### **Research Article**

# DIABETIC FOOT: A SIMPLE CATEGORIZATION FOR EFFECTIVE MANAGEMENT

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#### ABSTRACT

Diabetic foot is a very common and devastating complication of diabetes mellitus. Morbidity associated with diabetic foot is huge in India. Etiology of diabetic foot is multi-factorial. Diabetic neuropathy, peripheral arterial disease and immune-compromised state are various factors held responsible for diabetic foot. Diabetic foot can be categorized on basis of etiological origin. Differentiation in to different category helps in management as therapeutic approach vary in different category. Differentiation is simple but effect on treatment response is good. We conducted an observational study on 100 patients of diabetic foot accounted for 34 cases, mixed for 32 cases and ischaemic accounted for 14 cases. Infective category represented 20 cases which was surprisingly more than western studies. Categorization helped in identifying etiological factor and management.

Key words: Diabetic foot, Etiology, neuropathic, ischaemic

#### INTRODUCTION

Diabetic foot is very frequent reason for hospitalization in diabetics. According to Shankhdhar et al, 24% of total hospital *admissions* and 35% of total hospital stay in diabetic patients in India are due to diabetic foot.<sup>1</sup>

According to World Health Organization and the international working group on the diabetic foot, "Diabetic foot" is defined as the foot of diabetic patients with ulceration, infection and/or destruction of deep tissues, associated with neurological abnormalities and various degree of peripheral vascular disease in the lower limb.<sup>2</sup>

Diabetic foot can be classified in to following categories:

- 1. **The Neuropathic foot**: In this neuropathy predominates and there is good circulation with palpable peripheral pulses. Foot is warm, numb, dry and usually painless.<sup>3</sup>
- 2. **The ischaemic foot:** In this type, circulation is compromised. Foot is cool and the peripheral pulses are absent.<sup>4</sup>
- 3. Non neuro-ischaemic but purely infective: It is associated with neither significant neuropathy nor ischemia.<sup>5</sup>

4. **Mixed category foot:** It has features of both neuropathic as well as ischaemic with or without infection. <sup>3,4</sup>

Differentiation between these entities is important, because their complications are different & different therapeutic strategies are required. <sup>3, 4</sup> Differentiation requires thorough clinical examination as well as investigations specific to each entity. We conducted a study involving 100 patients and differentiate them in to above mentioned categories. Differentiation allows better management by introducing appropriate therapy.

#### AIMS AND OBJECTIVES

To classify the diabetic foot lesions based on detailed history and precise examination and investigations.

#### MATERIAL AND METHODS

This study has been conducted in department of surgery of Mahatma Gandhi Hospital attached to Dr. S.N. Medical College, Jodhpur on patients of diabetic foot admitted in surgical wards during 3 years. Study was done after obtaining approval of the Institute Ethics Committee, and an informed written consent was taken from all enrolled patients.

#### SELECTION OF CASES

All patients of diabetic foot has been critically examined and thoroughly investigated to classify into one of the following category.

#### (I) Neuropathic Foot

Features suggestive of neuropathic foot on examination:

- A dry foot with fissured skin
- Deformity of foot in form of claw toe, hammer toe and Charcot joint
- Presence of foot edema, callus formation and limitation of joint movement

Before labeling a patient into neuropathic foot, following tests were done.

- (a) **Tuning fork test:** Vibration sensation was tested using a 128 Hz tuning fork over the distal big toe and medial malleous. Patients who felt vibration both initially & after 5 seconds were scored as Normal. Vibration perceived initially but not at 5 second was scored as abnormal and vibration not perceived at all was scored as absent.
- (b) **Cotton Wool Test:** A wisp of cotton was swept lightly at the dorsum of foot/ medial malleolus and sensation was compared with patient's arm. Those who felt the same sensation were scored as Normal. Sensation not perceived was scored abnormal.
- (c) **Pin Prick Sensation:** Tested with a sterile safety pin over the planter aspect of the distal first, third and 5th toe with the stimulus applied once per site. Sensation was scored as sharp, dull or absent for each site.
- (d) **Joint Position Sense:** Assessed at the inter-phalangeal joint of each great toe for a  $10^{\circ}$  change. The toe was held at both sides with one hand while using the other hand to move

the distal phalanx up or down. After demonstrating "this is up, this is down" while moving the toe to that position, three trials for each foot were performed. Response per foot was scored as correct or abnormal.

