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Diabetes mellitus is emerging as a global problem and burden [1]. Like other complications of diabetes, diabetic foot problems are posing a health burden worldwide as well. This was the reason that International Diabetes Federation (IDF) has specifically focused on diabetic foot problems throughout the year 2005 and for which worldwide campaign to “put feet first” was held. Currently foot ulceration and its related problems has become common is, affecting up to 15% of patients with diabetes during their lifetime [2, 3]. Over 85% of lower limb amputations are preceded by foot ulcers and diabetes remains the most common cause of non-traumatic amputation in western world [4]. Furthermore, diabetes is now the most common cause of Charcot neuroarthropathy in Western world, which is again preventable [5]. By reviewing the diabetes history and Prior to 1980, it was thought that diabetic foot problems were due to be predominantly vascular and complicated by infection. Later on amputations were performed on patients with diabetes and osteomyelitis but found good blood supply on ulcer site [6,7]. Hence now diabetic foot problem is considered a complex and heterogeneous disorder and termed diabetic foot syndrome (DFS) with encompassing both neuropathy with vascular entity [8,9,10,11]. Only about half of patients actually notice the ulcer or wound themselves, with the majority occurring on the digits. Ill-fitting or poor footwear is among the most common cause of foot ulceration [12,13,14]. Hence Brand once documented, “pain is God’s greatest gift to mankind” because loss of pain and sensation (neuropathy) aggravates the pathology to develop foot ulcers and, despite of tissue damage and infection, patients continue walking with improper footwear which further complicates the situation [5,15]. Diabetic foot ulceration and amputations were estimated to cost US health care system about \$10.9 billion in 2001 and £ 252 million in UK in

2003 [16,17,18]. According to the most recent data from US, \$30.6 billion was spent on diabetic foot complications, ulcers, and amputations [19]. Nonetheless and in busy clinical practice, most of the physicians are unable to examine the diabetic feet properly and to provide education to diabetic patients regarding foot care.

Pathogenesis of diabetic foot ulcers

Apart from the patients' ignorance, poor footwear and poor hygienic conditions, diabetic neuropathy is the most common cause of foot ulcerations; neuropathy itself is most common form of the long-term complications of diabetes. Most common amongst the neuropathies which cause foot ulcers are chronic sensorimotor distal symmetrical polyneuropathy [20]. This type of neuropathy commonly results in a sensory loss of stocking distribution confirmed on examination by a deficit in the all sensory modalities. Patients may also give history of neuropathic symptoms such as burning/pricking or stabbing pain, and paresthesia especially at night. Hence neuropathy appears to be one of the most important risk factor and pathology for the development of diabetic foot ulceration. Others risk factors include cigarette smoking, dyslipidemia, and peripheral vascular disease (PVD). These all facts can be collected as a model for development of foot ulcers or Rothman model for causation. Both Pecoraro et al. [21] and later Reiber et al. [22] have taken the Rothman model as an explanation for the development of foot ulcers. According to this model, a component cause (e.g., neuropathy) is not sufficient in itself to lead to foot ulceration, but instead when component causes act together, they result in ulceration. Under this model, weight bearing areas (in the presence of dry skin due to neuropathy) are susceptible for callus (hypertrophic hard skin) formation due to repeated friction and trauma. This callus then acts as foreign body with central hemorrhage or necrosis. Plantar callus is the first trigger for the ulcer formation [23]. Similarly, abnormal plantar pressures play also an important role in the pathogenesis of foot ulcers [24]. Thus a combination of sensory and motor neuropathy with altered gait patterns result in the foot deformity or “high risk” neuropathic foot with clawing of the toes, prominent metatarsal heads, Hallux valgus, high arch and small muscle wasting. Advanced stages of neuropathy may lead to Charcot deformity.

In contrast to the neuropathic ulcers (which are usually painless), vascular ulcers are painful, and as a result of peripheral vascular disease (PVD). PVD is a major contributory factor in the pathogenesis of foot ulceration and subsequent major amputations [25]. Common unique symptoms of vascular involvement of lower limbs include claudication (pain in leg/calf by walking and relieved by rest) and rest pain. Patient also may present clinically with non-healing ulcers [26,27].

