Singapore Med J 1999; Vol 40(5):362-364

Thermal Burns in Diabetic Feet

P Thng, R M C Lim, B Y Low

ABSTRACT

Many patients with diabetes can lead a full life without developing diabetic lesions in their feet. This is because these patients have avoided the precipitating factors of which the most important is mechanical trauma and infections.

We present five cases of diabetic patients who, out of ignorance, listened to bad advice by using hot therapy to treat their peripheral neuropathy. This resulted in burns and secondary infections. All of them required large surgical debridement and prolonged costly hospital stay to treat their condition. Fortunately, none of them required amputation.

This paper hopes to highlight the dangers of self treatment and medication in diabetic foot lesions.

Keywords: diabetes mellitus, neuropathy, burns

INTRODUCTION

The complications of diabetes mellitus predispose to the development of foot lesions[9]. These complications are largely irreversible and the onset is unpredictable. When they occur, it may result in a limb threatening or even life threatening situation. If avoided, however, patients may live for many years and may eventually die of another vascular complication such as myocardial infarction[2]. This is because these patients have managed to avoid the precipitating factors of complications of the diabetic foot, of which the most important is mechanical trauma. Minor wounds or infections in a foot with normal sensation and blood supply are recognised by the pain they cause so that they are treated early and heal rapidly. In the neuropathic foot, however, a small lesion may progress and deteriorate because it is not recognised early and the source of injury not eradicated. Rapid progression of minor foot disorders may result in gangrene and amputation[5]. Impairment of blood supply may result in delayed healing. Infection is an important aggravating factor that may cause extensive tissue damage.

In this series, we look at the extreme range of thermal injury to the diabetic feet coupled with infection.

Effects of diabetes

Diabetes mellitus is a disease with multi-systemic complications causing retinopathy, nephropathy, dermopathy, neuropathy and arterial disease. An important group of these patients would be those with feet problems[12]. These feet complications are aggravated by the presence of peripheral neuropathy, arterial disease, skeletal deformity and an increased tendency toward sepsis for patients with diabetes[9]. Unrecognised repeated trauma or worsening infection in a neuropathic foot may result in marked progression of the disease before it is even detected by the patient. This is worsened by poor blood flow and hence healing potential in diabetic feet.

An unfortunate but surprising common cause of foot problems in Singapore is due to burns, often self induced out of ignorance[1]. Below are 5 cases seen and treated at (the former)Toa Payoh Hospital within 1 month. They all resulted from burns, peripheral neuropathy and our unique cultural beliefs.

Case 1

Mr TKH is a 67-year-old Chinese gentleman with diabetes mellitus for 8 years and peripheral neuropathy involving both hands and feet. On the advice of his friends, he poured "almost boiling hot" water over his feet in an attempt to evoke sensation from his anaesthetic feet.

Unfortunately, all that resulted was an ulcer 6 cm in diameter that was complicated by *pseudomonas* infection and required intravenous antibiotics and prolonged wound cleansing. This was compounded by a compromised circulatory status [ankle brachial index (ABI): 0.6]. Hospitalisation totalled 27 days and healing took nearly 48 1/2 months.

Case 2

Mr GCS is a 57-year-old man with long standing diabetes mellitus of 25 years, with end stage renal failure on dialysis and a previous right below knee amputation. He also had peripheral neuropathy and wanted to improve the circulation of his numb feet. On the advice of his wife, he soaked his remaining foot in a basin of hot water.

This resulted in large infected ulcers on the dorsum and plantar aspects of his remaining foot. His ankle brachial index was 0.7, and the capillary refill was only fair. He required intravenous antibiotics therapy and surgical debridement. Skin grafting was not performed and the total hospitalisation was 43 days.