(e) **Ankle reflexes:** If no reflex was obtained, the attempt was repeated with reinforcement. The reflex was scored as O (absent with reinforcement), 1 (Present but decreased), 2 (Normal), 3 (increased) or 4 (greatly increased with clonus).

(f) Monofilament Sensation: Nylon monofilament tests the threshold to pressure sensation. If the patient does not detect the filament, then protection pain sensation is lost. It was tested with Semmes- Weinstein 5.07 Monofilament at 10 sites per foot. Nine planter sites (Distal great toe, third toe and fifth toe, first, third and fifth metatarsal heads, medial foot, lateral foot and heal) and one dorsal site were tested. The monofilament was applied until it buckled and held for one second. Monofilament sensation was demonstrated on one of the patient's hand. The individual test sites were recorded as correct or incorrect stimulus. For each foot, if a single test was incorrect, then that site was tested two more times. If both additional tests were correct, then the site was recorded as correct. Otherwise, the site was recorded as incorrect.

#### (2) Ischaemic foot:

Features suggestive of ischaemic limb:

-Intermittent claudication

-Rest pain

-Absent popliteal or posterior tibial pulse

-Thin, stretched or shiny skin

-Hair loss on lower leg and foot

-Brittle nails

-Redness of affected area when the legs are dependent and pallor when elevated.

Before labeling a patient into ischemic foot, following tests were done

(a) Ankle brachial pressure Index: ABPI was calculated after taking the ankle systolic BP and brachial systolic BP.

#### Interpretation of ABI Value:-

ABPI <0.9- occlusive arterial disease may be present

ABPI <0.8- Highly suggestive of vascular disease

ABPI between 0.5 & 0.8- Most likely single segment occlusion

ABPI <0.5- Multi-segmental disease

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#### ABPI < 0.45- Severe, limb threatening

(b) Doppler ultrasound was used for further confirmation.

#### (3) Mixed category foot

Mixed category foot was classified as patients having neurological and ischaemic features, with or without sepsis.

#### (4) Non Neuroischaemic but purely infective lesions:-

- (a) Local signs of infection include erythema, pain, tenderness
- (b) Presence of septicaemic features
- (c) Presence of Pus
- (d) Presence of osteomylitis

#### **OBSERVATIONS AND RESULTS**

In our study, 100 patients of diabetic foot were studied and following results were obtained.

Table 1 shows that most commonly affected age group is 45-60 years (50%). Next most common age group is 60-75 years (24%). Eighteen patients were in age group of 30-45 years and 6 patients were in age group of 75-90 years. Males are affected more commonly then females. In our study of 100 patient 76 were males in compare to 24 females.

Table 2 shows that right side is slightly more frequently affected then left side. Fifty-four of diabetic foot involves right side and forty-four involve left side. Bilateral involvement was in 2%.

Table 3 showed that forefoot and dorsum of foot is more commonly involved. Dorsum of foot was involved in 42 % and toes were involved in 36 %. Whole foot was involved in 6 %, sole was involved in 8% and heel was involved in 8 %.

Table 4 showed that 50% of cases having diabetes of <5 years duration. Twenty-two percent having diabetes of 5-10 years duration and 14 % having duration of 10-15 years. So, majority of cases (72%) present within first ten years.

Table 5 showed that overall neuropathic foot account for majority of cases. Thirty-four (34 %) diabetic foot were neuropathic, 32 (32 %) were mixed, 14 (14 %) were ischaemic and 20 (20 %) were infectious.

