

## A Study to evaluate Clinico-pathology and management of diabetic foot

Gaurav Agrawal\*, Mayank Mahajan and R.M Manorkar

Department of Surgery, Sumandeep University, Piparia Vadodara Gujrat 391760 India

### \*Correspondence Info:

Dr. Gaurav Agrawal  
Assistant Professor,  
Department of Surgery, Sumandeep University  
Vadodara Gujrat 391760 India  
E-mail: [drgurav2001@yahoo.in](mailto:drgurav2001@yahoo.in)

### Abstract

**Objective:** The aim of the study bacteriology in diabetic wound, the pathophysiology of diabetic wound, various wound salvage procedures and outcome of different treatment modalities and newer techniques wherever applicable to prevent complications and to minimise the progression of occurred complication.

**Methods:** The 100 patients admitted with diabetic foot in the department of Surgery, SBKS MIRC, Pipariya Vadodara (Gujrat) prospectively studied from July 2014 to Jan 2015. Patients with diabetes mellitus presenting with wound i.e. ulcer, blister, abscess, gangrene were included in our study. Patients with chronic wound due to cause other than diabetes such as traumatic, arterial, venous, trophic, TB, Syphilitic, malignant ulcer were excluded from study.

**Results:** Highest number of cases was found in 51 – 60 years of age (34%) followed by 61 – 70 years of age (26%). 78 (78%) cases were male and 22 (22%) cases were female. Most of case had history of trauma 62%. As per Wegner's classification of the diabetic foot 44 cases presented with grade 2 lesion, 32 cases grade 4 lesion, 18 cases grade 3 lesion, 4 cases grade 1 lesion, 2 cases, grade 5 lesion. Most of lesion (50%) are found in lower limb in which 40 cases presented with ulcer, 28 cases with gangrene of toe or limb, 16 cases with cellulitis, 4 cases with abscess and 12 cases with osteomyelitis. Most common isolated organism was *s. aureus* (36) followed by *pseudomonas* (20). The average hospitalisation in graded 2,3,4,5 lesion around 32 days. About 10% case required amputation while 56% cases managed only by daily dressing & slough excision. Among the complicated diabetic foot 12 patients developed osteomyelitis. All these patients had lesion of grade 3 and out of these 12 patients, 2 patients required AKA, 8 patients BKA, 5 patients had disarticulation from metatarsophalangeal joint.

**Conclusion:** Diabetes affects all age groups, mainly manifest in middle part of life. Males are more affected than females. Neuropathy, ischemia along with immunological disturbance is important predisposing factor in pathophysiology. However both aerobic & anaerobic pathogens involve in diabetic wound infection but among them aerobic (mostly *s. aureus*) is more common. Commonest presenting lesions in foot were ulcer, followed by cellulitis and gangrene. In the management of DFU the first requirement is strict control of diabetes, & early detection and treatment of lesions and regular foot care is also important.

**Keywords:** diabetic foot, gangrene, amputation

### 1. Introduction

A diabetic foot is one of the most feared complications of diabetes and it is the leading cause of the hospitalization among diabetic patients. It is characterized by several pathological complications such as neuropathy, peripheral vascular disease, foot ulceration and infection with or without osteomyelitis, which leads to the development of gangrene and which even necessitates limb amputation. The Indian diabetic population is expected to increase to 57 million by the year 2025. The individuals with diabetes have at least a 10-fold

greater risk of being hospitalized for soft tissue and bone infections of the foot than individuals without diabetes.

Diabetic lesions are a significant health and socioeconomic problem, having adverse effects on quality of life and imposing a heavy economic burden on the patient. It can result in prolonged hospitalization and the need for rehabilitation and home care services.

