%)	0.976
	25 – 29 kg/m^2	9 (33.3%)	46 (32.2%)	
	>29 kg/m^2	11 (40.7%)	57 (39.9%)	

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	>60 Years	10 (37.0%)	39 (27.3%)	
Presentation of PVD	Intermittent Claudication	3 (11.1%)	10 (7.0%)	0.339
	Rest Pain	5 (18.5%)	15 (10.5%)	
	Ulcer/Gangrene	19 (70.4%)	118 (82.5%)	
Duration of Disease	Upto 4 weeks	13 (48.1%)	67 (46.9%)	0.902
	> 4 weeks	14 (51.9%)	76 (53.1%)	

DISCUSSION

This study aimed to ascertain the prevalence of both significant and non-significant carotid artery stenosis in patients exhibiting PVD. The majority of patients in our cohort had critical limb ischemia, particularly ulcers or gangrene, with most demonstrating moderate to severe ischemia as indicated by the ankle-brachial index (ABI). The findings are clinically significant as concurrent carotid artery disease in PVD patients elevates the likelihood of cerebrovascular incidents, underscoring the necessity for vascular screening in this high-risk group.

On stratified analysis, although no statistically significant differences were detected across variables, trends indicated a higher frequency of significant stenosis in females, in patients younger than 50 or older than 60 years, in obese individuals, and among those presenting with advanced limb ischemia (ulcers or gangrene). Although traditionally men are considered at higher risk for atherosclerosis, few studies have shown that female patients with PVD can exhibit significant carotid involvement, possibly due to delayed diagnosis and more aggressive disease at presentation. Moreover, in our setting, the number of female patient is far more than male patients that could be a contributing factor. Similarly, Age is a well-established risk factor for arterial disease. Studies have demonstrated that older age was independently associated with higher prevalence of carotid stenosis. Younger patients with PAD may represent a subgroup with more aggressive atherosclerosis driven by strong genetic or metabolic factors. Obesity on other side, is also a known contributor to atherosclerotic disease progression through mechanisms such as insulin resistance, chronic inflammation, and dyslipidemia. Although direct associations between obesity and carotid stenosis have been inconsistently reported, its role in accelerating systemic atherosclerosis supports its consideration as a plausible trend. The severity of PAD is correlated with the burden of systemic atherosclerosis. Past studies found that patients with severe PAD (e.g., Fontaine stage IV) had higher rates of significant carotid stenosis, suggesting that more advanced ischemia may reflect greater global vascular disease, including in the carotid arteries.

Our findings are closely aligned with previous international studies. In a recent cross-sectional study, Li Z and colleagues, reported that significant carotid artery stenosis (≥50% stenosis) was present in 19.6 % (n=128/653) of patients with peripheral vascular disease, while 80.4% (n=525/653) of patients had no significant stenosis (mild or no stenosis i.e. <50%).[vi] They identified older age, very low ABI (<0.5), and Fontaine stage IV disease as strong predictors, consistent with our observation of higher stenosis rates among patients with critical ischemia. In the SMART study by Simons et al.,[vii] the prevalence of previously unknown CAS in patients with PVD was reported as 14%, similar to our observed prevalence (15.9%). They identified advanced age, low body weight, and low diastolic blood pressure as predictors for CAS, highlighting that patient profiling could enhance screening

strategies, a concept reinforced by our stratification trends although without statistical significance. Similarly, a meta-analysis reported a prevalence of 25–28% for >50% stenosis and 14% for >70% stenosis in PVD patients, which brackets our findings well. Their emphasis on heterogeneity and the need for stratification supports our observation that no single risk factor fully predicted carotid stenosis in PVD patients.[viii]

The study by Alexandrova et al. [ix] found a much higher prevalence (57% had ≥30% stenosis and 25% were surgical candidates with severe stenosis), likely explained by an older mean age (70 years) and a higher prevalence of risk factors like smoking, coronary artery disease, and prior cerebrovascular events compared to our relatively younger, lower-risk population. They emphasized the value of routine carotid screening, a recommendation also supported by our findings, particularly in more advanced clinical stages of PVD.

Cinà and colleagues[x] reported a 33% prevalence of >50% stenosis in PVD patients, with risk factors including age >70 years, diabetes mellitus, prior stroke, and low ABI. Although our prevalence was lower, our study corroborates the pattern of increasing carotid involvement in more severe PVD cases, as evidenced by higher stenosis rates among patients with critical ischemia and low ABI. The findings from Shakeri Bavil et al.[xi] in Iranian patients differ notably from ours, with a much lower prevalence (4.2% significant stenosis), possibly reflecting ethnic, genetic, or environmental factors. Importantly, like our study, they found no statistically significant association between individual risk factors and significant carotid disease. In contrast, Bez and co-authors[xii] from Brazil found a very high prevalence of carotid stenosis (84% overall, 40% significant, and 17% severe) in PVD patients, emphasizing the strong correlation between severe limb ischemia and cerebrovascular disease. Their recommendation for systematic carotid evaluation in symptomatic PVD patients aligns with our conclusion that patients with advanced presentations (e.g., ulcer or gangrene) might benefit most from carotid screening. Collectively, these comparisons reinforce that while the overall prevalence of significant carotid artery stenosis among PVD patients varies across populations (4.2% to 40%), our findings fit well within the internationally reported range. Variations can be attributed to differences in study populations' demographics, comorbidities, diagnostic criteria, and severity of PVD at presentation.

A notable characteristic of our study is the focused assessment of a particular high-risk demographic utilizing objective imaging techniques. Nonetheless, it is constrained by its relatively small sample size, single-center design, and absence of comprehensive data on conventional vascular risk factors (e.g., smoking, diabetes, hypertension, dyslipidemia) that could have enhanced risk classification. The lack of follow-up data on cerebrovascular events constitutes another constraint, hindering a direct evaluation of clinical outcomes associated with identified stenoses.

CONCLUSIONS

In conclusion, a substantial percentage of individuals with PVD exhibited considerable CAS. Despite the absence of statistically significant relationships in the stratified analysis, trends indicate an elevated risk among females, persons at the extremes of age, those who are obese, and patients exhibiting advanced limb ischemia. Our results align with global data, highlighting the necessity of targeted carotid artery screening, particularly in PVD patients exhibiting critical limb ischemia or other high-risk characteristics, to avert detrimental cerebrovascular incidents.

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