
Review Article

Physiatrist's Assessment and Management of Diabetic Foot

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ABSTRACT

The incidence of diabetes is increasing day by day in India. By the year 2030, India will be the world capital of diabetes. Foot ulcerations, infections and Charcot neuropathic osteoarthropathy are three serious foot complications of diabetes mellitus that can too frequently lead to gangrene and lower limb amputation. Although not all foot complications can be prevented, dramatic reductions in their frequency have been achieved through the implementation of team approach to diabetic patient management. A multidisciplinary team approach is recommended for individuals with diabetic foot ulcers. Foot ulcers and wound care may require care by a podiatrist, orthopedic surgeon, vascular surgeon and physiatrist experienced in the management of individuals with diabetes. A Physiatrist is a medical doctor who specializes in physical medicine and rehabilitation. Physiatrists diagnose and treat both acute and chronic pain, and specialize in a variety of nonsurgical treatment for the musculoskeletal system. Initial screening for peripheral arterial disease (PAD) should include a history of claudication and an assessment of pedal pulse. Ankle brachial index (ABI) to be obtained in as many patients with PAD being asymptomatic. The neurologic examination recommended is designed to identify loss of protective sensation by simple clinical tests like use of a 10 G monofilament, tests of pinprick sensation, ankle reflex assessment, vibration testing using a 128HZ tuning fork and testing vibration perception threshold with a Biothesiometer. Patients with diabetes and high risk foot conditions should be educated about proper care of the foot and the selection of appropriate footwear. Plantar pressure is measured using podia scan and areas of high plantar pressure are identified. Footwear which offers pressure relief over these high plantar pressure areas is then prescribed. Interim footwear to be used by the patients who have forefoot and hind foot ulcers which require off loading the ulcer areas till the ulcer is healed.

Key words: Ankle brachial Index, Biothesiometry, Podia scan, Ideal diabetic footwear

INTRODUCTION

The incidence of diabetes is increasing day by day in India. In India, diabetic foot ulcers affect 15% of diabetics during their lifetime. Evidence from published literature shows 100,000 leg amputations are done per year due to diabetes related problems which results in an expense of approximately \$1,960 for complete treatment of diabetic foot ulcers. Out of 62 million diabetics in India, 25% develop diabetic foot ulcers, of which 50% become infected, requiring hospitalization

while 20% need amputation. Diabetic foot ulcers contribute to approximately 80% of all non-traumatic amputations in India, annually. ⁽¹⁾

The risk factors for the diabetic foot ulceration include vascular disease, peripheral neuropathy, limited joint mobility, foot deformities, abnormal foot pressures, minor trauma, history of ulceration or amputation, and impaired visual acuity. Early recognition and management of risk factors can prevent or delay adverse outcomes and the goal of the

Physiatrist is to prevent limb loss among diabetics and maintain their quality of life.

FOOT CARE RECOMMENDATIONS ⁽²⁾

- ❖ Perform a comprehensive foot evaluation at least annually to identify risk factors for ulcers and amputations.
- ❖ Patients with evidence of sensory loss or prior ulceration or amputation should have their feet inspected at every visit.
- ❖ Obtain a prior history of ulceration, amputation, Charcot foot, angioplasty or vascular surgery, cigarette smoking, retinopathy, and renal disease and assess current symptoms of neuropathy (pain, burning, numbness) and vascular disease (leg fatigue, claudication).
- ❖ The examination should include inspection of the skin, assessment of foot deformities, neurological assessment (10-g monofilament testing with at least one other assessment: pinprick, temperature, vibration), and vascular assessment including pulses in the legs and feet.
- ❖ Patients with symptoms of claudication or decreased or absent pedal pulses should be referred for ankle-brachial index and for further vascular assessment as appropriate.
- ❖ A multidisciplinary approach is recommended for individuals with foot ulcers and high-risk feet (e.g., dialysis patients and those with Charcot foot or prior ulcers or amputation).
- ❖ Refer patients who smoke or who have histories of prior lower-extremity complications, loss of protective

sensation, structural abnormalities, or peripheral arterial disease to foot care specialists for ongoing preventive care and lifelong surveillance.

- ❖ Provide general preventive foot self-care education to all patients with diabetes.
- ❖ The use of specialized therapeutic footwear is recommended for high-risk patients with diabetes including those with severe neuropathy, foot deformities, or history of amputation.

