

Prevention of Diabetic Foot Ulcer

Bijan Iraj, Fariborz Khorvash¹, Alireza Ebnesahidi, Gholamreza Askari²

Isfahan Endocrine and Metabolism Research Center, Isfahan University of Medical Sciences, Isfahan, Iran, ¹Department of Neurology, Neuroscience Research Center, Isfahan University of Medical Sciences, Isfahan, Iran, ²Food Security Research Center, Isfahan University of Medical Sciences, Isfahan, Iran

Correspondence to:

Assistant Prof. Gholamreza Askari,
Food Security Research Center,
Isfahan University of Medical
Sciences, Isfahan, Iran.
E-mail: askari@mui.ac.ir

Date of Submission: Jan 27, 2012

Date of Acceptance: Oct 12, 2012

How to cite this article: Iraj B, Khorvash F, Ebnesahidi A, Askari G. Prevention of diabetic foot ulcer. *Int J Prev Med.* 2013;4:373-6.

INTRODUCTION

It is estimated that on an average 7% of the world population are diabetics now and this number is estimated to increase to 8.3% by 2030. It is also estimated that 80% of the diabetics patients live in developing countries.^[1]

On an average every 30 s an extremity is amputated due to complications of diabetes mellitus (DM) and the majority of these amputations are secondary to foot ulcers.^[2]

Diabetic foot ulcer (DFU) is not only a patient problem but also a major health care concern throughout the world. Diabetic foot ulcer is one of the common and serious complications in diabetic patients.

Treatment of infection in diabetic ulcer is difficult and expensive. Patients usually need to take long-term medications or become hospitalized for an extended period of time. It is estimated that usually 15-25% of diabetic patients develop DFU during their life-time.^[3]

On the other hand, more than 70% of patients who have developed DFU, experience an exacerbation of the disease in the next 5 years.^[4] The ulcer usually appears in the same extremity or the extremity of the opposite side; at least a quarter of these ulcers do not heal.^[5,6]

If an ulcer develops unfortunately, the treatment is challenging and need long duration. Teamwork consists of orthopedic surgeon, endocrinologist, infectious disease physician and a trained nurse in dressing is necessary to care for the wound. It is also advisable to add a podiatrist to the team if one is available.

DFU treatment is expensive. On an average, the treatment cost for wounds with Wagner grade I in five industrialized countries was \$3096 in 2010. However, if the wound becomes complicated and amputated, the cost will rise to almost \$107900.^[7] Therefore, based on the noble quote in health care profession "prevention is better than the treatment of the disease," Diabetic patients and health care providers to diabetic patients should familiarize themselves with the principals of diabetic foot ulcer prevention. The training methods should be designed in a manner that diabetic patients understand and perform the foot care as it is intended.

Now the goal should be based on decreasing the amputation rate in diabetic patients, in addition to adequate training of the patients and the team providing care to the patients. The periodic

close monitoring of the patient by the health care providers should also be considered.

It is important to note the increased prevalence of type two DM in children and adolescences, which by itself is a worldwide health problem. As a result, we unfortunately should expect the higher rate of micro and macro vascular complications of diabetes and increase rate of DFU in younger ages.^[8]

PATHO PHYSIOLOGY

The most common contributing factors in creating DFU are neuropathy, peripheral artery disease (PAD), deformity and minor trauma.^[9] However, when the ulcer appears, other factors usually influence the outcome of the disease. The additional contributing factors are necrosis, gangrene, infection, PAD, advanced age of the patient and other co morbidities such as end stage renal disease (ESRD), and heart failure.^[10] The DFU patients are usually older males with a history of prolonged DM combined with poor health condition. They usually depend on assistance of others to perform their daily activities. The average age of these patients is 65 years and they are usually presented with the disease for at least 10 years. The majority of them have a history of uncontrolled diabetes in addition to increased level of HbA1c, and in one-third of the cases other co-morbidities are present.^[11]

Neuropathy results in insensitivity and sometimes causes a deformity in the foot. In these patients, even a minor trauma may lead to a chronic ulcer. Furthermore, the persistent walking on the affected foot, which is insensitive to pressure sense, alters the healing process. In the presence of peripheral vascular disease, the wound becomes ischemic and a non-healing ulcer develops.

