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FREQUENCY OF LOWER EXTREMITY ARTERIAL DISEASE AND ITS DETERMINANTS DETECTED BY DUPLEX ULTRASOUND IN PATIENTS PRESENTING WITH NONSPECIFIC LEG PAIN IN A TERTIARY CARE HOSPITAL

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Abstract

Objective: *To determine the frequency of lower extremity arterial disease (LEAD) among patients with nonspecific leg pain using duplex ultrasound (DUS) and to explore its associated determinants.*

Study design: *Descriptive cross-sectional study*

Place and Duration of study: *The study was conducted at the Radiology Department of Combined Military Hospital, Rawalpindi from 1st August 2022 to 25th December 2023 after approval from the Hospital Ethics Committee.*

Methodology: *Data was calculated from adult patients aged 30 to 80 years with nonspecific leg pain who were referred to the Radiology department for lower limb arterial Doppler. Convenience sampling was used and sample size was determined using the WHO sample size calculator requiring 350 patients. Lower limb arterial duplex ultrasound (DUS) was conducted by a single experienced Resident Radiologist. Data analysis was conducted using IBM SPSS version 20.*

Results: *The percentage of LEAD was 62.0% in patients presenting with nonspecific leg pain. The mean age of participants was 60.3 years, with a male predominance (72.9%). Foot was the most common site of pain (71.7%). Diabetes mellitus (48.6%), hypertension (25.1%), smoking (20.0%), and hyperlipidemia (19.7%) were the most common determinants.*

Conclusion: *LEAD is a significant contributor to nonspecific leg pain particularly among older males with diabetes. Duplex ultrasound proved to be a reliable diagnostic tool, due to its ability to bypass arterial calcification issues, highlighting the need for routine vascular assessments in high-risk populations.*

INTRODUCTION

Lower extremity arterial disease (LEAD) is a progressive atherosclerotic condition affecting the distal aorta, common iliac, internal iliac, external iliac, femoral, popliteal, and crural arteries, which results in reduced blood flow to the lower limbs.[1] It is characterized by deposition of fatty plaques in the arterial walls, leading to signs and symptoms like claudication, rest pain, tissue loss, non-healing wounds or ulcers, infection, gangrene, and ultimately limb loss. [1, 2]

The global burden of LEAD is substantial, with an estimated 230 million people affected in 2015, and prevalence continues to rise due to aging populations and increasing rates of diabetes, hypertension, and dyslipidemia.[3] South Asia carries one of the highest global prevalence rates, attributed to genetic susceptibility and the high number of modifiable risk factors.[3] Internationally, LEAD prevalence in adults over 40 years ranges from 12% in high-income countries to 20% in low- and middle-income countries.[4, 5]

In the regional context, South Asian studies have reported LEAD prevalence between 20 to 32% in general populations, with markedly higher rates in high-risk groups.[3] In Pakistan, limited epidemiological evidence exists, but available data suggest a significant disease burden.[5] One study among type 2 diabetics reported a prevalence of 31.6% when using the ankle–brachial index (ABI) as a screening tool. [6] However, ABI can yield false-negative results in patients with medial arterial calcification, particularly those with diabetes or chronic kidney disease. [7]

A major challenge in LEAD detection is that only about 10% of patients present with classic intermittent claudication, while 50% experience atypical leg pain and 40% remain asymptomatic, delaying diagnosis and timely intervention. [4,5] Even when symptoms occur, they are often attributed to musculoskeletal or age-related conditions. Duplex ultrasonography (DUS) offers a non-invasive, cost-effective, and sensitive diagnostic option that can assess both the anatomical and hemodynamic status of lower limb arteries, making it particularly useful in patients where ABI is unreliable. [8, 9]

Major risk factors of LEAD include hypertension, diabetes, smoking, and hypercholesterolemia. [2]

Given the high prevalence of risk factors for LEAD in Pakistan and the frequent presentation of nonspecific leg pain in clinical practice, there is a need to quantify the burden of disease in such patients and identify associated determinants using a reliable diagnostic modality. This study was conducted to determine the frequency of LEAD detected by DUS in patients presenting with nonspecific leg pain in a tertiary care setting and to evaluate its association with major cardiovascular risk factors.