Management of diabetic foot ulcers

Education and prevention

Patient education in diabetology clinics and medical clinics is an essential component for diabetic foot management. Diabetic patient should know about regular self-inspection of feet, foot hygiene, proper foot wear, about regular examination by chiropody/podiatry person, and what action to take in case of injury or foot ulcer [28,29,30].

Screening/examination of feet in the diabetology clinics

First step in prevention is the identification of the “at risk” foot for which annual/bi-annual review is essential in the diabetology or general practitioner clinics. A taskforce of the American Diabetes Association recently has recently proposed “comprehensive diabetic foot examination (CDFE)” for annual review [31]. CDFE includes through inspection of foot such that evidence of past/present ulcer; foot shape (prominent metatarsal heads/claw toes, hallux valgus, muscle wasting, Charcot deformity); dermatologic

(callus, erythema, sweating); neurological (10-g monofilament, vibration testing using 128 Hz tuning fork, pinprick sensation testing, ankle reflexes); and vascular examination (foot pulses, ankle brachial index,ABI). Most important, presence of callus should alarm the physician that this patient is at high risk of developing ulceration, and callus should be removed by podiatrist or foot care specialist nurse. Callus usually contains central hemorrhage and is a potential site for infection and future ulceration.

Referral to specialist diabetic foot care multidisciplinary team

Any non-healing chronic wound should be referred to diabetic foot specialist team. This includes endocrinologist/diabetologist, chiropodist or podiatrist, orthopedic surgeon and plastic surgeon (the surgical team) and rehabilitation unit for off-loading, making special foot wear and appropriate medical management of infection and comorbidities or surgical intervention [32,33,34,35,36,37,38,39].

All above described facts about diabetic foot are briefly described in table-1

Table 1. Etiopathology of foot ulcers, types, prevention and treatment in brief

Primary reasons for foot problems in diabetes			
Microvascular	Peripheral neuropathy & loss of protective sensation		
Macrovascular	Vascular insufficiency/ischemia, peripheral vascular disease (PVD)		
Metabolic	Hyperglycemia		
Trauma	Repetitive and acute, footwear injury		
Foot deformities	Prominent metatarsal heads/claw toes (excess plantar pressures), hallux valgus, hammer toes, bunion, Charcot deformity		
Dermatologic	Dry skin, callus, corns, tinea (fungal infection), ulcers (\pm infected)		
Types of foot ulcers			
Description	Neuropathic	Ischemic	Neuro-ischemic
Circulation	Intact/bounding pulses	Decreased/absent pulses	
Site of ulcer and infection	Pressure/plantar surface; often preceded by callus formation (with central hemorrhage); \pm sepsis/osteomyelitis	Lesions on the margins of foot, tip of toes, heels; absence of callus; \pm necrosis/gangrene/osteomyelitis (pink to blackish discoloration) Critical ischemia (urgent attention) Pink, painful, pulseless and often cold foot	Sharing both features of neuropathic and ischemic ulcers
Pain	Painless (other symptoms: burning, stabbing, pricking sensations specially at night)	Severe pain all over the day and night	
Feet temperature	Warm	Not warm/cold	
Examination	10-g monofilament (to check loss of protective sensations) vibration perception by 124 Hz tuning fork, pin prick, tendon reflexes	Pulses (dorsalis pedis, posterior tibial, popliteal); ABI, ankle brachial index, assessment useful Normal : 1-1.3 Ischemia < 1.0 Calcified > 1.3 (false +)	
Prevention			
Patient Education and foot care advises			
Regular clinical examination of feet			
Planter pressure measurement by special devices			
Therapeutic footwear			
Foot ulcers : Treatment principles (Multidisciplinary team approach)			
Debridement			
Pressure relief (“off-loading”)			
Appropriate wound management			
Management of infection			
Management of ischemia			
Medical management of co-morbidities			
Surgical management			

Globally, diabetic foot complications remain still a major medical, social and economic problems that are seen in every country with varying prevalence[40,41].

There remains an unresolved issue in diabetic foot management which demands further research in diabetic medicine [42]. Diabetes remains a major cause of non - traumatic amputation worldwide with rates being as much as 15 times higher than in the non-diabetic population.

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