

EXPLORING DIABETIC FOOT ULCERS: CLINICAL FEATURES, CHALLENGES, AND INNOVATIONS

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ABSTRACT

DFUs are one of the significant complications of DM. It is formed as a result of neuropathy, hyperglycemia, and peripheral vascular disease, causing high morbidity and mortality in the population of the world. For this review, the clinical aspects, classifications, management strategies, and preventive measures of DFUs have been considered. The most commonly used classification systems are the Meggitt-Wagner and University of Texas wound classifications, which play a major role in determining the severity and management. Its treatment includes pharmacological interventions in the form of broad-spectrum antibiotics, such as cephalosporins, fluoroquinolones, and aminoglycosides; and non-pharmacological interventions, such as debridement, arterial bypass surgery, and advanced techniques, such as Negative Pressure Therapy (NPT) and Hyperbaric Oxygen Therapy (HBOT). Therefore, these new interventions, improved oxygen supply and tissue granulation, fasten the healing process of these wounds. Measures for prevention like glycemic control, proper footwear, foot hygiene, and educating the patient would reduce the incidence of DFUs. Multidisciplinary management leading to better results, decreased morbidity, and a quality life improvement for the DFU patients relates to the correct treatment of such conditions along with early diagnosis and preventive strategies.

KEYWORDS: Diabetic Foot Ulcer (DFU), Diabetes Mellitus (DM), Neuropathy, Peripheral Vascular Disease (PVD), Wound Classification, Antibiotic Therapy.

INTRODUCTION

Diabetes Mellitus is one of the most prevalent chronic metabolic endocrine Disorder, characterised by increased blood glucose levels (**Hyperglycemia**) resulting from defect in insulin function, secretion or both.^[1,2,3,4&5] The common long-term consequences of DM are microvascular complications (Neuropathy, Nephropathy, Retinopathy) and aggravation of macrovascular complications (coronary artery disease, peripheral vascular disease, cerebral vascular disease).^[6] Among various complications of DM, The Most leading complication which may be life threatening in patients with DM is **Diabetic Foot Ulcers**.^[1,7]

DIABETIC FOOT ULCER

Diabetic Foot Ulcer can be defined as an **Infra malleolar infection**, which is a soft tissue or bone infection just under the malleoli.^[7,8] A full thickness skin break with ulceration, infection, or destruction of deep tissues associated with neurological abnormalities and various degrees of PVD in the lower limb.^[9,10] It is a frequent serious medical, socio-economic problem associated with substantial morbidity and mortality.^[11,12]

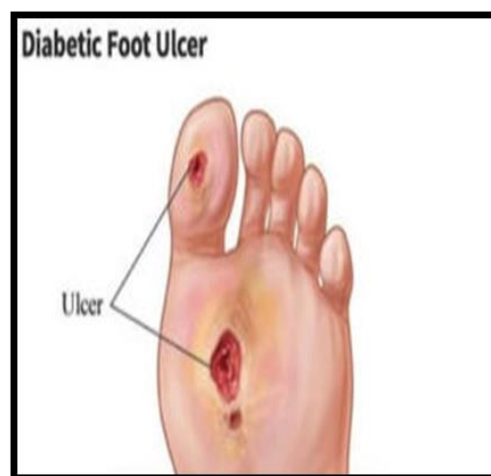


Figure 1.1: Shows Diabetic Foot Ulcer.

The spectrum of Diabetic Foot infection includes.^[7]

Paronychia		Necrotizing fasciitis	
Cellulitis		Septic Arthritis	
Myositis		Tendonitis	
Abscesses		Osteomyelitis	

Figure 1.2: Describes the spectrum of Diabetic Foot Ulcer.