Table 6 shows that in first 5 years, infection and mixed category forms the majority of cases. Initial 5 years, 18 cases were infective, 16 were mixed, 10 were neuropathic and 6 were ischaemic. After 5 years neuropathy is predominating. Total 22 cases were having diabetes of 5 to 10 years duration, of which 12 were neuropathic, 4 were ischaemic and 6 were mixed. There were total 14 cases having diabetes of 10-15 years duration in which neuropathic accounted for 8 cases while ischaemic, mixed and infective accounted for 2 cases each. Total 8 cases were having diabetes of 15 to 20 years duration, of which 4 were neuropathic, 2 were ischaemic and 2 were of mixed category.

TABLE 1 INCIDENCE OF DIABETIC FOOT IN RELATION TO A	GE AND SEX OF
THE PATIENTS	

Age	Male	Female	Total
<15	2	-	2
15-30	0	0	0
30-45	12	6	18
45-60	42	8	50
60-75	18	6	24
75-90	2	4	6
	76	24	100

#### TABLE 2 SIDE INVOLVEMENT IN DIABETIC FOOT

S. No.	Side involved	Patients	Percentage
1	Left	44	44
2	Right	54	54
3	Bilateral	2	2

#### TABLE 3 SITE OF LESION IN IN DIABETIC FOOT

S. No.	Site involved	Patients	Percentage
1	Toes	36	36
2	Dorsum	42	42
3	Sole	8	8
4	Heel	8	8
5	Whole foot	6	6

S. No.	<b>Duration in years</b>	Patients	Percentage
1	0-5yrs	50	50
2	5-10yrs	22	22
3	10-15yrs	14	14
4	15-20yrs	08	08
5	20-25yrs	02	02
6	25-30yrs	04	04

#### TABLE 4 DURATION OF DIABETES IN DIABETIC FOOT LESIONS

#### TABLE 5 INCIDENCE OF FOOT LESION ACCORDING TO CLASSFICATION

Classification of foot lesion	No. of Cases	Percentage
Neuropathic	34	34%
Ischaemic	14	14%
Mixed	32	32%
Purely infectious	20	20%

## TABLE 6 SHOWS THAT IN FIRST 5 YEARS, INFECTION AND MIXEDCATEGORY FORMS THE MAJORITY OF CASES.

Duration of diabetes	Number of Cases	Neruo- pathic	Ischaemic	Mixed	Infective
0-5yrs	50	10	6	16	18
5-10yrs	22	12	4	6	-
10-15yrs	14	8	2	2	2
15-20yrs	08	4	2	2	-
20-25yrs	02	-	-	2	-
25-30yrs	04	-	-	4	-

#### DISCUSSION

In this study, the known cases of Diabetes mellitus presenting with foot complications were critically analyzed. They were completely investigated and then categorized according to the characteristics of the lesion

In our study of 100 cases of diabetic foot the mean age of patients was 57.7 years. This closely resembles to that of 53.5 years in Indian series conducted by Sharad Pandsey et al.<sup>6</sup> Lithner et al reported mean age to be 68 years in western population.<sup>7</sup> So, mean age at diagnosis is considerably lower in Indian diabetic as compare to western.

In our study, male to female ratio was 3.16: 1 that again resembles to the ratio of 3: 1 in the Indian series. <sup>6</sup> As compared to western population where ratio is 2.7:1, the Indian males have higher incidence of foot lesions in compare to female. <sup>7</sup> This can be explained as outdoor works mainly looked after by males.

In our study, right side was involved is 54% patients whereas left side was affected in 44% patients. Bilateral was uncommon. Delbridge et al reported more frequent involvement of left side (36%) as compared to right side (26%). <sup>8</sup> Bilateral involvement was as frequent as left side in their study and they said bilateral involvement is more common in females and they attributed this finding with the fact that DVT is common in females which impairs tissue oxygenation and predisposes to infection. <sup>8</sup> Uncommon bilateral involvement in our study could be because of less number of females.

