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Patterns and Severity of Peripheral Vascular Disease in the Pakistani Population

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ABSTRACT

***Objective*:** To assess the patterns and severity of peripheral vascular diseases (PVD) in a Pakistani population, using CT angiography.

***Study Design*:** Prospective longitudinal study.

***Place and Duration of Study*:** Department of Vascular Surgery, Combined Military Hospital, Rawalpindi Pakistan, from Aug to Dec 2023.

***Methodology*:** A total of 81 adult patients with clinically suspected lower limb PVD were included. Participants underwent a first routine clinical assessment, arterial Doppler, and then lower limb CTA if required to confirm the diagnosis. Patient characteristics, including demographic data and co-morbid conditions, were recorded. The arterial tree was divided into aorto-illiac, femoro-popliteal, and infra-popliteal segments, and the lesions were graded using the TASC-II classification.

***Results*:** The study included 62 males (76.5%) and 19 females (23.5%), with a mean age of 62.91±8.99 years. Hypertension (66.7%), diabetes (59.3%), and ischemic heart disease (51.9%) were common comorbidities. Smoking was reported in 49.4% of patients. The most affected segments were the femoro-popliteal arteries (55.6%), followed by the aorto-illiac (45.7%) and the infra-popliteal arteries (34.6%). Multiple segment involvement was noted in 34.6% of cases. Circumferential calcification was observed in 67.9% of patients. Diabetes was significantly less associated with infra-popliteal disease (p=0.035).

***Conclusion*:** There is a significant burden of PVD in the Pakistani population, particularly among males and individuals with comorbid conditions such as hypertension, diabetes, and ischemic heart disease. There is a predominance of femoro-popliteal involvement and an advanced nature of atherosclerosis, indicated by prevalent calcification and prevalent type D TASC II disease pattern in different arterial regions.

Keywords: Atherosclerosis, Aorto-iliac Computed Tomography Angiography, Diabetes, Peripheral Arterial Disease, Risk Factors

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INTRODUCTION

Peripheral vascular disease includes a spectrum of different degrees of hypoperfusion that primarily involves the lower limbs, and symptoms range from asymptomatic to debilitating ulcers with high chances of limb and life loss.[1] Globally, the burden of peripheral artery disease (PAD) has been on the rise, especially in the last decade. Estimates suggest an additional 34 million people were affected between 2010 and 2015.[2] Widespread atherosclerosis in several arterial regions, including the brain and coronary circulations, is indicated by PAD. Furthermore, PAD, cerebrovascular disease (CBVD), and coronary artery disease (CAD) have a great deal of similarities.[3] The risk of CBVD and CAD, as well as their outcomes, is elevated in individuals with PAD. Individuals with PAD have a 4-5 times greater chance of dying from a cardiovascular event and a 2-3 times higher risk of dying from all causes combined.[4] Diabetic patients have two folds risk of developing PAD as compared to non-diabetics.[5]

The incidence of PAD has increased by 28.7% in low- and middle-income countries and 13.1% in high-income countries between 2000 and 2010.[6] Overall, PAD largely goes undiagnosed owing to a lack of screening programs and concomitant presence of other CBVD. In Pakistan, most studies focusing on PAD were done on people with diabetes. There is generally paucity of data on patterns of PAD and general configuration of arterial system among such patients.[7] Although there are no studies available to estimate the exact prevalence of PAD, indirect measures show that diabetics patients may increase from 11 million to 16 million by 2030, and people with diabetes are more prone to develop PAD hence indicating it may well be rampant in our population.[8] The clinical signs of peripheral arterial disease (PAD) might be caused by atherosclerotic blockage of the aortoiliac arterial segment or any place in the lower limb arterial tree.

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The superficial femoral and popliteal arteries are the anatomical areas most frequently impacted.

Numerous studies have examined the comorbidities associated with PAD and its risk factors, as well as how these variables affect the disease's occurrence. Nevertheless, little research has used Computed Tomography Angiography (CTA) to assess the anatomical distribution patterns of PAD and determine whether any correlation exists between particular parameters and the location of atherosclerotic stenosis and blockage. Recent data suggests that different distribution patterns of PAD are linked to various atherosclerosis risk factors and associated co morbidities.[9] Numerous worldwide articles have emphasised the structural differences in arterial involvement depending on a wide range of risk variables in order to understand the pattern of PAD distribution.[10] Given that patient characteristics differ throughout populations, this study may offer important new understandings of how different risk variables influence vascular involvement in Pakistani individuals. Moreover, TASC II classification was also used to delineate the disease severity. The study would help us understand the disease process in our population and may help in taking steps to mitigate the effects of PAD.