EPIDEMIOLOGY OF DIABETIC FOOT ULCER

- ❖ Diabetes is the worrying global health predicament in the modern age and a biggest cause of disease related mortality that affects 537 million people worldwide in that 19-34% will develop DFU as a complication in their life time and approximately 20% require lower extremity amputation (LEA) either minor (below the ankle) or major (above the ankle) or both.^[8,13,14]
- ❖ Mortality rates after major amputation were 273.9 per 1,00,000 and 113.4 after a minor amputation.^[15]

RISK FACTORS ASSOCIATED WITH DEVELOPMENT OF DIABETIC FOOT ULCER

Various Risk factors associated with increased chances of developing diabetic foot diseases are;

- Duration of diabetes for more than 10 years,
- Poor glycemic control,
- Poor socioeconomic background,
- Neuropathy,
- Alcohol consumption,
- Tobacco use.^[10,16]

CLASSIFICATION OF DIABETIC FOOT ULCERS

There are Various classification of Diabetic Foot Ulcers. They are as follows.

- Meggit-Wagner classification,
- University of Texas wound classification system,
- The Pedis classification system,
- Edmon classification of Diabetic foot ulcers.^[10,13,17]

MEGGITT-WAGNER CLASSIFICATION

It is the widely used system of classification, based on the Depth of wound & extent of tissue necrosis.^[13]

- ❖ **Grade 0:** No ulcer in a high-risk foot- Has bony prominence/callus/deformities...etc.
- ❖ **Grade 1:** Superficial ulcer involving the full skin thickness but not underlying tissues- Not infected.
- ❖ **Grade 2:** Deep Ulcer, penetrating down to ligaments and muscles, but no bone involvement or abscess formation.
- ❖ **Grade 3:** Deeper ulcer with cellulitis or abscess Formation, often with osteomyelitis- check with a probe, correlate with X-ray findings.
- ❖ **Grade 4:** Localised gangrene- Toes or fore foot.

❖ **Grade 5:** Extensive gangrene involving the whole foot.^[7,13]

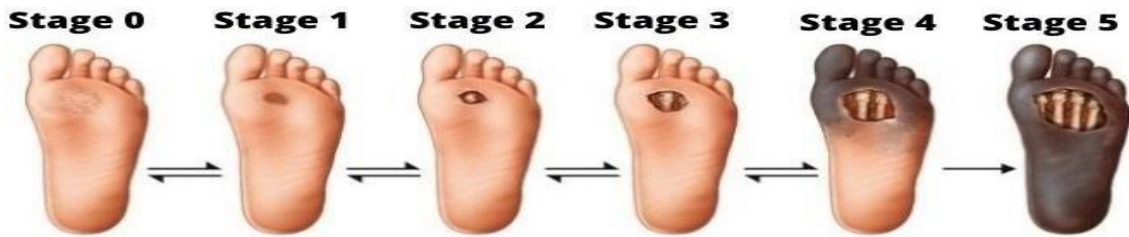


Figure 2: The figure shows various grades of Meggitt-Wagner classification of Diabetic foot ulcer.

UNIVERSITY OF TEXAS WOUND CLASSIFICATION SYSTEM

Table 1.1: The Table shows University of Texas classification system of Diabetic foot ulcer.^[10]

STAGE/GRADE	0	1	2	3
A	Pre-ulcerative Or post-ulcerative lesion completely epithelialized	Superficial Wound not involving tendon, capsule or bone	Wound penetrating to tendon or capsule	Wound penetrating to bone and joint
B	With infection	With infection	With infection	With infection
C	With ischemia	With ischemia	With ischemia	With ischemia
D	With infection & ischemia	With infection & ischemia	With infection & ischemia	With infection & ischemia