## 2. Materials and Methods

The 100 patients admitted with diabetic foot in the Department of Surgery, Dhiraj Hospital attached to SBKS MIRC, Pipariya Vadodara (Gujrat) prospectively from July 2014 to Jan 2015. Patients with diabetes mellitus presenting with wound i.e. ulcer, blister, abscess, gangrene were included in our study. A Patients with chronic wound due to cause other than diabetes such as traumatic, arterial, venous, trophic, TB, Syphilitic, malignant ulcer were excluded from study. These entire wound classified as per Meggit-Wagner Classification:

### Wagner Ulcer Classification System

Grade	Lesion
0	: No open lesions; may have deformity or cellulitis
1	: Superficial diabetic ulcer (partial or full thickness)
2	: Ulcer extension to ligament, tendon, joint capsule, or deep fascia without abscess or osteomyelitis
3	: Deep ulcer with abscess, osteomyelitis, or joint sepsis
4	: Gangrene localized to portion of forefoot or heel
5	: Extensive gangrenous involvement of the entire foot

Most common and widely used Classification system is the Wagner Diabetic Foot classification System. This system is basically anatomical with gradations of superficial ulcer, deep ulcer, abscess osteitis, gangrene of the fore foot, and gangrene of the entire foot. Only grade 3 addresses the problem of infection. In this system foot lesions are divided into different grades starting from grade 0 to grade 5. Grade 0 includes high risk foot but no active lesion and grade 5 includes gangrene of entire foot. But this system does not mention about ischemia or neuropathy and that is the drawback of this system.

## 3. Results

Out of 100 cases Highest number of cases was found in 51 – 60 years of age (34%) followed by 61 – 70 years of age (26%). 78 (78%) cases were male and 22 (22%) cases were female. Most of cases have history of trauma 62%.

As per Wegner's classification of the diabetic foot 44 cases presented with grade 2 lesion, 32 cases with grade 4 lesion, 18 cases with grade 3 lesion, 4 cases with grade 1 lesion, 2 cases with grade 5 lesion and no case of grade 0 limb (Table 1). Most of lesion (50%) are found in lower limb in which 40 cases presented with ulcer, 28 cases with gangrene of

toe or limb, 16 cases with cellulitis, 4 cases with abscess and 12 cases with osteomyelitis (table 2). Most common isolated organism was staph. aureus (36) followed by pseudomonas (20) in pt who had ulcer or who required amputation (table 3). 30% cases presented with lesion have neuropathy out of which 60% cases have diabetes > 10 year (Table 4). On doppler study of these patient 24% cases had absent flow in *dorsalis pedis* & 11% in both *D. pedis* and ant tibial (table 5). The average hospitalisation in graded 2,3,4,5 lesion around >32 (table 6). About 10% case required amputation while 56% cases managed only by daily dressing & slough excision. Out of amputated patient 90% patient was male with average duration of DM 11.2 years (table 7). Among the complicated diabetic foot 12 patients developed osteomyelitis in which 9 were male and 3 were female and all have the diabetes for more than 5 years and age more than 50 years. All these patients had lesion of grade 3 and more out of 12 patients, 2 patients required AKA, 8 patients BKA, 5 patients had disarticulation from metatarsophalangeal joint and debridement of the wound was done in 2 patients (table 8) and amputation was saved.

**Table 1: Clinical grading of lesion**

Clinical grading	No. of cases	Percentage
0	0	0
1	4	4
2	44	44
3	18	18
4	32	32

**Table 2: Mode of presentation**

	No of cases	Percentage
Ulcer	40	40%
Gangrene	28	28%
Cellulitis	16	16%
Abcess	4	4%
Osteomyelitis	12	12%
Charcot joint	0	0
Total	100	-

**Table 3: Comparison of microorganism in relation to lesion**

Grading of lesion (ulcer)	No. of cases caused by microorganism						Total
	SA	PS	Kleb	E-coli	Prot	NHS	
0	0	0	0	0	0	0	0
1	2	0	0	0	2	0	4
2	16	12	6	6	4	2	44
3	10	2	4	2	0	0	18
4	8	6	6	4	6	2	32
5	0	0	0	0	0	2	2
Total	36	20	16	12	10	6	100