Case 3

Mr TKL is a 54-year-old man with newly diagnosed diabetes mellitus of 3 months also with the problem of peripheral neuropathy. He was told that massaging

Department of Orthopaedic Surgery
Changi General Hospital
2 Simei St 3
Singapore 529889

P Thng, MBBS, FRCS (Glas), FRCS (Edin)
Registrar

R M C Lim, MBBS
Medical Officer

B Y Low, FRCS (Glas), FRCS (Edin), FAMS
Senior Consultant and Chief (A&E)

Correspondence to:
Dr P Thng

his foot would help improve the circulation to his foot and decrease his symptom of numbness. An electrical massager was used to massage his foot. Unfortunately, the metal portion of the massager overheated and burnt his foot.

He developed a right sole ulcer which was subsequently infected. Wound cultures grew both *pseudomonas* and methacillin resistant *staphylococcus aureus*. He required a prolonged hospital stay (34 days) and treatment to eradicate the infection.

Case 4

Mr TH is a 57-year-old Indian gentleman with diabetes for 9 years who also suffered from peripheral neuropathy. He is a devout Hindu and one hot day, he walked 1 kilometer barefooted to the temple. He only realised that his feet were burnt when his friends pointed it out to him. He too required hospitalisation.

Case 5

Mr KCC is a 59-year-old man with diabetes mellitus for 4 years. He burnt his left foot with hot water in 1994. Despite long term antibiotic treatment and repeated surgical interventions, which included repeated debridement and excision arthroplasties of his left second and third metatarsal head of the foot, his wound refused to heal and he has had repeated admissions to hospital for recurring foot infections. This was again compounded by a poor vascular supply to the limb (weak dorsalis pedis and posterior tibial pulses and slow capillary refill.) He was still suffering from ulceration of the foot 6 months after the initial injury.

DISCUSSION

Limb or life threatening complications in patients with diabetes mellitus can be prevented with an integrated and multi-disciplinary approach[5]. Peripheral neuropathy is a common and well documented complication of diabetes mellitus, of which the most common form is that of distal symmetric polyneuropathy. Glycemic control retards the progression of neuropathy, which is the most important risk factor for ulceration[5]. Distal symmetric polyneuropathy results in varying involvement of sensory, motor and autonomic nerve fibre function. In general, the sensory deficits predominate over the motor component. It arises first distally and progress proximally, resulting in a "glove and stocking" distribution of paraesthesia.

All 5 cases presented suffered from distal symmetric polyneuropathy secondary to diabetes mellitus. The neuropathy resulted in insensate feet and the loss of protective sensation. This would explain why such patients were more prone to repeated injury (whether mechanical, thermal, chemical or otherwise) of the feet without either realising it or recognising the severity of the injury until the later stage of the disease, with resultant ulceration and infection. The problem is compounded owing to the poor healing potential of such patients secondary to poor peripheral circulation and poor glycemic control.

The best approach socially and economically therefore, is to aim for prevention rather than seeking to treat these problems as they arise[4,7]. Good patient education would go a long way in helping to minimise these problems[8]. The better informed patient would generally be one who would take a more active and responsible part in the management of their own diabetic foot. All 5 patients above developed their foot lesions largely because of misinformation.

If one would seek to soak one's foot in warm-water, then one should follow guidelines of the human experimental skin temperature-tone scald burn curve shown in Fig 1 measured by Hennques and Moritz[13] to minimise the risk of foot burns.

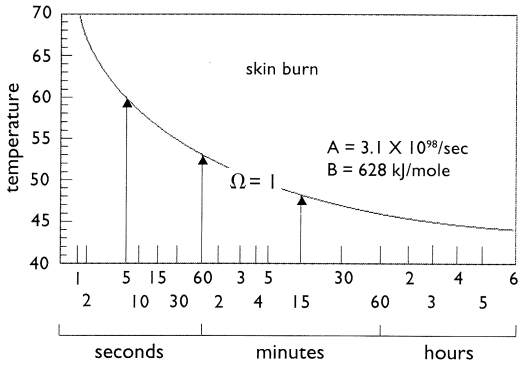

Fig 1 – Kinetics of heat damage accumulation in tissue seems to follow closely the behaviour of a single chemical reaction despite the complexity of tissue molecular structure.

