

# Prevalence of Peripheral Vascular Disease in Diabetic Foot Infections and its Effect on Management Outcome

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## Summary:

**Background:** Foot infection is a common problem affecting diabetics. Ischemia is a major factor contributing to progress and morbidity of the disease. The prevalence of peripheral vascular disease is higher in diabetics with faster progression.

**Aim:** This study aimed to observe the prevalence of peripheral vascular disease in patients with diabetic foot infections presenting to this tertiary care centre.

**Methods:** This prospective observational study evaluated 250 patients with diabetic foot infection admitted to Ibrahim Medical College and BIRDEM General Hospital, Dhaka, from 1<sup>st</sup> January 2015 to 31<sup>st</sup> December 2015. Total 72 patients were selected for Duplex study of lower limb vessels, Ankle Brachial Pressure Index (ABPI) and Pulse oxymetry which established the diagnosis of peripheral vascular disease and all patients were treated according to the standard protocol.

**Results:** Of the 72 patients peripheral vascular disease was found in 25 patients (34.7%) and majority of them (88%) had distal below the knee vessel stenosis. There was significant correlation with older age (75%) and history of

tobacco use (64%). The clinical presentations and outcomes such as hospital stay, healing time, pain were worse in individuals with peripheral vascular compromise on Duplex study of lower limb vessels, ABPI and pulse oxymetry.

**Conclusion:** In this study we observed that significant number of diabetics presenting with foot infections have underlying peripheral vascular disease. The patients might not all be symptomatic or show obvious signs of PVD but need to be investigated for the same. Early detection of peripheral vascular disease in patients presenting with diabetic foot infection, using Duplex study, ABPI and Pulse oxymetry with routine clinical and laboratory assessment can be of great value in long term care of these individuals.

**Keywords:** Peripheral vascular disease, Diabetic foot, Duplex study, Ankle Brachial Pressure Index (ABPI), Pulse oxymetry.

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## Introduction:

The management of Diabetic foot infection is the commonest cause of hospital admission for diabetic patients. More than 50% of lower extremity amputations occur in diabetics (1). On average, diabetic patients with

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lower extremity infections are found to be in their fifth decade, have had diabetes for average of 18 years and more often on insulin for glycaemia control. The average hospital stay for a diabetic with foot infections in the United States was found to be about a month with high cost to the individual and the society<sup>2</sup>.

Ischemia and neuropathy are two major predisposing factors for the development of diabetic foot infections<sup>3</sup>. The development of peripheral vascular disease (PVD) has been documented in more than 50% of diabetics having disease for 10 to 15 years in some studies<sup>4</sup>. The prevalence found to be 22% with weak or absent ankle pulses in 13% of subjects. Not only is atherosclerotic disease manifest at an earlier age in diabetics, but it tends to involve distal and smaller vessels<sup>5</sup>. Multi segmental occlusive pattern occurs more commonly below the popliteal region in diabetics than in age matched controls, the metatarsal arteries are occluded in up to 60% of diabetics.

In the presence of impaired blood supply or sensation,

minor trauma to the foot can result in serious foot infection. Lack of attention to foot hygiene and use of poorly fitting foot wear are major preventable factors in the development of infection (6). Diabetic foot infections range from local fungal infections of nail to severe necrotizing limb or life threatening infections.

There is a need for systematic evaluation of PVD in all diabetic patients especially presenting with diabetic foot infections, the information can help in formulating protocols for effective management of diabetic foot with the aim of limiting the morbidity and social costs associated with the disease

Diabetes is rising in developing countries like Bangladesh with high incidence in the developed world. Diabetic foot infections are one of the most common manifestations of the disease necessitating hospital admissions. More Than 50% of lower extremity amputations occur in diabetics, In addition to neuropathy and trophic ulcers, peripheral vascular disease plays a major role in the evolution and outcome of diabetic foot infection. The prevalence of peripheral vascular disease is higher in diabetics, with faster progression (7). The prevalence differs among populations. For these views this prospective study was undertaken to evaluate the prevalence of PVD in diabetic foot infections and to see its effect on management outcome. This study shall help us to provide an idea about the prevalence of peripheral vascular disease in patients with diabetic foot infections and its effect on the management outcome.