SA-S. aureus, PS- P. seudomonas, Kleb- Klebsella, Prot- proteus

**Table 4: Neuropathy with duration of Diabetes**

Duration of Diabetes	No. of cases	Percentage
<5 yrs	4	4
5-10 yrs	8	8
>10 yrs	18	18
Total	30	30

**Table 5: Peripheral Vascular Examination**

Treatment	No of cases
Slough excision and dressing	56
I&D and fasciotomy	24
Disarticulation	10
Below knee amputation ( BKA)	8
Above knee amputation ( AKA)	2
	100

**Table 6: Comparison of grade of lesion relation to duration of hospitalization**

Name of Artery Palpated	No. of patients			Percentage (%) of Palpable Artery
	Fully Palpable	Feeble	Absent	
Dorsalis Pedis	57	19	24	76%
Anterior Tibial	62	17	11	89%
Posterior Tibial	72	15	13	87%
Popliteal	89	5	6	94%
Femoral	100	-	-	100%

**Table 7: Treatment**

No. of days of hospitalization	Grade of lesion					
	0	1	2	3	4	5
Mean/Average days	0	10.75	30.86	31.61	33.37	30

**Table 8: Osteomyelitis in diabetic foot**

Osteomyelitis in diabetic foot				
Limb involvement	Fore foot	Mid foot	Hind foot	Leg
	5	1	4	2
treatment	Debridement	Disarticulation	Amputation	-
	2	5	5	-
Grade of lesion in osteomyelitis	Grade 3	Grade 4	Grade 5	-
	3	7	2	-

#### 4. Discussion

The prevalence of diabetes worldwide was estimated to be 2.8% in 2000 and is projected to be 4.4% in the year 2030, with the total number of people with diabetes expected to rise from 171 million in 2000 to 366 million in 2030. Postoperative hyperglycemia with or without reaching the threshold for diabetes is an independent predictor of surgical site infections. Epidemiologic studies suggest that 2.5% of diabetic patients develop diabetic foot (DF) ulcers each year and 15% develop DF ulcers during their lifetime.

In the present study, 62% patients had grade 2 and 3 diabetic foot. In a similar study by Rooh *et al*[1], 55% patients had grade 2 and 3 diabetic foot; Maximum numbers of patients present with ulcer and pus discharge. 12% patients showed osteomyelitis in the present study which was comparable to the study conducted by Scott *et al*[2]; in which 15% patients developed osteomyelitis.

The analysis also shows that at admission FBS > 200 mg/dl is independent risk factor for amputation. Lehto *et al*[6], reported that the risk of amputation increases in a linear fashion with increases in plasma glucose level. Boyoko *et al*[5] found that severe hyperglycemia was associated with a higher risk for diabetic foot ulcer. Chaturvedi *et al*[8] also suggested glucose level as a key risk factor for amputation. However, many studies have shown that levels of blood glucose over periods of time, as assessed by HbA1C, would be a better predictor for diabetic foot amputation.

In the diabetic person, the pathogenesis of wound infections is multifaceted. Vascular insufficiency, neuropathy, and decreased resistance to infection, possibly from metabolic imbalance, have all been implicated. In the individual patient, the relative contribution of each of these factors can vary. The presence of peripheral neuropathy can lead to loss of sensation in limb, loss of sweating in limb, in turn leading to drying, fissuring, and cracking, and to deformities arising from poorly perceived microfractures. More than 60% of diabetic patients are affected by neuropathy, which include distal symmetrical polyneuropathy (DSPN), mono-neuropathies, and a variety of autonomic neuropathies. These changes, in the presence of the diabetic state, with or without significant vascular impairment, can set the stage for the entry of bacterial pathogens and the progression of the infections process.

