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Original Research Article

Assessment of Peripheral Vascular Disease Among Diabetic Foot Ulcer Cases: A Hospital-Based Retrospective Analysis

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Abstract:

Background: Diabetes mellitus is a global epidemic, with India having one of the highest diabetic populations worldwide. Diabetic foot ulcers (DFUs) are a common and serious complication, often associated with peripheral vascular disease (PVD), which significantly impacts patient morbidity and risk of amputation.

Aim: This study aimed to assess the incidence and characteristics of peripheral vascular disease among patients presenting with diabetic foot ulcers in a tertiary care hospital.

Methodology: A retrospective observational study was conducted at AIIMS Patna, including 120 patients aged ≥18 years with diabetic foot ulcers (Wagner Grades I–IV). Patient records were reviewed for demographic, clinical, and vascular assessment data, including Doppler ultrasonography and Ankle-Brachial Pressure Index (ABPI).

Results: The majority of patients were males (60%) aged 51–80 years (85.8%). Common presenting symptoms included abscess (36%), swelling (35%), and gangrene (29%). PVD was diagnosed by ultrasound in 26.7% of cases. ABPI values indicated that 24% of patients had arterial insufficiency (ABPI <0.8), while most had normal or elevated ABPI. Smoking was prevalent only among males, while tobacco use was more common among females. The duration of diabetes was predominantly 10–20 years in nearly half of the patients.

Conclusion: Peripheral vascular disease is a significant complication in diabetic foot ulcer patients, especially among older males with long-standing diabetes. Routine vascular assessment using ultrasound and ABPI is critical for early detection of PVD, enabling timely interventions to reduce severe complications and improve patient outcomes.

Keywords: Ankle-Brachial Pressure Index, Doppler Ultrasound, Diabetes Mellitus, Diabetic Foot Ulcer, Peripheral Vascular Disease, Vascular Assessment.

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Introduction

Diabetes is considered a "global epidemic" and 500 million people, or approximately 1 in every 11 people, suffer from this disease. According to the International Diabetes Federation (IDF), 74 million people in India have diabetes — the largest number of people living with disabilities of any country in the world, and second only to China which has an estimated 121 million diabetic patients. The rise in prevalence of the disease poses a public health challenge in particular because it often presents a plethora of debilitating complications. One of the most common and debilitating complications among diabetic patients, is the development of foot ulcers which severely diminish their quality of life as well as longer hospital stays [2].

The term "diabetic foot" is broadly applied to any foot pathology that is caused directly by diabetes or its complications, for example neuropathy, peripheral vascular disease, or metabolic disturbances. Foot related complications in people with diabetes represent an important global cause of morbidity and healthcare burden. The WHO considers the diabetic foot as an entity with a high risk of infection, ulceration, deep tissue loss, and is usually associated with neurological conditions like peripheral neuropathy and diagnoses of reduced circulation from peripheral arterial disease or systemic metabolic conditions. These pathophysiological changes impair the body's normal healing capacities, complicating the treatment of diabetic foot ulcers and also potentially leading to significant consequences like amputation. This information underscores the importance of early detection, proper management and education to prevent diabetic foot complications and improve prognoses for patients with diabetes [3].

Peripheral artery disease (PAD) is one of the significant etiological contributors to diabetic foot, which is even more common in patients with diabetes, with close to half of those with diabetic foot ulcers having concomitant peripheral artery disease. The prevalence of foot ulcers in hospitalized patient with diabetes is 4 to 10%. The Global Lower Extremity Amputation Study Group have estimated that between 14 and 24% of those with DFU may require an amputation48. Some recent studies have found that the risk of developing a foot ulcer in diabetic patients is approximately 25% during their lifespan [4]. The risk factors for developing DFU include: male gender, diabetes for > 10 years, peripheral neuropathy, structural changes in the foot (bones, callouses, thicking of nails), peripheral arterial disease and smoking, previous history of ulcers or amputation, and poor glycemic control.