#### **Aims and Objectives:**

##### **i) General Objective:**

To study the prevalence of peripheral vascular disease in patients with diabetic foot infections and to see its effect on management outcome

##### **ii) Specific Objectives:**

1. To determine the prevalence of peripheral vascular disease by duplex study of lower limb vessel, ABPI, pulse oxymetry in patients with diabetic foot infection.
2. To study the duration of hospital stay, healing rate and pain assessment among the patients with diabetic foot infection.

#### **Selection Criteria:**

##### **Inclusion criteria:**

Patients with diabetic foot infections aged above 18 years with grade 0 to 3, according to the Wagner grading system for diabetic foot infections.

##### **Exclusion criteria:**

1. Patients with previous history of peripheral arterial disease, previous surgeries for arterial occlusive disease, with necrotizing fasciitis, severe sepsis, previous amputations, ketoacidosis and with severely ill condition or patients with obvious clinical signs of vascular insufficiency as well as ischemia including absent peripheral pulses.
2. Patients below 18 years and above 80 years of age.
3. Patients with Grade 4 & 5 according to the Wagner grading system for diabetic foot infections.

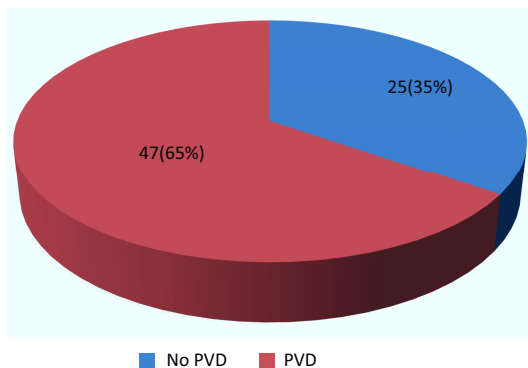
#### **Method:**

This prospective observational study evaluated 250 patients admitted to Ibrahim Medical College and BIRDEM General Hospital, Dhaka after being diagnosed as a case of Type-2 Diabetes with diabetic foot infections. The data collection was done after getting ethical clearance from Ethical review committee of the Diabetic Association of Bangladesh (BADAS) in 2014. Duration of the study was from 1<sup>st</sup> January 2015 to 31<sup>st</sup> December 2015. Among the evaluated patients total 72 patients were selected according to the selection criteria and Duplex study of lower limb vessels, Ankle Brachial Pressure Index (ABPI) and Pulse oxymetry were done which established the diagnosis of peripheral vascular disease. All patients of diabetic foot infection with or without peripheral vascular disease were treated according to the standard protocol. Outcome in patients with PVD in the form of requirement of re-bridement after initial procedure, healing time, assessment of pain and hospital stay were assessed. All the findings were recorded and plotted on the data sheet and level of significance (p value) was set at 0.05. All the collected data were analyzed using SPSS for Windows version 16.0.

#### **Results:**

During 1 years of study period from January 2015 to December 2015 a total of 72 cases of Diabetic foot infections underwent Duplex study of lower limb, ABPI and pulse oxymetry investigations. Of the 72 patients in

the studied population 25 patients (34.7%) were found to have some form of reduced arterial flow to the lower limb and 47 patients (64.3%) patients were found to have a normal lower limb blood flow by Duplex study and ABPI (Fig-1). Age ranges from below 40 and up to 60 years, prevalence increases linearly with 13% patients below 40 age group showing vascular compromise, 22% of patients in their fourth decade, 75% of patients in