METHODOLOGY

The prospective longitudinal study conducted at the Department of Vascular Surgery, Combined Military Hospital, Rawalpindi Pakistan, from August to December 2023 after approval was sought from the Ethical Review Board (EC/IRB 647 dated 3 Jul 2024). Sample size was calculated using the WHO calculator taking the proportion of patients with profunda femoris involvement in PVD was 4.1% in the Pakistani population.[7] Non-probability consecutive sampling was employed.

Inclusion Criteria All adult patients (over the age of eighteen) who initially showed up to our medical institution with a clinical suspicion of PAD of the lower limb and whose presumptive diagnosis was verified by lower limb CTA and/or CA were included.

Exclusion Criteria: Patients with non-atherosclerotic lesions as auto-immune disorders, patients having normal angiograms, and iatrogenic injuries, such as lower extremity amputation or prior vascular intervention, were not included.

Patient characteristics and patterns of segmental artery involvement were noted. Basic demographic data, including age and sex, as well as related variables, like risk factors and metabolic comorbidities, were included in the patient characteristics. After reviewing the radiological scans, consultants in vascular and interventional radiology revealed the existence of stenotic atherosclerotic lesions. Based on earlier research, the lesions were divided into the following three categories: (a) Aortoiliac arteries: these comprise the common, external, and internal iliac arteries as well as the infrarenal aorta; (b) Femoro-popliteal arteries: these comprise the superficial, deep, and common femoral arteries as well as the popliteal arteries; and (c) Infra-Popliteal arteries: these comprise the anterior, posterior, and peroneal arteries.[11]

The definition of hypertension was (i) being on antihypertensive medication or (ii) having a systolic blood pressure more than 130–139 mmHg or a diastolic blood pressure greater than 80–89 mmHg. Body mass index (BMI) was used to quantify obesity. Serum haemoglobin A1c >6.5% was used to define diabetes mellitus.[12]

All data was analysed using the software Statistical Package for the Social Sciences (SPSS) version 23. Continuous variables were represented as mean and standard deviation. Gender, type of arterial disease, Obesity status, smoking status, calcification, and comorbidities were presented as frequency and percentage. The Independent sample t-test was applied to compare the means between two groups. The Chi-square test was applied to examine the effects of qualitative variables between groups. The *p*-value was considered significant if ≤0.05.

RESULTS

A total of 81 cases participated in the study. The mean age of participants was 62.91±8.99 years, ranging from 30 to 90 years. There were 62(76.5%) males and 19(23.5%) females in the study. The most common comorbidities in patients were hypertension in 54(66.7%), diabetes in 48(59.3)%, and Ischemic heart disease in 42(51.9%). Moreover, there were 40(49.4%) smokers in the study group. The main complaint of patients who underwent scanning was rest pain in 29(35.8%) patients. The rest of the distribution is shown in Figure-1. The arterial tree of the lower limb was divided into aorto-iliac, femoro-popliteal, and infra-popliteal segments, and our data showed that 37(45.7%) patients had aorto-iliac disease, 45(55.6%) had femoro-popliteal disease, and 28(34.6%) had infra-popliteal problems. A total of 28(34.6%) patients had more than one segment involved. These segments

were further graded according to severity as per the TASC-II classification shown in Figure-2.

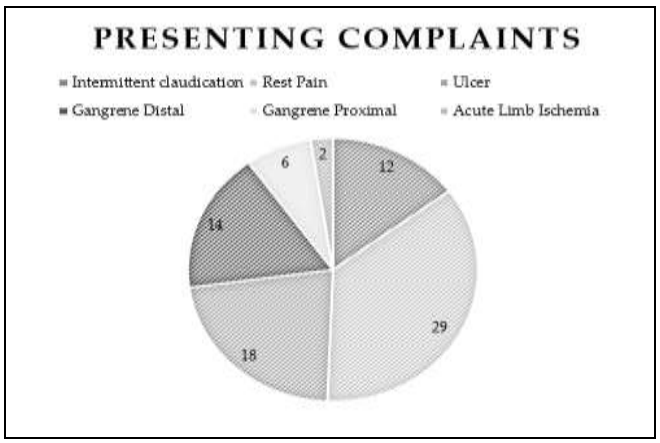

Figure-1: Main Presenting Complaint of Study Participants (n=81)