VASCULAR EXAMINATION:

Peripheral vascular disease rarely leads to foot ulcerations directly. However, once ulceration develops, arterial insufficiency will result in prolonged healing and imparts an elevated risk for amputation. Vascular assessment would include inspection and assessment of pedal pulses. Initial screening for PAD should include a history of decreased walking speed, leg fatigue, claudication, and an assessment of the pedal pulses. Ankle-brachial index testing should be performed in patients with symptoms or signs of PAD. ⁽³⁾ The Ankle Brachial Index (ABI) is the ratio of the blood pressure in the lower legs to the blood pressure in the arms. Compared to the arm, lower blood pressure in the leg is an indication of blocked arteries (peripheral vascular disease). The ABI is calculated by dividing the systolic blood pressure at the ankle by the systolic blood pressures in the arm. The following can be used as a guide to interpreting results of ankle brachial index ⁽⁴⁾

1. Normal ABI ranges from **1.0 — 1.4**
 - a. Pressure is normally higher in the ankle than the arm.
2. Values **above 1.4** suggest a non compressible calcified vessel.
 - a. In diabetic or elderly patients, the limb vessels may be fibrotic or calcified. In this case, the vessel may be resistant to collapse by the blood pressure cuff, and a signal may be heard at high cuff pressures. The persistence of a signal at a high pressure in these individuals results in an artifactually elevated blood pressure value.
3. A value **below 0.9** is considered diagnostic of PAD.
4. Values **less than 0.5** suggests severe PAD.
 - a. Individuals with such severe disease may not have sufficient blood flow to heal a fracture or surgical wound; they should be considered for revascularization if they have a non-healing ulcer.

Figure 1: Interpretation of the Ankle Brachial Index

Refer patients with significant symptoms or a positive ABI for further vascular assessment and consider exercise, medications, and surgical options. Patients with ABI 0.6 to 0.9 will be taught Buerger's exercise and prescribed vasodilators like Cilostazol 100 mg twice daily until symptoms improve. Cilostazol is a quinolinone derivative that inhibits specific cellular phosphodiesterases, which cause arterial vasodilation and inhibition of platelet function and makes it a valuable as a therapy of intermittent claudication and as a means of secondary prevention of stroke. (5) Patients with ABI 0.5 – 0.8 and below 0.5 to undergo non-invasive arterial studies like Doppler study and referred for revascularization procedures to prevent limb loss because arterial perfusion is a vital component for ulcer healing.

NEUROLOGICAL EXAMINATION:

The neurologic examination recommended is designed to identify loss of protective sensation (LOPS) rather than early neuropathy. The clinical examination to identify LOPS is simple and requires no expensive equipment. Five simple clinical tests (use of a 10-g monofilament, vibration testing using a 128-Hz tuning fork, tests of pinprick sensation, ankle reflex assessment, and testing vibration perception threshold with a biothesiometer), are considered useful in the diagnosis of LOPS in the diabetic foot.

Use of the vibration perception threshold (VPT) is a simple way of detecting large-fiber dysfunction, thus identifying individuals with diabetes at risk of ulceration. (6-7) The Bio-thesiometer is an instrument designed to measure simply and accurately the threshold of appreciation of vibration in human subjects. It is essentially an "electrical tuning fork" whose amplitude may be set to any predetermined level or whose amplitude may be gradually increased until the threshold of vibratory sensation is reached. The Bio-thesiometer is not only far superior to a tuning fork in accuracy, but will detect neurological changes that are not disclosed with a tuning

fork. The results of the vibration perception threshold (VPT) testing are interpreted as follows: (7)

Table 1: Interpretation of vibration perception threshold values:

Vibration Threshold	Pressure	Interpretation/ Grading for risk of developing foot ulcer
< 15 V		Normal
15 – 20 V		Mild
20 -25 V		Moderate
> 25 V		Severe

The risk of developing a neuropathic ulcer is much higher if a person has a Bio-thesiometer reading greater than 30-40 volts.

Patients with diabetes and high-risk foot conditions should be educated regarding their risk factors and appropriate management. Patients at risk should understand the implications of the LOPS, the importance of foot monitoring on a daily basis, the proper care of the foot, including nail and skin care, and the selection of appropriate footwear. Patients' understanding of these issues and their physical ability to conduct proper foot surveillance and care should be assessed. Patients with visual difficulties, physical constraints preventing movement, or cognitive problems that impair their ability to assess the condition of the foot and to institute appropriate responses will need other people, such as family members, to assist in their care. Patients who are found to have diabetic neuropathy are treated with antidepressants, anticonvulsants, topical agents, opiate analgesics and vitamin B12 supplementation.

