UNIT NO. 5

FOOT CARE

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ABSTRACT

There is an increasing incidence of diabetes worldwide; the morbidity and the mortality is expected to increase.

Early recognition of the at-risk foot is paramount. The NICE (National Institute for Clinical Excellence) classification of foot risk stratification has been adopted even in local screening programs. Foot complications (ulceration, infection, the charcot foot, and the dreaded amputated foot / limb) usually are the result from the interplay of several causes; a triad of peripheral sensory neuropathy, trauma, and deformity has been quoted. Identification of the neuropathic or the neuroischaemic ulcer will help direct management of treatment. The Wagner Ulcer Classification System and the University of Texas at San Antonio Ulcer Classification System helps predict outcome. Diabetic foot infections are a medical emergency; early and aggressive treatment by antibiotics, debridement and off-loading cannot be overemphasised.

Nevertheless, a holistic approach in ensuring good glycaemic control and 'treating to target' other cardiovascular risk factors are also goals in management.

The family physician, together with the informed patient, can prevent or minimise morbidity by regular screening and early recognition of the at-risk foot. Where necessary, the family physician co-ordinates care and treatment of diabetic foot complications with a multi-discplinary foot care team.

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INTRODUCTION

Globally, it is estimated that at least 1 in 20 deaths are attributable to diabetes across all ages, and in adults aged 35 to 64, the proportion is at least 1 in 10 deaths. It is projected that by 2030, the number of diabetics will more than double. In Singapore, the prevalence of diabetes is 8.2%[1] (2004 National Health Survey, NHS) and it is also the eighth commonest cause of death, 3.3% in 2006 (up from 3.1% in 2005).

Diabetes mellitus is associated with a two- to three-fold increase risk of accelerated atherosclerosis. Other important risk factors are hyperlipidaemia, hypertension, cigarette smoking, age, hereditary, obesity and physical inactivity.

Lower extremity complications of diabetes such as neuropathy, ulceration, infection, and PAD are common and lead to significant morbidity, including major amputation. Appropriate and careful management of patients with type 2 diabetes can delay or prevent foot complications. The importance of early recognition of the at- risk foot and early treatment of the complications cannot be overemphasised. Diabetic foot infections are a medical emergency; a delay in their diagnosis and management increases amputation rate, morbidity, and mortality; diabetic foot disease accounts for 700 lower limb amputations in Singapore annually.

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ETIOLOGY OF DIABETIC FOOT PROBLEMS

Foot complications usually are the result from the interplay of several causes. A multi-centre study had attributed 63% of diabetic foot ulcers to the triad of peripheral sensory neuropathy, trauma, and deformity.

Diabetic neuropathy involves sensory, motor, and autonomic neuropathy. Sensory neuropathy leads to a loss of protective sensation. As such, a minor foot trauma may remain unrecognised, leading to ulceration. Common causes of trauma include ill-fitting footwear, unnoticed foreign objects in the shoes, use of improper instruments for foot care, application of corn cures and agents for removing hard skin, walking barefooted, and scalds from washing with hot water. The ulcer forms an entry point for bacteria, and infection then ensues.

Motor neuropathy can lead to muscle atrophy, foot deformity, and altered bio-mechanics; this exposes parts of the foot to high pressures during standing or walking, or to pressure points with an ill-fitting shoewear. The repeated trauma remains unnoticed because of sensory deficit. Autonomic neuropathy results in a loss of sweating and the dry skin leads to cracks and fissures, the latter being portals of entry again. Autonomic neuropathy also leads to an alteration of the neurogenic regulation of cutaneous blood supply and an altered response to infection.

Diabetes is also associated with an increased risk of peripheral arterial disease (PAD). PAD is generally not the primary etiology; however it can be a major factor in an altered response to foot infections and the non-healing of foot ulcerations. The patients may not present with the typical claudication pain; nevertheless, it is still necessary to conduct a vascular examination to evaluate for PAD even in the absence of symptoms.