Peripheral artery disease is described as clinical condition wherein there is stenosis or occlusion of arteries in the lower limbs. Atherosclerosis is the most common cause of peripheral artery disease in individuals over age 40. Diabetics have a two to four times higher prevalence of PAD than non-diabetics. Peripheral artery disease is a significant predictor of foot ulceration in diabetics [5]. The physician caring for a diabetic patient or foot ulcer should be able to assess the vascular status of the lower limbs and specifically assess for ischemic symptoms because nearly 50% of these patients have PAD [6,7]. Nevertheless, recognition of PAD and assessing the severity of disease in diabetic patients developing foot ulcers is a clinical challenge due to altered PAD symptoms and limitations on diagnostic tests. In this study we describe the Assessment of Peripheral Vascular Disease in Diabetic Foot Ulcer Cases: A Hospital-Based Retrospective Study.

Methodology

Study Design: This is a retrospective, observational, single-centre study conducted to assess the incidence of peripheral vascular disease (PVD) in patients with diabetic foot ulcers.

Study Area: The study was carried out in the Department of General Surgery, All India Institute of Medical Sciences (AIIMS), Patna, Bihar, India for one year

Inclusion and Exclusion Criteria

Inclusion Criteria

- Patients aged 18 years and above.
- Patients of either gender.
- Patients diagnosed with diabetic foot ulcers (Grades I–IV based on Wagner's classification).
- Patients whose medical records included vascular assessment data (e.g., Doppler ultrasound or angiographic findings).

Exclusion Criteria:

- Patients below 18 years of age.
- Patients with incomplete or missing data related to vascular evaluation.
- Patients with a known history of peripheral vascular surgeries.
- Patients with foot ulcers due to trauma or non-diabetic causes.
- Patients with concurrent life-threatening infections or systemic illnesses.

Sample Size: A total of 120 patients who met the inclusion criteria were selected for the study.

Procedure: Patient data were obtained from the hospital's medical records section, specifically from the archives of the Department of General Surgery. Case files of patients admitted with diabetic foot ulcers were thoroughly reviewed by the research team using a predesigned data extraction form. The files were examined for demographic details (age, gender, occupation, and residence), type of diabetes (Type 1 or Type 2), duration since diagnosis, treatment modality (oral hypoglycemics, insulin, or both), and history of glycemic control (recent HbA1c levels, if available). Clinical parameters such as the grade of foot ulcer (as per Wagner's classification), laterality, presence of infection, and history of previous ulceration or amputation were noted. Comorbidities including hypertension, dyslipidemia, nephropathy, neuropathy, and cardiovascular diseases were also recorded. Special attention was given to vascular assessments. Reports of investigations such as Ankle-Brachial Index (ABI), color Doppler ultrasonography of the lower limbs, and digital subtraction angiography were reviewed to evaluate arterial flow and detect peripheral vascular occlusions. Any documentation of vascular surgical or interventional radiological procedures was also noted to confirm the presence of PVD.

Statistical Analysis: The collected data were compiled in Microsoft Excel and analyzed using SPSS version 27.0. Descriptive statistics such as frequencies, percentages, means, and standard deviations were calculated for baseline characteristics. The incidence of PVD was determined, and associations with clinical parameters (e.g., age, gender, diabetes duration, ulcer grade) were examined using the Chi-square test and logistic regression. A p-value of <0.05 was considered statistically significant.

Result

Table 1 shows the age distribution and sex of the study population. The majority of participants were between 51 and 80 years old, with 30.83% in the 51–60 age group, 30% in the 61–70 group, and 25% in the 71–80 group, together making up 85.83% of the total. Younger age groups were much smaller in number, with only 0.83% aged 30 or below. Regarding sex distribution, males constituted 60% of the

population, while females accounted for 40%. This indicates a predominance of older adults and a higher proportion of male participants in the study.