Materials and Methods

This cross-sectional study was conducted at the Department of Radiology at Combined Military Hospital, Rawalpindi, for 18 months from 1st August 2022 to 25th December 2023 after approval from the Hospital Ethics Committee (reference number: 239). After initial history and examination, patients were counselled regarding the study procedure and informed consent was taken. A standard questionnaire was filled out, including demographics, clinical and radiological findings.

Inclusion criteria:

Patients aged 30 to 80 years presenting with nonspecific lower limb pain who were referred to the Radiology department of CMH Rawalpindi for lower limb arterial Duplex ultrasound.

Exclusion criteria:

Patients known to have peripheral arterial disease, those with lower limb ulcers, necrosis, gangrene, a history of lower limb surgery including amputation and revascularization, significant lower limb swelling or filariasis impairing Doppler image quality, diabetic foot, or complaints of cold periphery.

Convenience sampling was used to select study participants. The minimum required sample size, determined using the WHO sample size calculator with a 95% level of confidence, 5% margin of error, and a population proportion of 31.67%, was 333.

A total of 400 patients were assessed for enrolment initially, of which 50 were excluded based on the exclusion criteria and 350 were included in the study. The patient flow diagram is illustrated in Figure-1 below.

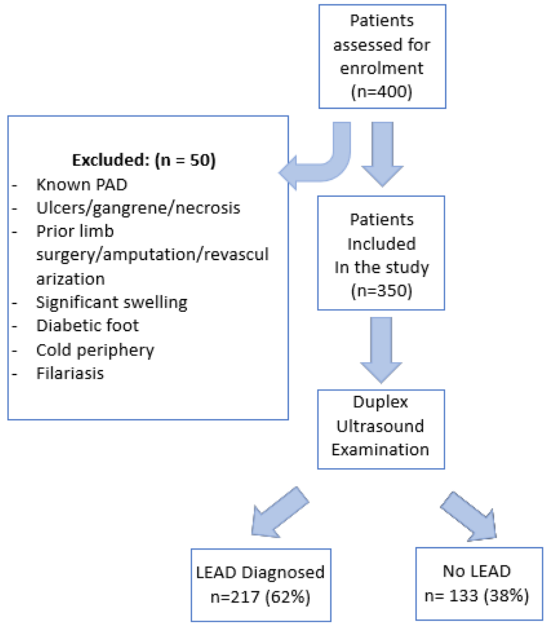

Figure-1: Patient flow diagram

Lower limb arterial DUS was conducted using an ultrasound machine (Esaote MyLabSeven) by a single experienced Resident Radiologist. Common and superficial femoral, popliteal, anterior and posterior tibial, peroneal, and dorsalis pedis arteries were scanned with a high-frequency linear probe.

LEAD analysis followed standard guidelines and previous study data. A Duplex USG study was deemed normal if both lower limbs displayed arteries with a clear lumen and thin, uniform walls, and triphasic Doppler waveforms in all visualized arterial segments with a clear spectral window. Patients were classified as having LEAD if one or both legs exhibited any of the following DUS findings: atherosclerotic plaques causing diameter stenosis (mild 1-19% diameter reduction, moderate 20-49% diameter reduction, severe 50-99% diameter reduction), spectral broadening and filling of the spectral window, abnormal peak systolic velocity (normal ranges for adult common femoral, superficial femoral, popliteal, and tibio-peroneal arteries are 100 cm/sec, 80–90 cm/sec, 70 cm/sec, and 40–50 cm/sec, respectively), a biphasic waveform indicating a clear transition from a triphasic signal along the vascular tree, a monophasic Doppler waveform, or absence of color flow.

Data analysis was conducted using IBM SPSS version 20. Descriptive statistics were used to summarize the demographic, clinical, and risk factor profiles of the patients. Categorical variables, such as gender, presence of pain and risk factors/determinants were presented as frequencies and percentages. Continuous variables, such as age, were reported as mean and range. The data were organized into tables and visualized using bar charts and pie charts for categorical distributions and line plots for continuous variables where applicable.

Results:

The dataset consisted of 350 patients with nonspecific leg pain referred for lower limb Duplex ultrasound. The mean age of the patients was 60.3 years, with ages ranging from 26 to 80 years. The majority of the patients were male (255, 72.9%), while 95 patients (27.1%) were female. Table-1 summarizes the demographic and clinical characteristics of the study population.