DIABETIC FOOT ULCERS

A thorough evaluation of any ulcer is critical; an adequate description of the ulcer size, depth, appearance, and location is necessary. Serial measurements of the wound can help measure the rate of healing and therefore, the efficacy of treatment. Probing of the ulcer may be necessary to detect sinus tract formation, undermining of ulcer margins, and penetration to tendon sheaths, bone, or joints; osteomyelitis must be excluded. Radiographs may be helpful in deep or

longstanding ulcers to rule out osteomyelitis; however, radiographs are not a very sensitive indicator of acute bone infection. Where the radiographs are negative and in the presence of clinical suspicion, bone scan or MRI may be conducted. Bone scan may be falsely positive in the Charcot's arthropathy; MRI offers better specificity. Nevertheless, the gold standard for osteomyelitis is a bone biopsy.

Assessment of the cause of the ulcer assists the clinician in determining the most appropriate treatment; a predominatly ischaemic cause must be differentiated vs. a neuropathic cause. Treatment for neuropathic ulcers is mainly non-surgical. However, patients with ischaemic or neuroischaemic ulcers may require revascularisation to achieve healing.

CLASSIFICATION AND TYPES OF DIABETIC FOOT ULCERS[11]

Several foot classifications schemes have been proposed. The Wagner and University Of Texas systems are the ones most frequently used for classification; the latter becoming an increasingly popular system.

The University of Texas diabetic wound classification system first grades wounds by depth and then stages them by the presence or absence of infection and ischaemia. The UT system's inclusion of stage makes it a better predictor of outcome; it has been found that increasing stage, regardless of grade, is associated with increased risk of amputation and prolonged ulcer healing time.

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 localised to portion of forefoot or heel
5	Extensive gangrenous involvement of the entire foot

The diabetic foot ulcers can be divided into two groups:
a. the *neuropathic* ulcers
b. the *neuroischaemi*c ulcers

	Neuropathic foot/ ulcers	**Neuro-ischaemic foot/ ulcers**
Feet	Foot is warm, well perfused with palpable pulses. Sweating is diminished; skin dry with fissuring.	Foot is cool and pulseless. Dusky/ cyanotic colour. Skin is thin and shiny, and without hair. Atrophy of subcutaneous tissue Intermittent claudication and rest pain +/- (latter if neuropathy)
Cause of ulceration	Repetitive mechanical forces of gait leading to callus formation. The callus presses on the soft tissues underneath, causing ulceration.	Tight shoes Slip on shoes causing friction on the vulnerable margins of the foot
Pre-ulcerative lesion	Callus	Red mark on the skin Superficial blister
Site of ulcer	Plantar aspect of the foot under the metatarsal heads or on the plantar aspects of the toes 	On the margins of the foot especially on the medial surface of the first metatarsophalagenal joint and the lateral aspect of the fifth metatarsophalagenal joint Tips of the toes Beneath any toenails 

The annual diabetic foot screen:

1. History:

- Symptoms of numbness, pain and needles, claudication pain,
- Past history / existing foot problems (e.g. previous ulceration, amputation)

2. Examination

a. Inspection:

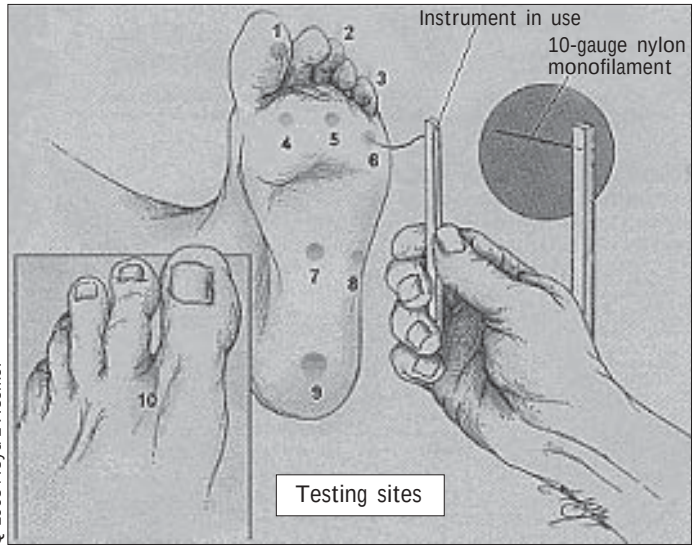
- General condition
- Colour of skin
- Type of skin (dry / cracked / peeling) – remember the toe webs
- Edema
- Callus / signs of pressure
- Nail deformities (thick / deformed)
- Deformities (e.g. high arch feet, bunions, claw toes, hammer toes, Charcot foot)
- General hygiene / self care