The problems were aggravated in some because of delay in seeking proper treatment, again largely due to their ignorance of the condition.

We would like to propose that the following be included in patient education:

1. An understanding of diabetes mellitus with its associated complications and the need for good glycemic control;
2. Patient counselling for specific problems that each patient may face;
3. Printed instruction with pictorial illustrations be made readily available in addition to verbal instructions.

Specifically for the care of the diabetic feet:

1. The importance of the regular use of other means (visual and tactile) together with the lack of reliance of foot sensation to detect early diabetic foot lesions;
2. Instruction for the care and regular cleaning of the feet;
3. The protection of the feet with appropriate footwear that will not cause excessive pressure on the feet's pressure points; to be strictly adhered to when going out and to be seriously recommended even at home;
4. The need for early consultation with the relevant medical personnel for early diabetic foot lesions.

It is important that advice and instruction be simple to understand and easy to follow. Also, one would need to take the local culture into consideration. For example, shoes are often not routinely worn in the Asian home. One may need to specifically instruct patients to keep a separate pair of footwear for home use. Also, slippers are a popular form of footwear locally, but these leave the toes exposed with the increased risk of injury. Patients should therefore be advised to buy covered shoes to protect their feet. Patients should not be told just to buy comfortable shoes but to visually check their shoes and feel for points of excessive pressure that may cause pressure ulceration owing to the loss of protective sensation in the feet.

With the combined effort of medical personnel and the assumption of active and responsible self care of the diabetic patient of his feet, it would be possible to reduce the morbidity and mortality of diabetic foot lesions to the minimum. The need of amputation of such feet can also be minimised.

REFERENCES

1. Ewins DL, Bakker K, Young MJ, Boulton AJ. Alternative medicine: Potential dangers for the DM Foot. Diabetes Med 1993; 10:980-2.
2. Boutes KP, Storm AJ, de Gsoot RR, Uitsloges R, Eskelens DW. The DM foot in Dutch hospitals: epidemiological features and clinical outcome. Eur J Med 1993; 4:215-8.
3. Young MJ, Veves A, Boulton AJ. The DM Foot-aetiopathogenesis and management. DM Metab Rev 1993; 2:109-27.
4. Shenaq SM, Klebuc MJ, Vango A. How to help diabetic patients avoid amputation. Prevention and management of foot ulcer. Post Grad Med 1994; 5:177-80, 183-186, 191-2.
5. Caputo GM, Cavanagh PR, Ulbrecht JS, Gibbons GW, Korchmer AW. Assessment and management of foot disease in patients with DM. N Engl J Med 1994; 13:854-60.
6. Sanders LJ. DM - Prevention of amputation. J Am Podiatr Med Assoc 1994; 7:322-8.
7. Kosinski M, Ramcharitar S. In-office management of common geriatric foot problems. Geriatrics 1994; 5:43-7.
8. Valento LA, Nelson MS. Patient education for DM patients. An integral part of quality health care. J Am Podiatr Med Assoc 1995; 3:177-9.
9. McNelly MJ, Boyko EJ, Aujoni JH, Stensel VL, Reiber GE, Smith DG. The independent contributions of diabetic neuropathy and vasculopathy in foot ulceration. How great are the risks. Diabetes Care 1995; 2:216-9.
10. Veves A, Sarnow MR. Diagnosis, classification and treatment of DM peripheral neuropathy. Clin Podiatr Med Surg 1995; 1:19-30.
11. De Fronzo RA, Reasner C. The diabetes control and complication trial study, implication for the DM foot. J Foot Ankle Surg 1994; 6:551-6.
12. Hodges D. Management of DM foot. Am Fam Physician; 5:189-95.
13. Henriques FC, Moritz AR. Studies of thermal injury V: the predictability and the significance of thermally induced rate processes leading to irreversible epidermal injury. Arch Pathol 1947; 43:489-502.