PATHOGENESIS OF DIABETIC FOOT ULCER

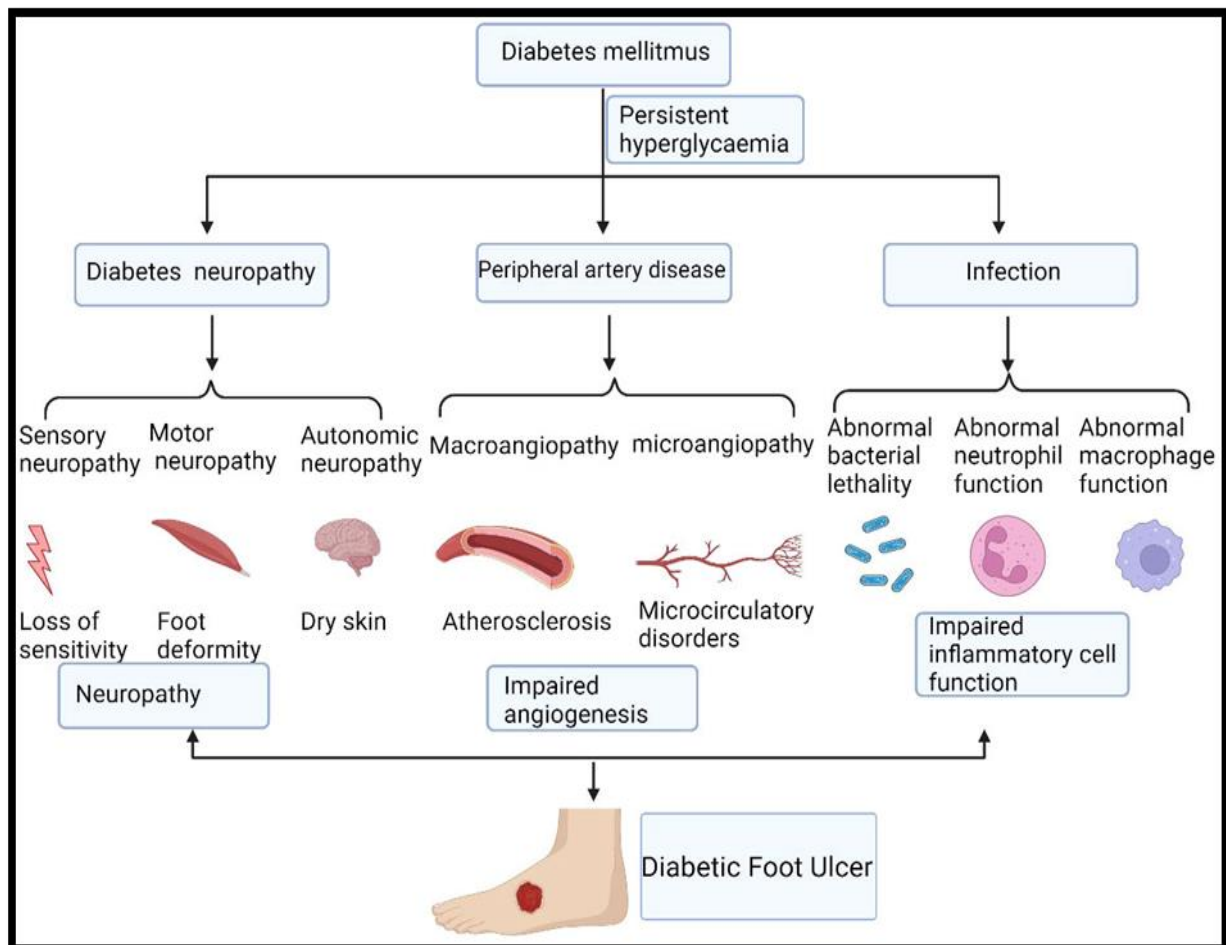


Figure 3: The Figure represents the Pathogenesis of Diabetic Foot Ulcer.^[18]

CLINICAL FEATURES OF DIABETIC FOOT ULCERS

Numbness, Discolouration of skin, Foul smell, Swelling/Inflammation, Large calluses or cracked heels,	Blisters, Redness, Discharge of fluid or Pus, Tingling sensation, Pain at the site of infection. ^[19,20]
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DIAGNOSIS OF DIABETIC FOOT ULCER

- Physical Examination (Based on Wagner's classification),
- Swab test for secondary infection,
- X-rays for bone involvement,
- MRI studies (To check the extent of damage caused by ulcer),
- Angiography.^[20,21]

MANAGEMENT OF DIABETIC FOOT ULCER**PHARMACOLOGICAL MANAGEMENT**

Diabetic Foot Ulcer Infections are polymicrobial, hence antibiotic therapy should be based on bacterial culture results and the antibiotics toxicity capability.^[13,17] The commonly used drugs in the treatment of DFUI.^[7,11,17&22]