b. Vascular examination

- Palpation of foot pulses – Dorsalis pedis and the posterior tibial pulses
- Ankle-brachial pressures (ABPI): The division of the ankle systolic blood pressure over the brachial systolic pressure calculates the ABI. The normal ABI is 1 to 1.3. An ABI of 0.9 has 95% sensitivity of detecting angiogram positive PAD and is associated with greater than 50% stenosis in one major vessel. An ABI 0.4 to 0.9 suggests arterial obstruction associated with claudication and an ABI < 0.4 indicates severe ischaemia.
- Colour flow duplex ultrasonography

c. Neurological examination

- Sensory testing – 10G monofilament



Place the monofilament perpendicular to the non callused areas of the foot or unbroken skin, hold for 2 to 3 seconds after the monofilament buckles. This is a good test for light touch sensation.

- Vibration sense testing – Neurothesiometer
  The neurothesiometer assesses diabetic neuropathy by measuring the vibration sense. Apply the test tip to a bony point, record the voltage level that the patient can feel the vibration. Normal subjects should easily feel 5-10V but with diabetic neuropathy, the patient cannot feel 25V.

3. Result of examination

The patient may require close follow-up by the nurse or doctor. The patient with the at-risk foot may be referred to the podiatrist, vascular surgeon, or orthopaedic surgeon for further treatment.

MANAGEMENT OF THE DIABETIC FOOT

1. Classification of Foot risk

(Prevention and management of foot problems. London (UK): National Institute for Clinical Excellence (NICE); 2004)[10]

i. Low current risk (normal sensation, palpable pulses)
ii. At increased risk (neuropathy or absent pulses or other risk factor)
iii. At high risk (neuropathy or absent pulses plus deformity or skin changes or previous ulcer)
iv. Ulcerated foot

a. Care of People at **Low Current Risk** of Foot Ulcers (Normal Sensation, Palpable Pulses)
Foot care education is imparted to improve patient's knowledge, encourage self-care and to minimise inadvertent self-harm.

b. Care of People at **Increased Risk** of Foot Ulcer (Neuropathy or Absent Pulses or Other Risk Factor)
Patients with risk factors for ulceration should be referred to a foot team for regular 3-6 monthly reviews.

c. Care of People at **High Risk** of Foot Ulcers (Neuropathy or Absent Pulses Plus Deformity or Skin Changes or Previous Ulcer)
Patients at high risk for ulceration should be referred to a foot team for intensive review at 1-3 monthly.

d. Care of People with **Foot Care Emergencies and Foot Ulcers**
Foot care emergencies include new ulceration with swelling and discolouration in which case an urgent referral to a multidisciplinary foot care team should be made within 24 hours. The foot team is expected to investigate and treat the vascular insufficiency, initiate wound debridement and dressings, and start systemic antibiotic therapy for cellulitis or bone infection as indicated. The treatment should also include measures to offload, employing the use of special footwear, orthotics, and casts. Efforts to optimise glucose level control and control of risk factors must not be undermined.

TREATMENT OF THE DIABETIC FOOT ULCER – MULTIDISCIPLINARY APPROACH

The etiology of diabetic foot ulcers is multifactorial; the prevention and optimal treatment of which also require a multidisciplinary approach.

