DIABETIC FOOT ULCERS: CURRENT TRENDS IN MANAGEMENT

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ABSTRACT
The Diabetic foot is the commonest complication of Diabetes and is a leading cause of hospitalization and prolonged in – patient treatment. Diabetic foot ulcer is far and away the most frequent indication for non traumatic lower limb amputations. Appropriate preventive measures as well as patient education will markedly reduce ulcer formation and the frequency of amputations in addition to cutting down on healthcare costs.
Key words: Amputation, Multi-disciplinary team, Patient education, Prevention

INTRODUCTION
Diabetes mellitus is a chronic endocrine illness that manifests with elevated blood sugar levels resulting from an absolute or relative lack of insulin fraught with complications such retinopathy, nephropathy, macroangiopathy and the diabetic foot ulcers.
As at 2000, about 177 million persons were afflicted by diabetes which the WHO has predicted will rise to 300 million by 2025.[1] Fifteen percent of diabetics develop foot ulcers during their life time[2] with significant health related decrease in quality of life and consumption of a great deal of healthcare resources,[3,4] while diabetic foot ulcers account for between 50% to 80% of non traumatic amputations.[2,4] Presently substantial progress is being achieved in the treatment of diabetic foot ulcers in centres that base their management on the twin pillars of preventive measures / patient education and a multi-disciplinary team approach from the onset.

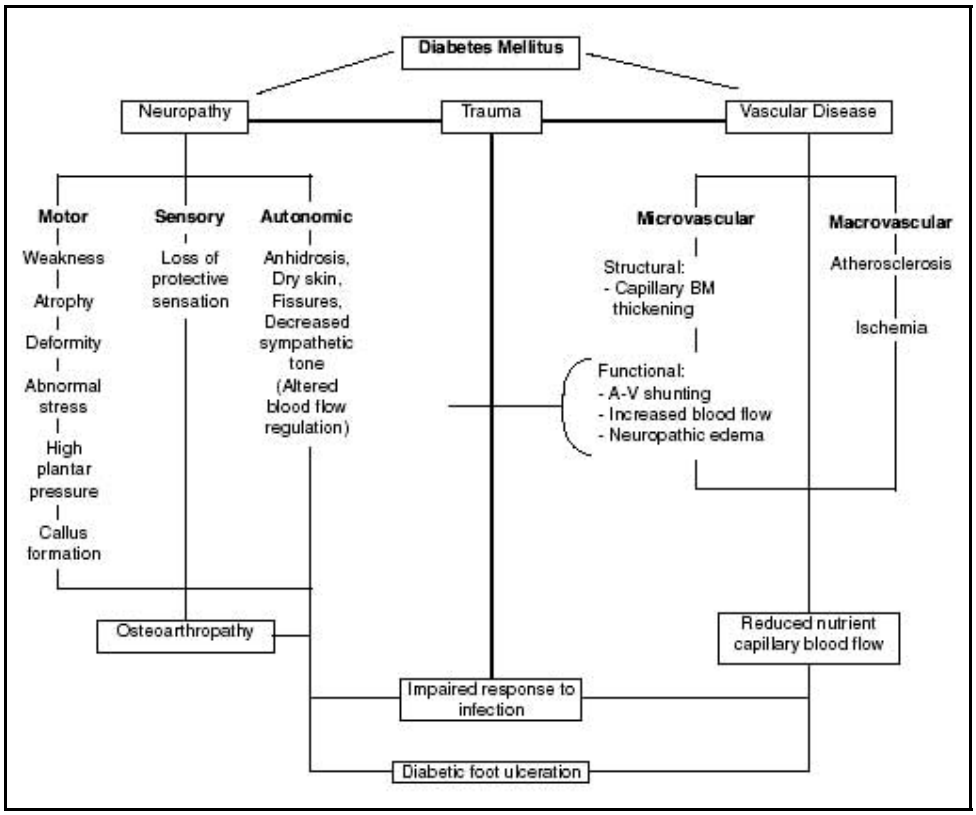
PATHOPHYSIOLOGY
The aetiological factors that contribute to the formation of ulcers include
Peripheral Neuropathy; which is present in about four fifths of the patients.[5] It may manifest as a sensory impairment (glove and stocking distribution), motor or autonomic neuropathy. Several mechanisms are involved in development of neuropathy viz, accumulation of harmful metabolites intracellularly, membrane conduction defects and nerve compression arising from swelling associated with water accumulation in the nerve. The patient is unaware of small injuries from repeated trauma and does not take protective action because the normal “pain and trauma” recognition response is lost.[3] The deformities which may follow neuropathy include charcot (neuropathic) foot, claw and hammer toes, hallux valgus / rigidus, pes planus, prominent metatarsal heads

and pressure at these points deformed bony prominences might lead to skin breakdown and ulceration.