- | | | | |
|-------------------|------------------------|---------------------|--------------------|
| 1) Penicillins | 2) Cephalosporins | 3) Fluoroquinolones | 4) Aminoglycosides |
| • Ampicillin | • Cefoperazone | • Ciprofloxacin | • Amikacin |
| • Amoxicillin | • Cefalexin | • Moxifloxacin | • Gentamycin |
| • Piperacillin | • Cefotaxime | | |
| 5) Beta lactams | 6) Others | | |
| • Clavulanic acid | • Linezolid | | |
| • Sulbactam | • Imipenem- cilastatin | | |
| • Tazobactam | • Erythromycin | | |
| | • Clindamycin | | |

NON-PHARMACOLOGICAL MANAGEMENT**SURGICAL TECHNIQUES^[13,20,23]**

Debridement, Incision & Drainage, Off-loading, Arterial bypass surgery [femoro-popliteal bypass]	Primary angioplasty Osseous resection [If osteomyelitis present] Achillies tendon lengthening Atherectomy
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NOVEL THERAPIES IN THE MANAGEMENT OF DFU

New Novel therapies are evolving as an adjuvant treatment. They are.

- G-CSF (Granulocyte-colony stimulating factor)
- NPT (Negative pressure therapy)
- HBOT (Hyper baric oxygen therapy)
- Ulcer excision and grafting.^[3,13&18]

PREVENTIVE MEASURES OF DIABETIC FOOT INJECTION

- ✓ Closely maintain blood glucose levels under control,
- ✓ Exercise and physiotherapy,
- ✓ Do not walk with bare foot,
- ✓ Keeping toenails adequately trimmed,
- ✓ Keeping your feet dry and moisturized,
- ✓ Disinfecting the skin around an ulcer,
- ✓ Do not walk with bare foot,
- ✓ Keeping the ulcer dry with frequent dressing,
- ✓ Cessation of alcohol and smoking consumption,
- ✓ Appropriate footwear - properly fitting soft shoes or made-to-measure insoles.^[16,21]

DISCUSSION

DFUs are a significant and difficult complication of DM with grave effects on patient morbidity, quality of life, and health care systems worldwide. The development of DFUs is characterized by numerous predisposing factors that involve long-standing hyperglycemia, neuropathy, and peripheral vascular disease (PVD). All of these factors act synergistically toward the ulceration, infection, and poor healing seen with the condition above.

The Meggitt-Wagner and University of Texas classifications help in establishing more reliable standards to evaluate the severity of DFUs and, in doing so, guide clinical management. It is peculiar that although the Meggitt-Wagner classification focuses on the depth of ulceration and necrosis, the University of Texas system adds infection and ischemia as more critical determinants to provide a more comprehensive understanding of disease progression.

The multifactorial pathogenesis of DFUs thus requires a multi-disciplinary approach to management. Pharmacological interventions include broad-spectrum

antibiotics as dictated by the culture and sensitivity results. There is polymicrobial infection with the use of cephalosporins, fluoroquinolones, aminoglycosides, and beta-lactams in advanced disease to salvage the limb and prevent additional complications through the use of interventions such as debridement, arterial bypass surgery, and osseous resection.

New auxiliary that could have possible uses to manage refractory wounds includes Granulocyte-Colony Stimulating Factor, Negative Pressure Therapy, and Hyperbaric Oxygen Therapy. Each of these newly invented techniques attempts to enhance the oxygen delivery across tissues near them, enhance the granulation of tissues, and enhance healing process.

Preventive measures need to be employed to reduce the risk of acquiring DFUs. These include management of hyperglycemia, proper hygiene of the foot, regular inspections of the foot, and usage of proper footwear as a part of patient education and care. All these preventive interventions along with early diagnosis and treatment can significantly reduce the number of DFUs.

CONCLUSION

Diabetic Foot Ulcers are one of the disabling complications of Diabetes Mellitus, having wide-ranging implications for patients and health care systems. Precise comprehension and practical implementation of classification systems, customized therapeutic strategies, and preventive measures are of great importance in treating this disease. This would not only enhance patient outcomes, lower morbidity rates, and ensure a better quality of life in patients with DFUs but would also involve integration of pharmacologic treatments, surgical interventions, and novel therapies in clinical practice. Preventive measures remain a mainstay of management, underpinning the emphasis on education and multidisciplinary care as measures to deal with this global health challenge.

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