1. Wound management

The mainstay of ulcer therapy is debridement of all unhealthy tissue, e.g. necrotic, callus or fibrous tissue. However, debridement should be cautious if the foot is ischaemic. It is also important to probe the ulcer to exclude an underlying sinus or osteomyelitis. Deep swab and tissue samples (not superficial skin swabs) should be sent for aerobic and anaerobic culture before initiation of wide spectrum antibiotic treatment. The gold standard test for osteomyelitis is a bone biopsy processed for culture and histology.

The inflammatory response may be decreased in diabetics and signs of infection may be masked; hence, cultures become imperative in treating these infections. Broad-spectrum antibiotics may be initiated at first; however, antibiotic coverage should subsequently be changed according to the clinical response and culture sensitivity results. Aerobic gram-positive bacteria are the sole causative pathogens for most mild and moderate infections; in chronic or previously treated wounds, infections are polymicrobial (comprising gram-negative bacilli and anaerobes). Treatment duration ranges from 1-2 weeks (for mild infections) to 6 weeks in the presence of osteomyelitis[12,13,14]. The aim of antimicrobial therapy is to cure the infection and not to heal the wound. Antibiotic treatment without off-loading is also unlikely to result in wound healing.

Pseudomonas aeruginosa and Enterococcus species often represent colonisers and do not need directed antibiotic therapy.

Anti-microbial therapy for infected foot ulcers in patients with Diabetes[12]

Clean, uninfected ulcers: no antimicrobial therapy needed

Mild infection (staphylococci and streptococci)

- Oral therapy: Cloxacillin 250–500 mg every 6 hours, Amoxicillin/clavulanate 500 mg every 8 hours or 875 mg every 12 hours
- If allergic to penicillin: Clindamycin 150 to 300 mg every 6 hours plus Levofloxacin 750 mg once daily or Ciprofloxacin 750 mg every 12 hours

Moderate to severe infection (mixed aerobic and anaerobic bacteria): Intravenous therapy

- Ampicillin/Sulbactam 3 g every 6 hours
- Piperacillin/Tazobactam 4.5 mg every 8 hours
- Clindamycin 900 mg every 8 hours plus Ciprofloxacin 400 mg every 12 hours or Levofloxacin 500 mg every 24 hours

Topical antiseptics are usually toxic to the healing wound; and a saline dressing will be recommended. Other commercially available special dressings include semipermeable films, foams, hydrocolloids and calcium alginate swabs.

Urgent surgical intervention is required if there is a large area of infected slough, fluctuance and expression of pus, crepitus with gas in the soft tissues, subcutaneous necrosis, and wet gangrene.

2. Mechanical control

Pressure relief on ulcers or off-loading should always be part of the treatment plan; the purpose of which is to redistribute the plantar pressures. The most effective way is to provide a total contact cast (TCC), a prefabricated cast for the neuropathic ulcer. Alternatives are removable walking braces, ankle foot orthosis to off load the plantar surface; felted-foam and soft polymeric insoles may be employed at the same time. Ill-fitting footwear should be replaced and crutches or a wheelchair might help.

In the neuroischaemic foot, the aim is to protect the vulnerable margins of the foot. As such, a wide-fitting shoe bought off the shelf may be adequate. Irrespective of the off-loading technique, diabetic patients with foot ulcers should be encouraged to reduce their activity levels, rest and elevation should be initiated at first presentation.

3. Vascular surgery

The standard treatment for patients with ischaemic or neuroischaemic ulceration had been femorodistal bypass. However, the treatment severe limb ischaemia remains controversial. The BASIL[15] (Bypass versus angioplasty in severe ischaemia of the leg) trial, a recent multi-centre, randomised control trial compared the outcome of bypass surgery and balloon angioplasty in such patients. The result was that in patients presenting with severe limb ischaemia due to infra-inguinal disease and who are suitable for surgery and angioplasty, a bypass-surgery-first and a balloon-angioplasty-first strategy are associated with broadly similar outcomes in terms of amputation-free survival, and in the short-term, surgery is more expensive than angioplasty.

4. Optimal glycaemic control and atherosclerotic risk reduction

Optimal glycaemic control is necessary for wound healing. Treatment for all forms of diabetic neuropathy also requires strict glycaemic control. The risk of atherosclerosis can be reduced by optimal blood pressure control, smoking cessation, dietary discretion, lipid lowering treatment, and antiplatelet treatment.