In this study, fore foot and dorsum of foot is more commonly affected because of the common involvement of these sites by trauma. Although no site in foot is immune to development of diabetic foot. Rieber GE divided foot into forefoot, mid foot, hind foot and dorsum of foot for the purpose of defining the site of foot lesion. In his series fore-foot was affected in 38.09%, mid-foot in 28.5%, hind foot in 66.6% and dorsum of foot in 14.7% of patients.<sup>9</sup>

In our study, majority of cases presented with in first 5 years of duration of diabetes. Wilfrid Oakley et al commented that the incidence of diabetic foot lesion appears to bear no relationship to the duration of diabetes. This indicates that other factors like age, susceptibility to trauma and probably adequate control of diabetes is more important than duration of diabetes.<sup>10</sup>

On the basis of criteria described earlier, the patients in our series are categorized into neuropathic, ischaemic, mixed and purely infectious type.

In contradiction to the western literature where half of the cases are neuropathic and rest half are ischaemic, in our study 34% had purely neuropathic features, ischaemia accounted for 12% and mixed etiology was present in 32% of the patients. Surprisingly a large percentage i.e. 20% of the patients belonged to purely infective category.

Half of the patients were found to have foot problems within 5 years of diagnosis of diabetes. In them purely infection cause was predominating and neuropathy had a lower role. Those who presented with long duration of diabetes (>5 years), neuropathy accounted for the primary factor. This is being accounted by the slow but progressive degeneration of nerves resulting in sensory and autonomic disturbance.

In neuropathic ulcer, neuropathy plays the central role with disturbances of sensory, motor and autonomic functions leading to ulceration due to trauma or excessive pressure on a deformed foot that lacks protective sensation.<sup>11</sup> Monofilament test was abnormal in all 34 cases reported to having neuropathic features and became the essential diagnostic method. Other tests were inconsistent and did not correlate well with monofilament test. The management of neuropathic foot includes adequate debridement with simple dressing and reduction of weight bearing forces.<sup>11</sup>

In our study, ischaemic cases accounted for 12 %. Assessment of ischaemia was done by examining peripheral pulses and ABPI. Further confirmation was done by Doppler investigations. Peripheral arterial diseases are almost 3-4 times more frequent in diabetics compared with age-and sex-matched non-diabetic.<sup>12</sup> Arterial lesions are more diffuse, frequently bilateral and tend to involve below the knee level in diabetic. <sup>12</sup> Management includes revascularization either by angioplasty or arterial reconstruction, which has led to reduction in the number of major amputations in diabetic patients.

Infective category has emerged as a major problem in Indian diabetics. This could be explained by the ignorance of the preventive measures and carelessness on the part of Indian diabetics to walk barefoot and negligence of trauma sustained.<sup>1</sup> Western studies rarely report infection as a primary cause of diabetic foot ulceration.<sup>2</sup> However it can complicate a neuropathic or neuro-ischaemic foot. A diabetic foot infection is most simply defined as any inframalleolar infection in person with diabetes mellitus. These include paronychia, cellulitis, myositis, abscesses, necrotizing fasciitis, septic arthritis, tendonitis and osteomyelitis. The most common and classical lesion however is the infected diabetic "Malperforans" foot ulcers.<sup>14, 15</sup> Optimal management of infective category requires aggressive surgical debridement and wound management, effective antibiotic therapy, and correction of metabolic abnormalities (mainly hyper-glycemia and arterial insufficiency).<sup>16</sup>

#### CONCLUSION

Diabetes is a disease of complications but no other complication is as devastating as the foot problems. Diabetic foot problems are complex and multifactorial and a multi discipline team should manage it.

On the basis of observation made in this study it is concluded that-

- 1. Patients of diabetes between 45 and 60 years of age are predisposed to diabetic foot lesion. Although other age groups are less frequently involved but no age can be considered as immune to these lesions.
- 2. Male patients suffers more commonly with diabetic foot lesion as compared to females  $(\approx 3:1)$
- 3. Right side is slightly more frequently affected (54%) than left side (44%) and though infrequent, bilateral lesions are also noted.
- 4. Dorsum of the foot and toes are (78%) very frequently involved and other parts of foot like sole and heel are also involved but with much less frequency.
- 5. 50 % of cases of diabetic foot presented with in 1st five years of diabetes. Infections were pre-dominant in majority (>50%) of cases occurring along or in combination with neuropathic or ischaemic foot. After five years of duration of diabetes, the most common foot lesion was neuropathic.

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