Vascular disease; this could be both macro and microangiopathy. Atherosclerotic changes may result in ischaemia and impaired wound healing.[6]

Infection; in addition to the foregoing is impaired response to infection occasioned by deficiency in phagocytic activity of leucocytes, diminished bacterial killing and a defect in normal chemotactic mechanisms[5]. **(Fig. I)** Infection leads to microthrombi formation, causing further ischaemia, necrosis, and progressive gangrene.[4]

Fig. I: PATHOPHYSIOLOGIC PATHWAYS IN THE DEVELOPMENT OF COMPLICATIONS OF THE DIABETIC FOOT.[5]



CLINICAL FEATURES

Diabetic foot ulcers may be predominantly neuropathic or ischaemic; rarely does one form exist to the total exclusion of the other however neuropathic ulcers are commoner. Neuropathic ulcers might be painless (though this is not always the case), with callus formation that progress to ulcer formation at the tip of the toes, plantar aspect of the metatarsal head; infections may supervene (usually polymicrobial – gram +ve, gram-ve and anaerobes)[4] leading to cellulitis, abscesses, osteomyelitis and even sepsis. Sepsis can lead to thrombosis with consequent gangrene. Pulses are present and the limb is warm. Ischaemic foot ulcers on the other hand are characterized by absent pulses, cold extremities and trophic changes.

ULCER GRADING

Grading is important in order to plan treatment and prognosticate. Most grading systems are based on the presence or absence of skin lesions,

depth of the lesion, presence of deep infections and presence or absence of gangrene. [7, 8, 9] the system developed by Prof Wagner of the University of Southern California enjoys popular followership. He classified the ulcers into six grades from 0 (foot at risk) to 5 (entire foot gangrene)[8,9]. **(Fig. II)**

Others include Brodsky,[2] Texas University[9] and the Diabetic foot severity score designed by Umebese and Ogbemudia[10] of the University of Benin to predict whether a limb should be salvaged or not. **(Fig. III)**, here the patient can score between 6 and 21, with <10 earning an amputation.

Fig II: WAGNER CLASSIFICATION OF DIABETIC FOOT ULCERS

Grade 0	skin intact but bony deformities produce a "foot at risk"
Grade 1	localized, superficial ulcer
Grade 2	deep ulcer to tendon, bone, ligament, or joint
Grade 3	deep abscess, osteomyelitis
Grade 4	gangrene of toes or forefoot
Grade 5	gangrene of entire foot

INVESTIGATIONS

Assist in identifying microbes and detailing their sensitivity profile (in the case of infection) and in establishing the type and extent of ulcer as well as in planning treatment.

Wound swab / tissue biopsy for M/C/S: Commonly cultured organisms are S. aureus, streptococci, E. coli, Klebsiella, Pseudomonas as well as anaerobes. It is wisdom to commence broad spectrum antibiotic therapy only after samples have been obtained for M/C/S

FBC / ESR: leucocytes and ESR may be elevated in the face of infection.

Blood sugar: should be monitored in order to achieve euglycaemic levels.

E/U/Cr: poor blood sugar control not only damages the kidneys directly it also can impair electrolyte homeostasis

Fig III: DIABETIC FOOT SEVERITY SCORE (DFSS) INDEX by Umebese and Ogbemudia[10]

Parameters	Description	Score
Colour of Foot Lesion	Normal	3
	Dark Discolouration	2
	Black	1
Peripheral Pulses	Dorsalis Pedis & Posterior Tibial Pulses Palpable	4
	Posterior Tibial only	3
	Dorsalis Pedis only	2
	None	1
Sensation	Light Touch, Pin prick	3
	Hypoaesthesia	2
	Insensate	1
Ulcer Grading	Ulcer/ gangrene of 1 or 2 toes	5
	Full thickness ulcer of dorsal skin only	4
	Ulcer>2 toes+ ball of foot	3
	Open putrid ulcer> 50% of the sole of the foot	2
	Whole foot gangrene + supramalleolar necrotizing cellulites	1
Foot X-Ray	Normal	3
	Chronic Osteomyelitis or calcified peripheral vessels	2
	Both	1
Age	40 yrs	3
	41-60 yrs	2
	>60 yrs	1
TOTAL		