Table-1: Demographic and clinical characteristics of patients (n = 350)

Variable	n (%)
Gender	
Male	255 (72.9)
Female	95 (27.1)
Site of pain	
Foot	251 (71.7)
Thigh	57 (16.3)
Hip	42 (12.0)
Risk factors	
Diabetes mellitus	170 (48.6)
Hypertension	88 (25.1)
Smoking	70 (20.0)
Hyperlipidemia	69 (19.7)
Chronic kidney disease	2 (0.6)
LEAD status	
LEAD diagnosed	217 (62.0)
No LEAD	133 (38.0)

The most common site of pain was the foot, reported by 251 patients (71.7%), followed by the thigh in 57 patients (16.3%), and the hip in 42 patients (12.0%) (Figure 2).

Pain while walking was reported by 173 patients (49.4%), whereas 177 patients (50.6%) did not experience pain while walking. Pain at rest was present in 181 patients (51.7%) and absent in 169 patients (48.3%). The distribution of sites of pain among the patients are described in Figure-2 below.

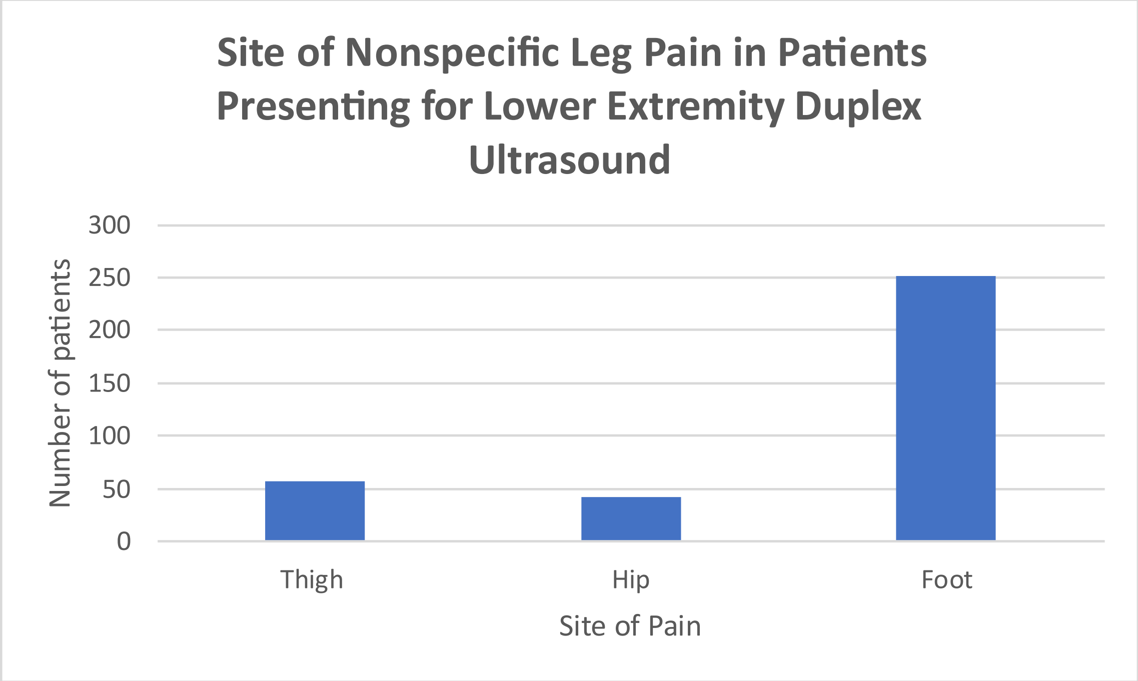

Figure-2: Site of Nonspecific Leg Pain in Patients Presenting for Lower Extremity Duplex Ultrasound (n=350)

Regarding risk factors, 170 patients (48.6%) had diabetes mellitus, and 180 patients (51.4%) did not have diabetes mellitus. Hypertension was present in 88 patients (25.1%) and absent in 262 patients (74.9%). Cigarette smoking was reported by 70 patients (20.0%), while 280 patients (80.0%) were non-smokers. Hyperlipidemia was present in 69 patients (19.7%) and absent in 281 patients (80.3%) as shown in Figure-3.