In patients with neuro ischemic ulcer, unfortunately, the classic signs of infection such as pain, warmth and tenderness are masked. The decrease in pain and tenderness is due to neuropathy and the warmth and redness diminishes significantly because of ischemia. These changes may confuse the physician and results in misdiagnosing for wound infection.

Patients' training plays an important role in prevention of DFU. The goal of training is to motivate the patient, and create adequate skills in

order to maximize the use of preventive methods. It is also essential to make sure that the patient has understood all the instructions.

It is determined that the classic pattern of plantar, fore foot and mid foot is observed in 22% of the patients, and the majority of the ulcers are located in the dorsal foot or in the interdigital spaces.^[11]

Therefore, the DFU prevention guidelines should be design for non-plantar ulcers.

The following risk-factors increase the risk of DFU or amputation in the patients: ^[12]

- Previous amputation
- Previous history of DFU
- Peripheral neuropathy
- Foot deformity
- PAD
- Diabetic nephropathy specially ESRD
- Poor glycemic control
- Cigarette smoking.

PREVENTION RECOMMENDATIONS

Prevention and management of diabetes complications

Diabetes is a chronic metabolic disease, which affects the vascular system extensively throughout the body. The metabolic complications of DM should be treated concomitantly with no bias in treating one metabolic complication over others. The metabolic diseases secondary to DM should be controlled and the target values should be kept below the recommended standard. As a result, the preventive measures should be taken in order to control the neuropathy and PAD, which are the main cause of DFU.

The preventive measures and management of diabetic complications consists of the following:

- Life style modification
- Blood pressure control
- Lipid management
- Glycemic control
- Smoking cessation.

Nail and skin care

- Diabetic patients should examine their feet on a daily bases. The maceration especially between the toes is usually caused by fungal infection and should be observed carefully. It is

recommended to use a mirror in order to better observe the plantar surface of the foot. In case, if the diabetic patient's vision is compromised due to retinopathy or the patient is unable to perform the daily examination of own feet, another individual who is fully trained should do the task for the patient.

- The feet should be washed and dry at least once a day. It is important to dry the inter-digital spaces between the toes very carefully.
- The temperature of the water used for rinsing the foot should be less than 37 centigrade. It is recommended to use the elbow or forearm in order to estimate the temperature of water. This method helps to prevent accidental burning of the extremities due to characteristic glove stocking neuropathy in diabetic patients.
- The diabetic patients, especially the ones with sensory neuropathy, should not use the heating pads over their bodies. It is also recommended to warn the patient not to place their feet close to the heaters during the winter.
- All the patients especially those with diabetic neuropathy or high risk diabetic foot should be instructed to use footwear both indoors and outdoors. It is recommended to wear special shoes with adequate size when the patient is walking indoor on the carpet. The use of the shoes without stockings in diabetic patients should be discouraged. In patients with neuropathy, it is also recommended to use the footwear's with enclosed frontal part in order to prevent the minor trauma to the fore foot.
- It is recommended to observe and physically examine inside the patients shoes on a daily basis. This recommendation is given to detect any external objects inside the shoes and to look for pressure effect on different surfaces of the patient's feet. The lateral engorgement of the shoes is an indication of pressure exerted by the first and fifth metatarsals and the swelling observed in the frontal part of the shoes is caused by the pressure of distal phalanges of the first digit.
- Diabetic patients due to autonomic neuropathy present with increased perspiration in the upper thorax and lower extremity, perspiration decreases. As a result, the dryness of the plantar surfaces of the feet and heels is common. The minor trauma combined with the dry skin creates cracks which facilitate the entrance of microorganisms into the

skin and consequently foot infection is inevitable. It is recommended to apply lubricants containing urea or salicylates with the ability to penetrate the dry and hyperkeratosis skin. However, the use of lubricants in the inter-digital spaces is discouraged.