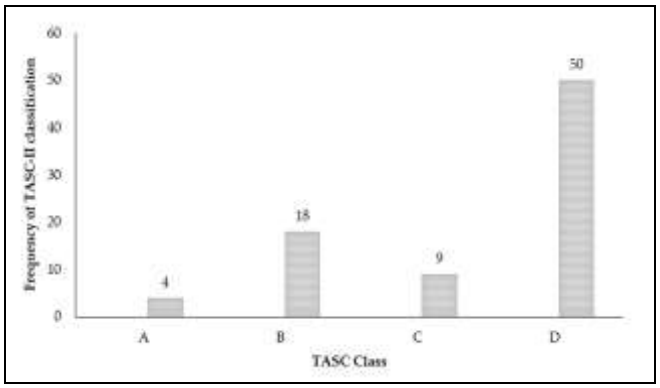

Figure-2: Severity of Disease as per TASC-II Classification (n=81)

Table-I: Association of Aortoiliac disease with Study Parameters (n=81)

Variables	Aortoiliac Disease		*p*-value
	Yes (n=37)	No (n=44)	
Age (years) Mean±SD	62.24±7.85	63.48±9.92	0.542
Gender			
Male	26(70.3%)	36(81.8%)	0.294
Female	11(29.7%)	8(18.2%)	
Diabetes Mellitus			
Yes	23(62.2%)	25(56.8%)	0.656
No	14(37.8%)	19(43.8%)	
Hypertension			
Yes	25(67.6%)	29(65.9%)	1.000
No	12(32.4%)	15(34.1%)	
Ischemic heart disease			
Yes	20(54.1%)	22(50%)	0.824
No	17(43.9%)	22(50%)	
Calcification			
Yes	25(67.6%)	30(68.2%)	1.000
No	12(32.4%)	14(31.8%)	
Smoking			
Yes	18(48.6%)	22(50%)	1.000
No	19(51.4%)	22(50%)	

The mean antero-posterior and transverse diameters of all participants were 2.07±0.35 cm and 2.11±0.37 cms, respectively. There was circumferential calcification seen in 55(67.9%) patients as well. To investigate the association between different diseases and patterns of arterial involvement, the Association of aorto-iliac disease with various variables is presented in Table-I. There was no significant association found. Similarly, femoro-popliteal association is shown in Table-II, and for infrapopliteal disease associations are shown in Table-III. Diabetes was less associated with infra-popliteal disease in our study.

Table-II: Association of Femoropopliteal Disease with Study Parameters (n=81)

Variables	Femoropopliteal Disease		*p*-value
	Yes (n=45)	No (n=36)	
Age (years) Mean±SD	63.04±9.67	62.75±8.22	0.885
Gender			
Male	34(75.6%)	28(77.8%)	1.000
Female	11(24.4%)	8(22.2%)	
Diabetes Mellitus			
Yes	28(62.2%)	20(55.4%)	0.650
No	17(37.8%)	16(44.6%)	
Hypertension			
Yes	31(68.9%)	23(63.9%)	0.813
No	14(31.1%)	13(36.1%)	
Ischemic heart disease			
Yes	24(53.3%	18(50%)	0.826
No	21(46.7%)	18(50%)	
Calcification			
Yes	33(73.3%)	22(61.1%)	0.338
No	12(26.7%)	14(38.9%)	
Smoking			
Yes	22(48.9%)	18(50.0%)	1.000
No	23(51.1%)	18(50.0%)	

DISCUSSION

Peripheral vascular disease (PVD) is a significant public health problem affecting a large population worldwide, particularly in low and middle-income countries. The limited data available from centres without proper vascular facilities prompted the necessity for this study. This study aimed to assess the patterns of peripheral vascular diseases and evaluate CT angiography as a diagnostic tool, providing detailed vascular maps. While not emphasizing procedural efficacy, our focus was on delineating disease patterns, severity, and their correlation with risk factors. Chatteri *et al.,* demonstrated the utility of CT angiography in diagnosing PVD with excellent results.[11] Additionally, Martenelli *et al.,* reported high diagnostic accuracy using this modality.[12]

Table-III: Association of Infra-popliteal Disease with Study Parameters (n=81)

