Diabetic Foot Ulcer and its Associated Risk Factors in Diabetic Patients with Peripheral Arterial Disease Presenting in the University Hospital of Nepal

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ABSTRACT

Background

Diabetic foot ulcers (DFUs) are a common complication in diabetic patients especially in those with peripheral arterial disease (PAD). However, it can be prevented if its risk factors can be identified and adjusted.

Objective

To investigate the frequency of diabetic foot ulcers and their associated risk factors in diabetic patients with peripheral artery disease.

Method

Diabetic patients under medication with known peripheral arterial disease diagnosed with Doppler ultrasonography were recruited from the outpatient department of the cardiothoracic and vascular unit, at Dhulikhel Hospital. The patients were interviewed about their demographic details, presenting clinical symptoms, and the risk factors such as smoking, hypertension, cardiovascular diseases, duration of diabetes, and hyperlipidemia. Also, the patients were assessed for any ulcers in their feet. Descriptive statistics and chi-square tests were used to analyze the data.

Result

The analysis demonstrated diabetic foot ulcers in 24.1% of the total 54 diabetic patients with peripheral arterial disease. The risk factors such as smoking (24.1%), increasing age (68.5%), hypertension (31.5%), and duration of diabetes (72.2%) were found in the majority of the patients. Out of these risk factors, smoking (Odds ratio: 6.81) and increasing age (Odds ratio: 0.28) were significantly associated with diabetic foot ulcers. ($p < 0.05$)

Conclusion

Diabetic foot ulcers affected about a quarter of diabetic patients with peripheral arterial disease and were found to be associated with increasing age and smoking.

KEY WORDS

Complication, Diabetes, Foot ulcers, Peripheral arterial disease, Risk factors

INTRODUCTION

Five hundred and thirty-seven million people globally are living with diabetes mellitus (DM), of which 3 in 4 adults are from low and middle-income countries (LMICs).[1] DM results in numerous complications imposing significant physical, mental, and financial burdens. Diabetic foot ulcers (DFUs) are one of the avoidable ones, the risk of which is estimated between 19-34% in DM attributed to peripheral neuropathy and peripheral arterial disease (PAD).[2]

PAD is typically presented as pain, intermittent claudication, and ischemia due to reduced perfusion to extremities.[3] Individuals with DM having PAD are 4 times more likely to have DFUs.[4] However, the symptoms of PAD are masked in DM due to peripheral neuropathy which when deteriorated may lead to amputation.[5] In fact, non-healing ulcers in DM secondary to PAD are the leading reason for non-trauma-related amputation worldwide causing enormous functional disability.[6] Hence, it may be beneficial to identify the risk factors for PAD early in DM and modify them to preclude the occurrence of DFUs.

The major risk factors of PAD comprise increasing age, smoking, hypertension, cardiovascular diseases, and DM, which are increasing dramatically worldwide so as in Nepal.[7,8] A study done in Nepal found a noteworthy association of these variables with diabetes, however, with its debilitating consequence DFUs is still unknown.[9] While other studies conducted in Nigeria and India demonstrated a correlation with DFUs.[10,11] Thus, in this study we aim to assess frequency of DFUs and their associated risk factors in diabetic patients with PAD.

METHODS

This study used a cross-sectional design and was ethically approved by the institutional review committee, at Kathmandu University. All patients diagnosed with PAD who are known diabetic under medication with or without neuropathic symptoms seen in vascular OPD of Dhulikhel Hospital from January 1st, 2021 to June 30th, 2021 were asked for their written consent for inclusion in this study. Patients were excluded if they have foot ulcers but are non-diabetic and/or if they are unwilling to participate. PAD was confirmed by the clinical findings and Doppler ultrasonography using Jagger's criteria. Clinical findings included the presence of pain, pallor, pulselessness, and claudication. Based on Jager's criteria, Grade III and IV stenosis represented PAD.

Proforma was created that included questions related to demographics, DM, smoking history, presence of any cardiovascular diseases, hypertension, and hyperlipidemia. The patients were then assessed for Diabetic foot ulcers. The foot was inspected for any ulcers in the pressure points that indicated diabetic foot ulcers. All the information was recorded and analyzed using Statistical Package for Social Sciences, version 23. A p-value less than 0.05 was considered for statistical significance.

RESULTS

A total of 54 diabetic patients with peripheral arterial disease (PAD) were included in this study. Of them, 28 were male (51.9%) and 26 (48.1%) were female. The mean age of the patient was 56.2 years (SD 13.4 years, Range 23-87 years).

In diabetic patients with PAD, pain (83.3%), pallor (31.5%), and claudication (46.3%) were the commonly reported symptoms. Most of the patients were diabetic for more than 3 years (72.2%). Out of 6 risk factors, smoking (24.1%), hypertension (31.5%), and increasing age (68.5%) were the major ones and 24.1% of the total patients had foot ulcers (Table 1).