**Fig.-1:** Presence of Peripheral vascular disease diagnosed by Duplex study of lower limb and ABPI

their fifth decade (Table-I). Among the 72 patients PVD was present in 19 male patients (out of 50) with a prevalence rate of 38% and 6 female patients (out of 22) with a prevalence rate of 27%. Distal calf vessels were involved in 22 (88%) out of 25 patients (Table-II). Habit of smoking was present in 16 (64%) of PVD patients as compared to only 4 (9%) of normal individuals (Table-III). More than 5 years diabetes was found in 8 (32%) of PVD patients as compared to 9 (19%) of normal individual (Table-IV) and hypertension was present in 16 (64%) patients with PVD. There were 34 patients with Ulcer extended to tendon, bone and capsule or deep ulcer with osteomyelitis and abscess who required some sort of amputation, among them 22 (64%) were found to have PVD. Total 6 (27%) patients with PVD after first procedure had unsatisfactory progress and had to be redebrided (Table-V). The mean duration of healing time for PVD patients was 43.76 days, whereas it was 14.1 days for normal individuals (Table-VI). Severe pain was present in 14 (56%) of PVD patients as compared to only 7 (15%) of normal individuals (Table-VII). The mean duration of hospital stay for PVD patients was 47.92 days, whereas it was 16.19 days for normal individuals (Table-VIII).

**Table-I**

Age distribution of PVD		
Age (Years)	PVD (%)	Number of patients
51 – 60	15 (75%)	20
41-50	8 (22%)	37
Below 40	2 (13%)	15

**Table - II**

Level of arterial stenosis		
Level	Numbers	Percentage (%)
Popliteal artery	3	12
Distal Posterior Tibial Artery	5	20
Distal Anterior Tibial Artery	4	16
Both Tibial Arteries Distal	3	12
Both Tibial Arteries Proximal	10	40
Total	25	100

**Table-III**

Presence of PVD and Smoking				
		PVD		Total
		No	Yes	
Smoking	No	4382.7%	917.3%	52100%
	Yes	420.0%	1680.0%	20100%
	Total	4765.3%	2534.7%	72100%

**Table-IV**

Duration of Diabetes Mellitus and PVD				
		PVD		Total
		No	Yes	
Duration of	< 5 Yrs	3869.1%	1730.9%	55100%
Diabetes	> 5 Yrs	952.9%	847.1%	17100%
Mellitus	Total	4765.3%	2534.7%	72100%

**Table-V**

Outcome in patient with PVD after initial procedure				
		PVD		Total
		No	Yes	
Redebride- ment	No	12100%	1673%	28
	Yes	00%	627%	6
	Total	12100%	22100%	34100%

**Table-VI**

<i>Assessment of healing time</i>					
	PVD	No of patients	Mean	SD	SEM
Duration of Healing time (Days)	PVD	25	43.76	12.34	2.468
	No PVD	47	14.1	6.67	0.967
t test for equality of means					
		t	df	Sig. (2-tailed)	Mean difference
Duration of Healing time	Equal variances assumed	12.263	71	0.000	24.33

**Table-VII**

<i>Assessment of Pain</i>				
		PVD		Total
	No	Yes		
Severity of Pain	No	04100%	0000.0%	04100%
	Mild	2882.35%	0617.64%	34100%
	Moderate	861.53%	538.46%	13100%
	Severe	733.3%	1466.7%	21100%
Total	4765.3%	2534.7%		72100%

**Table-VIII**

<i>Duration of Hospital stay</i>					
	PVD	No of patients	Mean	SD	SEM
Duration of hospital stay (Days)	PVD	25	47.92	12.36	2.471
	No PVD	47	16.19	7.374	1.076
t test for equality of means					
		t	df	Sig. (2-tailed)	Mean difference
Duration of hospital stay	Equal variances assumed	12.942	71	0.000	27.208

**Discussion:**

In this study, we tried to evaluate the prevalence of PVD in diabetic foot infections and to see its effect on management outcome. During the period of study, a total of 250 patients with diabetic foot infections were admitted to the department of general surgery in BIRDEM General Hospital. Of them, however, 95 patients did not meet one or more inclusion/exclusion criteria. 83 patients did not consent for the arterial Duplex study, ABPI or were discharged prior to the fixed date for the study. Thus 72 patients were included in the study. All patients were treated for a foot infection, risk factors, and diabetes. Patients found to have PVD were additionally treated with Tablet Cilostazol and if needed

were referred to a vascular surgeon for further management.