Semmes-Weinstein 5.07 (10 g) monofilament testing: assesses the touch sensation of the patient, it ideally should be done during clinical evaluation **(Fig. IV)**

Fig. IV: Semmes-Weinstein 5.07 (10 g) monofilament; the monofilament is applied to the high-risk areas on the plantar surface of the foot (i.e., toe pulps, metatarsal heads, heel). Patients who cannot feel pressure from the monofilament have lost protective sensation and are at risk of developing a diabetic foot ulcer.

Imaging techniques: soft-tissue pathology, such as abscesses and sinus tracts, can be better defined through ultrasonography, computed tomography (CT) scanning, and magnetic resonance imaging (MRI); while plain radiography is useful for detection of bone pathology and the confirmation of the development of osteomyelitis. However in the hands of

an experienced radiologist MRI is superior to plain radiography in the diagnosis of bone infections[2]

Vascular examination: Doppler sonography establishes the patency of the vascular tree and the nature and location of block if any while the ankle brachial index (ABI, the ratio of systolic blood pressure in the ankle to that in the brachial artery which is also the ischaemic index) predicts the ability of the wound to heal if amputation is being considered. An ischaemic index of 0.6, an absolute ankle pressure of 70 mm Hg or more, and an absolute toe pressure of 40 mm Hg or more are strong indicators that a limited foot amputation should heal, provided calcification of arteries is thought not to cause falsely high values.[7] Furthermore, a transcutaneous O_2 tension of 30 mmHg is also regarded as a strong indicator that an amputation stump should heal[4].

TREATMENT

Currently treatment is strongly biased in favour of preventive measures as well as patient education and a multidisciplinary team approach. Centres that practice these have recorded significant drop in morbidities generally and amputation specifically[3,6, 8].

Prevention and patient education: organizing a diabetic foot clinic where patients are seen regularly and their feet examined to pick up any sensory impairment or pre-ulcerative lesions (calluses blisters etc) is an important step. They are also educated here on dos and don'ts which should include abstaining from smoking (not just given a list). **(Tab. I)**. Rigorous attempts are to keep the patient euglycaemic since this has been shown to reduce the incidence of diabetic complications including foot lesions[4, 5, 6]

Multi-disciplinary team approach: as much as possible this should be adopted and potential members of the team should include[6, 11]

- Orthopaedic surgeon
- Endocrinologist
- Podiatrist
- Infectious disease specialist
- Diabetic nurse
- Vascular surgeon
- Interventional radiologist
- Pedorthotist
- Physical therapist
- Occupational therapist
- Members of the patient's family

Specific treatment depends on the stage of disease which also determines at what point different members of the team are consulted.

In the **at risk foot with the skin intact,** measures are taken to eliminate such risk or minimize them; ranging from comfortable well padded shoes with in-soles and wide toe box to surgeries for correcting deformities

Antibiotics should be used when clinically indicated and should be broad spectrum; giving coverage against gram +ve and –ve as well as anaerobes until sensitivity result is known.

Wound debridement involves removing infected and devitalized tissues in order to allow for granulation tissue to form. There after a walking cast or total contact cast is applied which helps to redistribute the weight in order to minimize weight bearing – a strong factor in ulcer perpetuation.[12] Depending on the grade (II or III), the debridement can be quite extensive after which the wound may be closed over a drain or left open to granulate and closure may be achieved by skin grafts or by raising flaps.[8]

Wound dressings with materials that are not toxic to the soft tissues while still carrying out their functions is what

is in vogue now. Honey, medical grade maggots, cytokine (e.g. granulocyte stimulating growth factors) impregnated dressing pads, crystalloids all help to render a wound clean with healthy granulation[13]