PLANTAR PRESSURE MEASUREMENT:

High plantar foot pressure has been identified as a significant risk factor for ulcerations. A large number of studies have suggested that plantar pressures are high in people with diabetic peripheral neuropathy (DPN) and in people with a history of diabetic foot ulcers. (8-17) Measurement of these foot pressures is possible utilizing a variety of modalities. Several computerized systems can provide quantitative measurement of plantar foot pressure. These

measurements are important in identifying areas of the foot at risk for ulceration and possibly in the evaluation of orthotic adjustments. Podia scan, which consists of Harris mat, special scanner copier and printer, image analysis software and patient reporting software is not as sophisticated, but can provide a qualitative measurement of plantar foot pressures, both dynamic and static. When the patient steps over the Harris mat, greater local foot forces deposit more ink and detects the area of greatest concern for ulceration. Thus the Harris mat produces a weight bearing imprint of the foot and the podia scan produces qualitative multi color output and makes the pressure reading easier.

DIABETIC FOOTWEARS:

People with neuropathy or evidence of increased plantar pressure (e.g., erythema, warmth, callus, or measured pressure) may be adequately managed with well-fitted walking shoes or athletic shoes that cushion the feet and redistribute pressure. ⁽¹⁸⁾ Proper footwear is an important part of an overall treatment program for people with diabetes. Ideal diabetic footwear will relieve areas of excessive pressure, reduce shock and shear, accommodate, stabilize and support deformities and accommodate shoe inserts. There are two types of therapeutic shoes for diabetes. They are depth shoes and custom molded shoe. Depth shoe provides a minimum of 3/16" (4.7mm) of additional depth used to accommodate custom – molded or customized inserts. People with bony deformities (e.g., hammertoes, prominent metatarsal heads, bunions) may need extra-wide or depth shoes. Custom–molded shoe is constructed over a positive model/mold of a patient's foot. People with extreme bony deformities (e.g., Charcot foot) who cannot be accommodated with commercial therapeutic footwear may need custom-molded shoes. Footwear which are mass produced and then modified to fit an individual is called customized footwear. Medically indicated temporary footwear that permits ambulation and facilitates wound

healing or post trauma recovery for the involved foot are called interim footwear. There are fore foot pressure relieving foot wear , hind foot pressure relieving footwear and rocker bottom footwear for relieving pressures at forefoot, hind foot and mid foot respectively.

PREVENTION:

The following are the important attributes of a foot ulcer prevention program undertaken within the framework of the multidisciplinary team.

- **PODIATRIC CARE**

Regular visits, examinations, and foot care

Risk assessment

Early detection and aggressive treatment of new lesions

- **PROTECTIVE SHOES**

Adequate room to protect from injury; well cushioned walking sneakers, extra depth, custom molded shoes

Special modifications as necessary

- **PRESSURE REDUCTION**

Cushioned insoles, custom orthoses, padded hosiery

Pressure measurements-computerized or Harris Mat

- **PROPHYLACTIC SURGERY**

Correct structural deformities- hammertoes, bunions, Charcot

Prevent recurrent ulcers over deformities

Intervene at appropriate time

- **PREVENTIVE EDUCATION**

Patient education – need for daily inspection and necessity for early intervention

Physician education – significant foot lesions, importance of regular foot examination, and current concepts of diabetic foot management.

CONCLUSION

Ulceration, infection, gangrene and lower extremity amputation are complications often encountered in patients with diabetes mellitus. These often result in extensive morbidity, repeated hospitalizations and mortality to the patient. All diabetic foot complications cannot be prevented but it is indeed possible to dramatically reduce their incidence through

appropriate management and prevention program. The multidisciplinary team approach to diabetic foot disorders is the optimal method to achieve favorable rates of limb salvage in the high risk diabetic patient. Foot care programs emphasizing preventive management can reduce the incidence of foot ulceration through modification of self care practices, appropriate evaluation of risk factors, and the formulation of treatment protocols aimed at early intervention, limb prevention and the prevention of new lesions. The physiatrist should play an integral role in this scheme, providing ongoing surveillance, education and management of new or impending lesions.

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