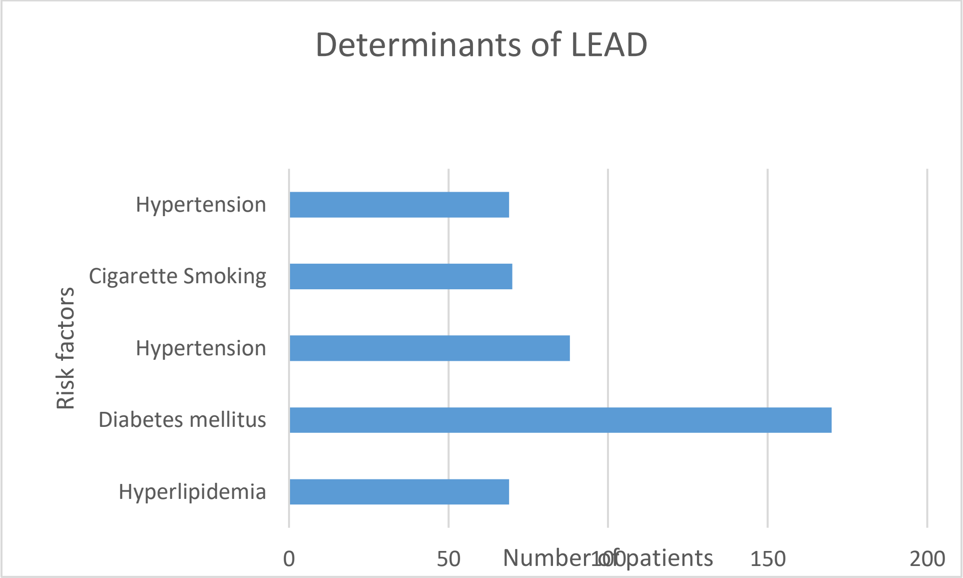

Figure-3: LEAD Determinants (n=350)

Lower extremity arterial disease (LEAD) was diagnosed in 217 patients (62.0%), while 133 patients (38.0%) did not have LEAD. In terms of comorbid conditions, 127 patients (36.3%) had diabetes mellitus, 85 patients (24.3%) had no comorbid conditions, 52 patients (14.9%) had hyperlipidemia, 50 patients (14.3%) were cigarette smokers, 34 patients (9.7%) had hypertension, and 2 patients (0.6%) had chronic kidney disease. Additionally, 132 patients (37.7%) had more than two comorbid conditions, whereas 218 patients (62.3%) had two or fewer comorbid conditions. This is also illustrated in Figure-4 below.

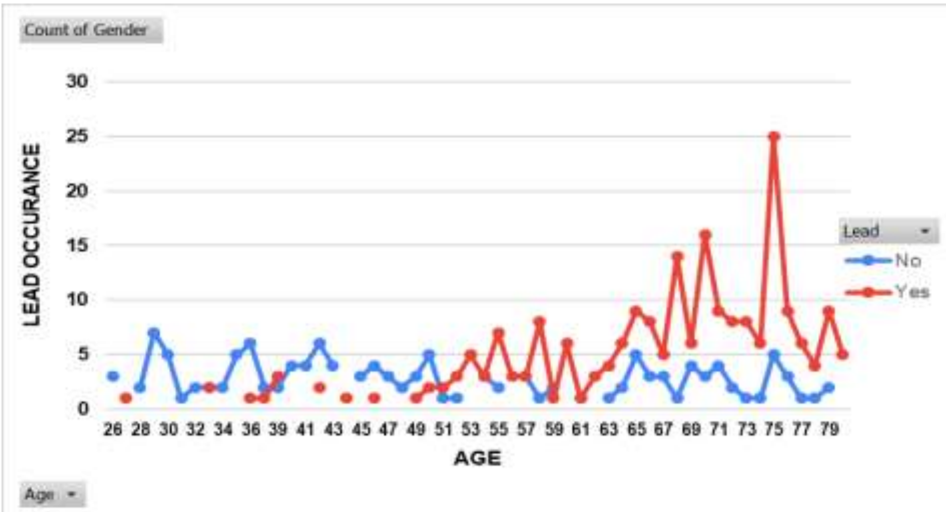

Figure-4: Age and LEAD occurrence (n=350)