PREVENTION

After the ulcer heals, the patient should continue to use appropriate therapeutic footwear. The provision of patient education and regular footcare can help prevent recurrent ulcers. Regular foot examinations and early detection of neuropathy help prevent ulcers caused by unrecognised foot injuries. Timely referral to a multidisciplinary foot care team may be necessary.

Nevertheless, the patient has to be engaged in care. Self-monitoring and inspection of feet by people with diabetes should be encouraged. (NICE guidelines Recommendation Grade D).

One excellent patient resource: 'Take care of your feet for a lifetime' by the National Diabetes Education Program (NDEP)[16].

There are many resources available at the polyclinics (NHGP and SingHealth), diabetic centres of the various hospitals, and the Diabetic Society of Singapore (DSS) that offers annual foot screen and foot care for the diabetic patient.

THE CHARCOT FOOT[17]

The Charcot foot is now seen mostly in patients with diabetes mellitus. In a study, 9 percent of patients with diabetic neuropathy had Charcot foot. Important aspects of the Charcot foot that the primary care physician should be aware:

- The acute Charcot foot can mimic cellulitis, or deep vein thrombosis.
- The acute Charcot process may include warmth, erythema, and swelling. However, pain and tenderness are usually absent because of sensory neuropathy; nevertheless, the presence of pain does not totally exclude the diagnosis. The absence of pain or minimal pain may cause patients and physicians to ignore this serious disease.
- Inappropriate treatment with antibiotic treatment or incision and drainage may lead to disastrous complications. Strict immobilisation and protection of the foot (most often in a total contact cast) are the recommended management of an acute Charcot process.
- Plain X-ray can be normal in the acute phase

Care of people with Charcot Osteoarthropathy

People with suspected or diagnosed Charcot osteoarthropathy should be referred immediately to a multidisciplinary foot care team for immobilisation of the affected joint(s) and for long-term management of offloading to prevent ulceration. An emergency referral to a multidisciplinary foot care team should be made within 24 hours if there is new ulceration, new swelling, or new discoloration (redder, bluer, paler, blacker over part or all of foot).

DIABETIC PAINFUL NEUROPATHY (DPN)

The pain associated with diabetic painful neuropathy is described as burning, stabbing, tingling numbness or itching and is typically worse at night. Treatment starts with strict glycaemic control as this can stop or slow the progression of sensorimotor neuropathy. The treatment of neuropathic pain may be oral medications, e.g. tricyclic antidepressants, antiepileptics, SSRI, duloxetine, tramadol, and narcotics. Transdermal medications, e.g. capsaicin cream, lidocaine patch, fentanyl patches have been used[18].

THE ROLE OF THE FAMILY PHYSICIAN

The family physician undoubtedly plays many important roles in the care of his diabetic patient[9]. The partnership of the informed activated patient with the prepared healthcare giver is paramount in providing optimal outcomes. The family physician performs the role of the *educator* who seeks engagement of his patient through education, is the *co-ordinator of care* when specialist care is sought and provided by a multi-disciplinary team.

Definitely, the family physician is the *comprehensive caregiver* who not only provides treatment for the diabetic condition and complications, but also treats to reduce the overall cardiovascular risk morbidity and mortality, and treats his medical conditions with respect to his social background. After all, the care of the patient is also about his quality of life.

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LEARNING POINTS

- **All diabetics should undergo an annual foot screen to identify the at risk foot; review may be at closer intervals if risk is assessed to be high.**
- **Diabetic foot ulcers should be adequately treated with antibiotics, debridement, off loading measures and if necessary, vascular surgery. Osteomyelitis must be excluded.**
- **Glycaemic control and other cardiovascular risk factors must be optimised.**
- **Remember the charcot foot in a diabetic.**
- **Engage the patient in partnership of care. A referral to a multi-disciplinary foot team may be necessary. However the family physician remains the coordinator of care.**