Variables	Infrapopliteal Disease		*p*-value
	Yes (n=38)	No (n=53)	
Age (years) Mean±SD	64.50±7.82	62.08±1.31	0.251
Gender			
Male	20(71.4%)	42(79.2%)	0.581
Female	18(28.6%)	11(20.8%)	
Diabetes Mellitus			
Yes	12(42.9%)	36(67.9%)	0.035
No	16(57.1%)	17(32.1%)	
Hypertension			
Yes	15(53.6%)	39(73.6%)	0.086
No	13(46.4%)	14(26.4%)	
Ischemic heart disease			
Yes	12(42.9%)	30(56.6%)	0.254
No	16(57.1%)	23(43.4%)	
Calcification			
Yes	19(67.9%)	36(67.9%)	1.000
No	9(32.1%)	17(32.1%)	
Smoking			
Yes	17(60.7%)	23(43.4%)	0.165
No	11(29.3%)	30(56.6%)	

Our study revealed a shift in awareness among the population, leading to increased early vascular consultations. Among the 81 patients evaluated, males were predominantly represented. We found a predominance of peripheral artery disease (PAD) affecting the femoropopliteal arteries, followed by the aortoiliac and infra-popliteal segments, aligning with global trends but necessitating region-specific data due to potential variations in risk factors. Comorbidities such as hypertension, diabetes mellitus, and ischemic heart disease were prevalent among the study population, exacerbating PAD symptoms and progression through various mechanisms. While age and gender showed no significant association with arterial disease distribution, diabetes mellitus was interestingly significantly less related to infra-popliteal disease, emphasizing targeted screening in this group. Ibrahim et al. showed that PVD is common in males compared to females, with the infrapopliteal segment being most commonly involved, and diabetes has a strong correlation with infrapopliteal disease. The classic Framingham study showed an increased prevalence of intermittent claudication among men.[13] In contrast, Pabon et al., showed that PAD was more prevalent and severe among women compared to men.[14] Similar to the Pakistani population, there is a high prevalence of disease in the femoropopliteal segment, followed by the aortoiliac and then infrapopliteal disease. Furthermore, the presence of calcification in a substantial proportion of patients underscores the advanced nature of atherosclerosis in this cohort. Calcification not only reflects disease severity but also poses challenges in endovascular interventions, potentially influencing treatment outcomes and long-term prognosis. Everhart et al. found a strong association between medial calcification in foot arteries and increased rates of any amputation.[15] More recently, Konijn et al. also demonstrated a strong correlation between arterial calcification and CLI.[16]

Clinically, vascular calcification is now accepted as a valuable predictor of coronary heart disease. Achieving control over this process requires understanding mechanisms in the context of a tightly controlled regulatory network. Thus, treatments for osteoporosis and cardiovascular disease may affect both vascular calcification and bone health.

The utilization of TASC-II classification provided valuable insights into the severity of arterial lesions, guiding treatment decisions and prognostication. This standardized classification system enables effective communication among healthcare professionals and facilitates the selection of appropriate revascularization strategies based on lesion complexity and anatomical location. Our study demonstrated type D severity among the study population, indicating an advanced pattern in any arterial region. A study by Patel AP and colleagues in the UK showed a higher prevalence of PAD among South Asian populations living abroad.[17,18] This study also highlights the evolving role of multidisciplinary teams in the management of PVD patients.

LIMITATION OF STUDY

Despite the strengths of this study, including its prospective design and utilization of advanced imaging modalities, the absence of long-term follow-up data restricts the assessment of disease progression and treatment outcomes over time. Further multicenter studies with larger cohorts are warranted to validate these findings and inform evidence-based approaches to Peripheral Arterial Disease management on a national scale.

CONCLUSION

The study underscores the significant burden of Peripheral Vascular Disease in the Pakistani population, particularly among males and individuals with comorbid conditions such as hypertension, diabetes, and ischemic heart disease. The findings highlight the predominance of femoropopliteal involvement, followed by aortoiliac and infra-popliteal segments. The study also reveals the advanced nature of atherosclerosis, indicated by prevalent calcification and prevalent type D TASC II disease pattern in different arterial regions.

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Authors' Contribution

Following authors have made substantial contributions to the manuscript as under:

AB & ABS: Data acquisition, data analysis, critical review, approval of the final version to be published.

NI & AMB: Study design, data interpretation, drafting the manuscript, critical review, approval of the final version to be published.

RK & AA: Conception, data acquisition, drafting the manuscript, approval of the final version to be published.

Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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