DISCUSSION:

This study found a high prevalence of lower extremity arterial disease (LEAD) of 62% among patients presenting with nonspecific leg pain. This proportion is substantially higher than the 31.6% reported in Pakistani type 2 diabetics screened using ankle–brachial index (ABI), and also exceeds prevalence estimates from population-based studies in South Asia, which range between 20–32%. [3, 6, 10] The higher prevalence in our cohort may reflect the use of duplex ultrasonography (DUS), which is more sensitive than ABI, particularly in patients with medial arterial calcification. [7, 11] Furthermore, the study population consisted of symptomatic individuals referred for vascular evaluation, rather than a general community sample, which is likely to yield higher detection rates.

Male predominance (72.9%) in our sample is consistent with global trends where higher exposure to modifiable risk factors such as smoking and dyslipidemia contributes to greater disease burden in men. [1, 3, 10] The mean age of 60.3 years aligns with findings from large international studies showing increased LEAD prevalence after the fifth decade of life. [1, 3, 10]

Diabetes mellitus emerged as the most frequent determinant (48.6%), followed by hypertension (25.1%), smoking (20.0%), and hyperlipidemia (19.7%). This pattern mirrors previous research demonstrating the strong association between LEAD and metabolic as well as lifestyle risk factors. [12,13] Our finding that 87.5% of diabetic patients had LEAD is comparable to the 93% detection rate by Doppler waveform analysis in a Maltese cohort and supports evidence that diabetes increases LEAD risk two- to four-fold. [8, 13] The relatively lower prevalence of smoking in our sample compared with Western populations may reflect cultural and regional differences in tobacco use, though underreporting cannot be ruled out.

The use of DUS in this study allowed for detection of both anatomical and hemodynamic abnormalities, including spectral waveform changes and plaque morphology, which improves diagnostic accuracy over ABI alone.[7, 9, 14] This is consistent with findings by Miossec et al., who reported that arterial Doppler waveform characteristics are independently associated with functional limitation in suspected PAD.[15] Agreement between clinical tests and DUS has also been documented, supporting the validity of our diagnostic approach.[16] While ABI remains a useful screening tool, its limitations in calcified vessels which are common in diabetics and chronic kidney disease patients, make DUS to be a valuable tool in high-risk groups.[7, 11, 14, 17]
Other diagnostic modalities, such as the toe–brachial index and toe systolic blood pressure, have been shown to be effective in PAD detection, particularly when ABI is unreliable.[18] However, their availability in routine practice is limited compared to DUS, especially in low-resource settings.
Our analysis also showed that over one-third (37.7%) of patients had more than two comorbid conditions, highlighting the multifactorial nature of LEAD. This clustering of cardiovascular risk factors is well-documented in the literature and underlines the need for integrated vascular risk assessment in clinical practice.[1, 3, 12]
Overall, our findings emphasize that LEAD is a common yet underrecognized cause of nonspecific leg pain in the Pakistani tertiary care setting. Routine vascular assessment, particularly using DUS in high-risk individuals, can facilitate earlier diagnosis and targeted risk factor modification. Given the high prevalence and significant overlap with other cardiovascular risk conditions, integrating LEAD screening into standard care pathways may improve patient outcomes and reduce the burden of advanced disease

LIMITATIONS:
The study has several limitations. First, the cross-sectional design does not allow us to infer causal relationships between determinants and LEAD. Secondly convenience sampling may introduce selection bias and limit the generalizability of the findings. Third - although DUS is highly sensitive and specific, its diagnostic accuracy may be influenced by operator expertise and image quality, particularly in patients with significant limb swelling or advanced disease.

CONCLUSION:
In conclusion, our study highlights a high prevalence of LEAD in patients with nonspecific leg pain, particularly among older males with diabetes.

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Authors' Contribution: Following authors have made substantial contributions to the manuscript as under:
AAA & ND: Conception, study design, drafting the manuscript, approval of the final version to be published.
UZ & HN: Data acquisition, data analysis, data interpretation, critical review, approval of the final version to be published.
TA& JA: 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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