Amputation unfortunately, even in the best of centres and with the most highly motivated of patients, gangrenous limbs (IV and V) are still encountered.The approach here then is to ablate at the most distal level where wound healing will be achieved. Clinical experience as well as angiography and Doppler will dictate the need for revascularization procedures since they will help making the site of election as caudad as possible and also increase the chances of good healing. Establishing the ischaemic index as well as the percutaneous O_2 levels will further help to assure healing at the site of election or decide in favour of a different level altogether[2,4,7,8]. Life-threatening, rapidly progressive infection such as gas gangrene or necrotizing fasciitis; chronic ulceration or infection that persists despite other treatment; gangrene; or severe, uncontrollable deformity or instability that precludes fitting in footwear or brace are some of the indications for amputation

Prosthetic fitting and rehabilitation should be incorporated into the decision and planning for the amputation as this will prepare the patient psychologically and as well shorten his time in rehabilitation. Amputation is the first step in the rehabilitation process; a good stump is important in ensuring a proper prosthetic fitting and the patient will need to be taught to ambulate with the new limb, in addition he may even require cutting down on his activity level as more energy is needed for ambulation following an amputation[1].

CONCLUSION

There is obviously meaningful room for upgrading the quality of care that patients with diabetes receive, particularly with respect to the prevention and treatment of foot complications. This will only come from a multidisciplinary approach that embraces patient education and motivation, preventive measures, vigilance for risk factors, and utilization of the most effective therapeutic options.

Table I: HOW PATIENTS WITH DIABETES CAN CARE FOR THEIR FEET

How Patients with Diabetes Can Care for Their Feet
1. Wash the feet every day • Feet should be washed gently but thoroughly every day. • After washing, pat dry with a clean soft towel. • Do not put lotions between the toes. • Discuss any foot powders with a healthcare professional prior to use.
2. Check the feet every day • The top, bottom, sides, and areas between the toes should be checked every day. • A mirror can be used to look at the bottom of the feet if necessary. • Red spots, wounds, bruises, rashes, or injuries are all cause for concern, and if any are identified the healthcare professional should be informed immediately. • Only allow a healthcare professional to remove calluses or corns.
3. Obtain regular foot exams • The ADA recommends that all diabetic patients have at least one professional foot exam each year. • Patients with neuropathy or any deformities of the foot (egg, bunions, and hammer toes) should have more frequent exams. • Early identification of conditions that could pose a risk of developing foot ulcers can help prevent serious consequences. • Monofilament test will assess nerve function and protective sensation. • A thorough evaluation of foot structure, mechanics, and circulation, as well as skin health and integrity, is essential. • Patients can remind their healthcare professional to examine their feet by removing their shoes upon entering the exam room.
4. Control blood sugars • The DCCT clearly demonstrated that good blood sugar control can reduce the risk of diabetic neuropathy by 40% to 60%. • Prevention of neuropathy will help avoid the progression of many other foot problems in diabetic patients.
5. Ensure proper shoe fit • Shoes should be comfortable from the moment they are purchased, and not require “breaking in.” • Ensure that they do not rub or constrict any part of the foot. • Buy shoes at the end of the day when the feet are slightly swollen, and try them with socks that are the same as those with which the shoes are likely to be worn. • Own two pairs of shoes that can be alternated, allowing each pair to dry out naturally between uses.
6. Consider prescription footwear • Foot deformities, a history of foot ulcers, prior amputation, severe vascular disease in the feet, nerve damage with calluses, and insensate feet are all indications for prescription footwear. • Medicare and many insurance providers will reimburse for prescription footwear.
7. Check inside shoes before wearing

- It is wise to check inside shoes before wearing them to ensure that there is nothing inside that could cause abrasion of the foot, such as foreign objects or pieces of leather or fabric.
- Discard shoes when they show signs of wear and tear.

8. Wear clean socks
   - Socks should be changed every day and not wrinkle when worn.
   - Seamless socks and socks with flat, unobtrusive, soft seams should be selected, not socks with bulky seams.
9. Plan for the weather
   - A healthcare professional should be consulted before exposing the feet to extreme temperatures.
   - Toe warmers, electric blankets, and heating or cooling gels all pose a risk to the feet, and should not be used without prior consultation with a healthcare professional.
10. Never walk barefoot
    - Diabetic individuals should keep their feet protected at all times.
    - Even at the beach or swimming pool, sandals or swimming shoes are essential to avoid damage that could have serious consequences.

Adapted from http://www.diabetes.org/.

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