Table 1: Age Distribution and Sex			
Category	**Subcategory**	**N**	**Percentage (%)**
Age Group (Years)	≤ 30	1	0.83%
	31 – 40	5	4.17%
	41 – 50	11	9.17%
	51 – 60	37	30.83%
	61 – 70	36	30.00%
	71 – 80	30	25.00%
Sex	Male	72	60%
	Female	48	40%

Table 2 presents the distribution of presenting symptoms among 120 patients, showing that abscess was the most common symptom, occurring in 36% of cases. Swelling was reported in 35% of patients, making it nearly as frequent as abscess. Gangrene was observed in 29% of the patients, representing the least common symptom among the three listed but still a significant proportion. These findings highlight that abscess and swelling are the predominant clinical presentations, with gangrene also affecting a notable portion of the patient group.

Table 2: Presenting symptoms		
Presenting Symptoms	**N (=120)**	**Percentage (%)**
Swelling	42	35%
Abscess	43	36%
Gangrene	35	29%

Table 3 presents the distribution of participants based on their years living with diabetes and their addiction profile among a sample size of 120. The majority of individuals (46.7%) have had diabetes for 10 to 20 years, followed by 30.8% with 0 to 10 years, and 22.5% with 20 to 30 years of diabetes duration. Regarding addiction habits, smoking is reported exclusively among males, with 55 male participants identified as smokers, while no females reported smoking. Tobacco use, however, is more common among females (40) compared to males (25), indicating a gender difference in addiction types within this diabetic population.

Table 3: Years with Diabetes and Addiction Profile (N = 120)		
Years with Diabetes	**N (=120)**	**Percentage (%)**
0 – 10	37	30.80%
10 – 20	56	46.70%
20 – 30	27	22.50%
Addiction	**Male**	**Female**
Smoking	55	0
Tobacco	25	40

Table 4 presents the ultrasound findings and diagnosis of peripheral vascular disease among 120 patients. According to the data, 32 patients, accounting for 26.7% of the sample, were diagnosed with the presence of peripheral vascular disease based on ultrasound examination. In contrast, the majority of patients, 88 individuals or 73.3%, showed no evidence of peripheral vascular disease on ultrasound. This indicates that about one-fourth of the studied population had vascular complications detectable by ultrasound, while the remaining three-fourths did not exhibit such signs.

Table 4: USG findings and diagnosis		
Ultrasound Diagnosis	**N (=120)**	**Percentage (%)**
Presence of Peripheral Vascular Disease	32	26.70%
Absence of Peripheral Vascular Disease	88	73.30%

Table 5 shows the distribution of the Ankle-Brachial Pressure Index (ABPI) among 120 subjects. The majority of individuals, 44.17%, had an ABPI greater than 1, indicating normal or possibly elevated arterial pressure. About 31.67% fell within the range of 0.8 to 1, which is generally considered normal. Smaller proportions were observed in the lower ABPI ranges: 15% had values between 0.5 and 0.8, and 9.17% had values between 0 and 0.5, suggesting varying degrees of peripheral arterial disease or arterial insufficiency in these groups. Overall, the data reflect that most participants have normal or above-normal ABPI readings, while a smaller segment shows potential arterial compromise.

Table 5: Distribution of Ankle-Brachial Pressure Index (ABPI)

ABPI Range	N (=120)	Percentage (%)
0 – 0.5	11	9.17%
0.5 – 0.8	18	15.00%
0.8 – 1	38	31.67%
> 1	53	44.17%

Discussion

The present study highlights key demographic, clinical, and diagnostic characteristics of patients with diabetic complications, emphasizing the predominance of older adults and male participants. The majority of the study population was aged between 51 and 80 years, consistent with the known higher prevalence of diabetes-related complications in this age group due to the cumulative effects of long-term disease and age-related vascular changes. The male predominance (60%) may reflect gender differences in diabetes prevalence, health-seeking behavior, or exposure to risk factors such as smoking, which was exclusively reported among male participants in this cohort. The prevalence of peripheral vascular disease (PVD) in patients with diabetic foot ulcers (DFU) in India was recently documented at approximately 30% prevalence among its subjects. This prevalence is higher than previous studies and shows a trend of increased prevalence in the region as a whole. The study in North India showed that neuropathic ulcers (NPU) are more prevalent than neuroischemic ulcers (NIU), with the presence of NIU being reported in 30%, and NPU in 70% of patients studied [8].