- In diabetic patients it is recommended to change and put on clean socks on a daily bases.
- The patients should be discouraged wearing tight sock and the seams should be toward the outside. In diabetic patients it is not advisable to wear stockings up to the knee.
- Especially in female diabetics, any kind of manipulation of the nails is not recommended. The nails should not be cut in a rounded fashion, the straight across cut is recommended.
- The patient should be instructed not to use any kind of chemical substances or commercial pads or plasters in order to treat the calluses of the feet.^[13]

ANNUAL COMPREHENSIVE FOOT EXAMINATION

All the diabetic patients should undergo comprehensive foot exam once a year. The goal of this examination is to determine the risk factors that may result in foot ulcer and consequently amputation of the affected organ. The physical examination contains observation, palpation of the pulses in the lower extremities, including the posterior tibial and dorsalis pedis pulses. The physical examination also includes neurological tests. At least two neurologic tests are performed and one of the tests should measure the protective sensation in which a 10 g monofilament is used. Vibration sensation using a 128 Hz diapason, Pinprick sensation, ankle reflex and position are other neurologic test performed in comprehensive foot exam.^[12]

CONCLUSION

DFU is a costly and debilitating disease with severe consequences in diabetic patients. It is important to carefully and completely train the preventive measures as well as foot care to all diabetic patients. The recommendation should be reinforced every time a physical examination is performed. The physician should be certain that

the patient has understood the recommendations and is able to care for their feet effectively. It is extremely essential to remind diabetic patients to specifically care for their feet.

REFERENCES

1. International Diabetes Federation. Diabetes Atlas. 5th ed. 2011.
2. Boulton AJ, Vileikyte L, Ragnarson-Tennvall G, Apelqvist J. The global burden of diabetic foot disease. *Lancet* 2005;366:1719-24.
3. Singh N, Armstrong DG, Lipsky BA. Preventing foot ulcers in patients with diabetes. *JAMA* 2005;293:217-28.
4. Apelqvist J, Larsson J, Agardh CD. Long-term prognosis for diabetic patients with foot ulcers. *J Intern Med* 1993;233:485-91.
5. Clinical Guidelines Task Force. Guide for Guidelines, a Guide for Clinical Guideline Development. Brussels: International Diabetes Federation. Available from: <http://www.idf.org>. [last assessed on 2003].
6. van Houtum WH. Barriers to the delivery of diabetic foot care. *Lancet* 2005;366:1678-9.
7. Hunt NA, Liu GT, Lavery LA. The economics of limb salvage in diabetes. *Plast Reconstr Surg* 2011;127:289S-295S.
8. Bakker K, Schaper NC, International Working Group on Diabetic Foot Editorial Board. The development of global consensus guidelines on the management and prevention of the diabetic foot 2011. *Diabetes Metab Res Rev* 2012;28 (Suppl 1):116-8.
9. Boulton AJ. The diabetic foot: From art to science. The 18th Camillo Golgi lecture. *Diabetologia* 2004;47:1343-53.
10. Apelqvist J, Bakker K, van Houtum WH, Schaper NC, International working group on the diabetic foot (IWGDF) editorial board. Practical guidelines on the management and prevention of the diabetic foot: Based upon the international consensus on the diabetic foot (2007) prepared by the international working group on the diabetic foot. *Diabetes Metab Res Rev* 2008;24:S181-7.
11. Prompers L, Huijberts M, Apelqvist J, Jude E, Piaggese A, Bakker K, *et al.* High prevalence of ischaemia, infection and serious comorbidity in patients with diabetic foot disease in Europe. Baseline results from the Eurodiale study. *Diabetologia* 2007;50:18-25.
12. Collier A, Dowie A, Ghosh S, Brown PC, Malik I, Boom S. Diabetic foot ulcer: Amputation on request? *Diabetes Care* 2011;34:e159. .
13. Bakker K, Apelqvist J, Schaper NC, International Working Group on Diabetic Foot Editorial Board. Practical guidelines on the management and prevention of the diabetic foot 2011. *Diabetes Metab Res Rev* 2012;28 (Suppl 1):225-31.

Source of Support: Nil, **Conflict of Interest:** None declared.