After reviewing the results of the study certain pertinent inferences could be made. The prevalence of PVD was found to be 35% with 25 out of 72 patients showing vascular compromise as diagnosed by an arterial duplex study. These findings are similar to other studies. Faglia E et al (8) study revealed that the prevalence of PVD in diabetic foot infection was 21.1%. Other studies conducted by Rabia K (9) and Muhammad R et al (1) found the prevalence rate was 16% and 58% respectively. The prevalence in males was found to be 38% while in females was 27%. This, however, was not found to be statistically significant owing to a lesser

number of female subjects in the study. Also, the patients in the study were asymptomatic while the rate represents more of subclinical peripheral vascular compromise.

The distal lower limb vessels were found to be more involved with 88% having lesions in the anterior tibial, posterior tibial or both (52%). The occlusion even among these subjects was found to be more distal (48%). Fagila E et al (8) study found that popliteal pulse was absent in 316 (12.3%) and tibia in 563 (22.0%) cases. This correlates with existing literature which shows that distal small arteries are more involved in diabetics (5).

Most of the individuals in this study were in the age group of 41 – 50 years accounting for 51% of subjects. The prevalence of PVD was found to linearly increase with age in patients above 50 years showing a prevalence of 75%. Although this seems higher compared to existing studies it correlates with accepted data that progression with age is significant and indeed faster in diabetics (1, 10, 11). This can also be explained by the fact that age-related atherosclerotic changes independent of diabetic status worsen with advancing age (12). As also seen from this data most patients were diagnosed less than 5 years prior to admission to be diabetics, some with age more than 50 years. The problem of late diagnosis of diabetic status seen in our region could explain the very high prevalence of PVD in older age groups as, by the time, the patients present to a tertiary care center with complications of diabetes and the pathophysiological changes in the foot including vascular compromise is at an advanced level. This also explains why this study could not demonstrate a statistical correlation between the duration of diabetes and the prevalence of peripheral vascular compromise.

A significant association, however, was found with regard to smoking. There were a total of 20 smokers in the study and 16 individuals (80%) among smokers showed the presence of PVD. When this is compared to only 9 out of 52 nonsmokers, the presence of PVD was significant. This correlates with existing data wherein smoking, as an independent factor, is implicated in the etiology of PVD and is also seen to accelerate changes in diabetic individuals (13, 14). In our study hypertension was present in 16 (64%) of the PVD patients (25) compared to only 18 (38%) normal individuals (47). A similar study done by Deribe B et al (15) showed that mean arterial blood pressure greater

than 90 mmHg was associated with a diabetic foot ulcer.

The severity of the diabetic foot infection and its outcomes were also significantly worse in individuals with PVD. In this study, out of the 34 patients with ulcer extended to tendon, bone, capsule or deep ulcer with osteomyelitis and abscess, 22 (64%) required some sort of amputation and were found to have PVD as compared to the other 12. The remaining 38 patients out of 72 had milder infections among which only 3 patients had PVD too. In terms of outcomes, after the initial surgical procedure, the 6 (27%) patients who needed to be re-debrided had a peripheral vascular compromise. None of the patients with normal arterial duplex findings had to go in for a repeat procedure. This again correlates with existing data that suggests that the worse outcomes including limb loss are more in individuals with peripheral vascular disease and diabetes (16-19). The peripheral ischemia contributes to an already unhealthy local environment for healing.

Healing time and duration of hospital stay was found to be higher in PVD patients. Also pain scoring was high in these patients. The mean duration of healing time for PVD patients was 44 days, whereas it was 14 days for Non PVD patients. Severe pain was present in 14 (56%) of PVD patients as compared to only 7 (15%) of normal individuals. Mean duration of hospital stay for PVD patients were 49 days and it was 16 days for Non PVD patients. These findings reflect the findings of study done by Muhammad R et al (1) which revealed that the mean hospital stay for stage I patients was 11 days (5-15 days), for stage II patients 15 days (5-30 days) and for stage III patients 22 days (6-60 days).