Clinically, abscesses and swelling were the most common presenting symptoms, reported in 36% and 35% of patients respectively, followed by gangrene in nearly one-third of cases. This symptom distribution underscores the severe soft tissue and vascular compromise often encountered in diabetic foot patients. The relatively high frequency of gangrene signals the advanced disease stage in a considerable proportion, emphasizing the need for timely diagnosis and intervention to prevent limb loss. In our department, our PAD group had 97 cases (56.4%) of endovascular revascularization, and 38 (22.1%) cases of bypass procedures. The other group did not have any revascularization procedures since ischemia was not involved in their disease development" [9].

The duration of diabetes was notably extended in this population, with nearly half of the patients living with the condition for 10 to 20 years. Prolonged diabetes duration is a well-established risk factor for microvascular and macrovascular complications, which aligns with the observed prevalence of peripheral vascular disease (PVD) in 26.7% of patients. This finding, supported by ultrasound diagnosis, confirms that a substantial subset of diabetic patients suffer from vascular insufficiency, a critical factor contributing to poor wound healing and ulcer progression. Recent studies investigating community-based studies for global prevalence and risk factors for PAD indicate that lossmoking was the most important risk for PAD, followed by DM, hypertension, and hypercholesterolemia in that order. In examining the National Health and Nutrition Examination Survey, smoking and DM were also the most significant risk factors for PAD, with odds ratios of 4.5 and 2.7 for smoking and DM respectively [10].

Ankle-Brachial Pressure Index (ABPI) measurements revealed that over 75% of participants had values within or above the normal range (>0.8), indicating preserved or elevated arterial pressures in most cases. However, about 24% exhibited ABPI values suggestive of varying degrees of arterial insufficiency, highlighting the heterogeneity of vascular status in diabetic individuals. These results suggest that while many patients maintain adequate peripheral perfusion, a significant minority are at risk of ischemic complications, necessitating careful vascular assessment and management. In a supplant study based tertiary setting in Eastern India, Peripheral Arterial Disease (ABPI<.09) was diagnosed in 141 (34.4%) patients. Peripheral Arterial Disease developed in in 46 percent of foot ulceration subjects compared with 32.7 percent of non-foot ulceration subjects [11, 12]. Additionally, the addiction profile illustrated gender-specific patterns, with smoking confined to males and tobacco use more common in females. Such differences might influence vascular health and disease progression, warranting targeted counseling and cessation interventions.

The study underscores the importance of comprehensive clinical and vascular evaluation in older diabetic patients, particularly males with long-standing disease, to identify those at higher risk of complications such as PVD. Early recognition of symptoms like abscess and swelling, along with vascular assessment through ultrasound and ABPI, can guide timely management to improve outcomes and prevent severe complications including gangrene.

Conclusion

The present study suggests that peripheral vascular disease is a frequent complication among individuals with diabetic foot ulcers and it is seen in approximately 1 in 4 of the sample population. The predominance of older elderly males with long-standing diabetes identified key at-risk groups with vascular insufficiency. The range of clinical presentations included abscess, swelling, and gangrene indicating that the degree of tissue and vascular compromise experienced by patients varies considerably. Although, most participants had normal or elevated Ankle-Brachial Pressure Index (ABPI) values, nearly 24% showed signs of arterial insufficiency, highlighting the degree of variation in the vascular status of diabetic individuals presenting with diabetic foot ulceration. Also, the different addiction profiles in males (smoking) and females (tobacco use) for females signify that these behaviours can further challenge vascular status and disease effects. Therefore, the findings highlighted the significant need for robust vascular assessment for diabetic foot ulcer patients ideally comprising ultrasound and ABPI in order to facilitate early intervening of compromised vascular integrity. If vascular insufficiency is identified and managed promptly, peripheral circulation can improve and reduce the potential of limb-threatening complications thereby providing better patient outcomes.

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