Table 1. Demographics, clinical characteristics, risk factors, and prevalence of diabetic foot ulcers in diabetic patients with PAD

Characteristics	Total n = 54 Mean (SD) or n (%)
Age	56.2 (13.4)
Gender	
Male	28 (51.9)
Female	26 (48.1)
Clinical findings	
Pain	45 (83.3%)
Pallor	17 (31.5%)
Pulselessness	5 (9.3%)
Current claudication	25 (46.3%)
Presence of risk factors	
Age > 50	37 (68.5%)
Smoking	13 (24.1%)
Hypertension	17 (31.5%)
Cardiovascular diseases (MI or stroke)	4 (7.4%)
Hyperlipidemia	4 (7.4%)
DM duration > 3 years	39 (72.2%)
Diabetic foot ulcer	13 (24.1%)

With regard to the associated risk factors of DFUs, smoking and increasing age were significantly associated with DFUs with an odds ratio of 6.81 and 0.28 respectively ($p < 0.05$) (Table 2).

DISCUSSION

DFUs are the major complication of DM. In our study, 24.1% of diabetic patients suffered from DFUs. A systematic review and meta-analysis by Zhang et al. reported a lower prevalence of 5.5% in Asia, 5.1% in Europe, 7.2% in Africa, and 13% in the United States.[12] However, a single-center

Table 2. Associated risk factors for Diabetic foot ulcers secondary to PAD

Risk Factors	Diabetic foot ulcers		*P*-value	Odds ratio (95% confidence interval)
	Yes	No		
Age*				
Age < 50	7	10	0.046	0.28 (0.08-1.02)
Age > 50	6	31		
Smoking*				
Yes	7	6	0.004	6.81 (1.69-27.39)
No	6	35		
Hypertension				
Yes	3	14	0.454	0.58 (0.14-2.45)
No	10	27		
Cardiovascular diseases (MI or Stroke)				
Yes	1	3	0.964	1.06 (0.10 0.090-11.12)
No	12	38		
Hyperlipidemia				
Yes	1	3	0.964	1.06 (0.10-11.12)
No	12	38		
DM duration				
< 3 years	6	9	0.090	0.328 (0.09-2.23)
> 3 years	7	32		

study like our study done in Nigeria and India found a high prevalence of 62.2% and 30% respectively.[10,11]

DFUs in DM may result in limb-threatening complications negatively affecting diabetic patients' quality of life.6 Nonetheless, DFUs are preventable by changing the risk factors associated with them.[13] Studies showed diabetic patients with PAD tend to be at higher risk for DFUs.[2,4] In this study, we included diabetic patients with PAD diagnosed using gold-standard Doppler ultrasonography and presenting clinical symptoms.[14] As shown in numerous studies, common symptoms patients presented in our study consisted of pain, pallor, and claudication due to inadequate blood supply to extremities.[3,10]

The major risk factors present in diabetic patients with PAD in this study were increasing age, smoking, hypertension, and duration of diabetes greater than 3 years. Consistent with our study, a recent Lancet study demonstrated increased odds of having PAD in those with the risk factors mentioned above.[7] Furthermore, a study done in Nigeria also showed similar results.[15]

In terms of the relationship between these risk factors and DFUs, there was a significant association between DFUs and smoking and increasing age. Numerous studies are in support of this finding.[11,12,16-18] Smoking has been found to diminish vasodilation and stimulate the adrenergic system constricting the vessels that impede the already decreased blood flow in diabetes.[19] Further, it has a negative effect on wound healing due to impaired angiogenesis increasing the risk of amputation.[19] Likewise, with aging there is a progressive atherosclerotic narrowing of the blood vessels raising the probability of DFUs.[16]

In this study, there was no association of DFUs with other risk factors such as hypertension, hyperlipidemia, cardiovascular diseases (MI or stroke), and duration of diabetes although demonstrated by various literature.[12,18,20] No association with hypertension could be because all the hypertensive participants were under anti-hypertensive medication with controlled blood pressure which could have lessened the probability of having DFUs. Furthermore, with regard to cardiovascular diseases and hyperlipidemia, very few numbers of participants in this group might have not been sufficient to show a statistically significant association. While in the case of duration of diabetes despite no statistical significance, a trend was observed.

The results of our study are confined to a University Hospital of Nepal thus limiting its generalizability. Future studies may explore other factors such as peripheral neuropathy and foot self-care practice and knowledge in an adequate sample size which are of importance, particularly in diabetic foot ulcers.

CONCLUSION

Diabetic foot ulcers affected one-fourth of diabetic patients with peripheral artery disease with an increased likelihood in older people and smokers. Smoking cessation may be helpful in preventing DFUs in diabetic patients with PAD.

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