#### **Conclusion:**

On the basis of the observations of this study, performing appropriate investigation in the presence of peripheral vascular disease and the need to do it on a routine basis even in apparently asymptomatic individuals can be advocated since this will result in benefit than harm to the patient.

#### **References:**

1. Khammash MR, Obeidat KA. Prevalence of ischemia in diabetic foot infection. *World J Surg.* 2003;27(7):797-9.
2. Bridges JR, Deitch EA. Diabetic foot infections. *Pathophysiology and treatment.* *Surg Clin North Am.* 1994;74(3):537-55.

3. Reiber GE, Vileikyte L, Boyko E, del Aguila M, Smith D, Lavery L, Boulton A. Causal pathways for incident lower extremity ulcers in patients with diabetes from two settings. *Diabetes Care*. 1999;22(1):157-62.
4. Dreyer M. Peripheral artery disease and disorders of microcirculation in patients with diabetes mellitus. *Der Internist*. 2011;52(5):533-8.
5. Got I. Peripheral vascular disease and diabetic foot. *Rev Med Interne*. 2008;29:S249-59.
6. Ikem R, Ikem I, Adebayo O, Soyoye D. An assessment of peripheral vascular disease in patients with diabetic foot ulcer. *The Foot*. 2010;20(4):114-7.
7. Premalatha G, Ravikumar R, Sanjay R, Deepa R, Mohan V. Comparison of colour duplex ultrasound and ankle-brachial pressure index measurements in peripheral vascular disease in type 2 diabetic patients with foot infections. *Japi*. 2002;50:1240-44.
8. Faglia E, Caravaggi C, Marchetti R, Mingardi R, Morabito A, Piaggese A, et al. Screening for peripheral arterial disease by means of the ankle brachial index in newly diagnosed Type 2 diabetic patients. *Diabet Med*. 2005;22(10):1310-4.
9. Rabia K, Khoo EM. Prevalence of peripheral arterial disease in patients with diabetes mellitus in a primary care setting. *Med J Malaysia*. 2007;62(2):130-3.
10. Shaw J, Boulton A. The diabetic foot In: Beard JD, Gaines PA, eds. *Vasc Endovascular Surg*. 2001.
11. Sum C, Lim S, Tavintharan S. Peripheral arterial disease and diabetes foot care. *Singapore Med J*. 2008;49(2):93.
12. Guzman RJ, Bian A, Shintani A, Stein CM. Association of foot ulcer with tibial artery calcification is independent of peripheral occlusive disease in type 2 diabetes. *Diabetes Res Clin Pract*. 2013;99(3):281-6.
13. Apelqvist J, Larsson J. What is the most effective way to reduce incidence of amputation in the diabetic foot? *Diabetes Metab Res Rev*. 2000;16(S1):S75-S83.
14. Sumpio BE, Lee T, Blume PA. Vascular evaluation and arterial reconstruction of the diabetic foot. *Clin Podiatr Med Surg*. 2003;20(4):689-708.
15. Deribe B, Woldemichael K, Namera G. Prevalence and factors influencing diabetic foot ulcer among diabetic patients attending Arbaminch Hospital, South Ethiopia. *J Diabetes Metab*. 2014;5(1):1-7.
16. Prompers L, Huijberts M, Apelqvist J, Jude E, Piaggese A, Bakker K, et al. High prevalence of ischaemia, infection and serious comorbidity in patients with diabetic foot disease in Europe. Baseline results from the Eurodiale study. *Diabetologia*. 2007;50(1):18-25.
17. Schaper N, Andros G, Apelqvist J, Bakker K, Lammer J, Lepantalo M, et al. Diagnosis and treatment of peripheral arterial disease in diabetic patients with a foot ulcer. A progress report of the International Working Group on the Diabetic Foot. *Diabetes Metab Res Rev*. 2012;28:218-24.
18. Jeffcoate WJ, Price P, Harding KG. Wound healing and treatments for people with diabetic foot ulcers. *Diabetes Metab Res Rev*. 2004;20(S1):S78-S89.
19. Viswanathan V. The diabetic foot: perspectives from Chennai, South India. *International wound journal*. 2007;6(1):34-6.