Diabetic patients also represent around 60 percent of non-traumatic limb amputations, the majority of which are secondary to infectious complications. Defects in immune function have been described as occurring in diabetics. In our study neuropathy changes seen in 30 cases, ischaemic changes noted in 24 cases and 8 cases had both neuropathy and ischaemic changes. Accelerated lower extremity arterial disease in conjunction with neuropathy makes diabetes mellitus accounting for ~50% of all non-traumatic amputations globally. Diabetics have a high risk of atherosclerotic peripheral vascular disease, in combination with peripheral neuropathy and minor trauma, it would be a cause of foot ulceration. The presence of peripheral

arterial disease has been cited by many authors as a risk factor for amputations in diabetics. The presence of peripheral vascular disease causes problems in the blood flow; adequate blood flow is essential for healing and for combating the severe infections that attack diabetic foot. Calle-Pascual *et al*[3] reported that 100% of the major amputations in their series were associated with peripheral vascular disease. In our study, it was found that, 28 cases had gangrene, where predominantly 24 cases are because of ischaemia, whereas in the remaining 4, the cause was sepsis.

The treatment of foot ulcers in diabetic patients varies constantly depending on the severity of the ulcer and the presence or absence of ischemia. However the basic points of treatment are, local wound care, debridement in case the ulcer presents thick edges or necrotic tissue, reduction in overload pressure, complete rest of the foot (orthotics) & treatment of the infection. The aim of therapy should be early intervention to allow prompt healing of the lesion and prevent recurrence once it is healed. Multidisciplinary management programs that focus on prevention, education, regular foot examinations, aggressive intervention, and optimal use of therapeutic footwear have demonstrated significant reductions in the incidence of lower-extremity amputations.

*Staphylococcus aureus* (36%) is the commonest organism in the present study. In a study conducted by European society of clinical microbiology and infectious disease; Helsinki Finland[4] gram positive cocci is the commonest organism isolated, staphylococcus accounting for 42% cases. This is mainly because skin lesions mostly

## 5. Conclusion

Diabetes affects all age groups and mainly manifest in middle part of life. Males are more affected than females. Neuropathy, ischemia along with immunological disturbance is important predisposing factor in pathophysiology of diabetic foot ulcer. However both aerobic & anaerobic pathogens involve in diabetic wound infection but among them aerobic (mostly *staph aureus*) is more common. Commonest presenting lesion in foot was ulcer, followed by cellulitis and gangrene. In the management of DFU the first requirement is strict control of diabetes, & early detection and treatment of lesions and regular foot care is also important. The importance of identifying these risk factors is that such knowledge is useful for developing methods to detect them at an early stage and thus prevent limb amputation.

caused by gram positive. A variety of physiology and metabolic distributions conspire to place diabetes patients at high risk for foot wounds. Microbial colonization of wound is inevitable, usually with endogenous bacteria, but these are potentially pathogenic in wound. Immunological disturbance are also an important predisposing factors of pathophysiology of foot ulcer; these includes abnormalities of migration, phagocytosis, intracellular killing, and chemotaxis. The cellular immune response and monocyte function are also reduced in diabetes, poor granulation formation, prolonged abscess, presence and impaired wound healing are further complicating the diabetic foot ulcer. The infection in diabetic foot is mainly by aerobic bacteria, anaerobic bacterial infection also plays a significant role in the infection of diabetic foot ulcer. The impact of anaerobes was reported first by Louie *et al*[7] and subsequently by many researchers. There are only few reports available on the incidence of fungal pathogens in diabetic foot infections. Diabetic foot ulcer infection is usually polymicrobial in nature and this was first reported by Louie *et al*[7].

The unique anatomy of the foot is the main reason that infection is potentially serious in this location. The structure compartment, tendons, sheaths, and neurovascular bundles tend to favour the proximal spread of infection. The deep planter spaces were divided into medial, central, and lateral compartments. The infections may spread from one compartment to another at their calcaneal or by direct perforation of septae, but lateral or dorsal spread is alate sign on infection.

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