

Diabetes and Diabetic Foot Ulcers: An often hidden problem

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Diabetes affects an estimated 16 million people in the United States and only just over half of whom are aware they have the disease. It is one of the leading causes of disease-related deaths in the U.S. Diabetes and its related complications claim the lives of approximately 190,000 Americans annually. In South Africa the situation is just as dire with between 4 - 6 million people having Diabetes.

“Diabetes Mellitus” represents a group of chronic diseases characterised by high levels of glucose in the blood and when the body does not produce enough insulin, or doesn’t produce insulin effectively. Insulin is a hormone necessary for the metabolism of sugar, starches and other foods.

As a result, blood sugar rises far above normal levels and over time begins to damage organs and tissues.

Diabetic patients, both type 1 and type 2, are at significant risk for a number of health complications associated with the eyes, feet, heart, blood vessels and the kidneys.

Diabetic Foot Ulcers

One of the debilitating complications faced by people with diabetes is diabetic foot ulcer. More than 15% of people with diabetes will develop a diabetic foot ulcer in their lifetime. These open wounds may occur when an injury to the foot (for example, a blister or small cut) goes unnoticed. The diabetic condition is often associated with peripheral neuropathy, a disorder that is common among people with diabetes.

Peripheral neuropathy is a deteriorating state in which the nerves in the lower leg may be affected causing muscle weakness and numbness and associated with reduced sensation to both temperature and pain.

Due to this lack of perception, diabetics often develop chronic, non-healing wounds which can become infected and lead to serious complications.

Infected diabetic foot ulcers are a major cause of hospitalisation in diabetic patients and most non-traumatic amputations are associated with diabetic foot infections.

This article will focus the causes of diabetic foot ulcers, the potential risk factors for them developing and recommended treatment pathways.

What is a diabetic foot ulcer?

The term “diabetic foot ulcer” is used to define a clinical condition, but simply put it is merely a wound on the foot of a patient who is diabetic. Health care workers should remember that when they are dealing with a diabetic patient with a foot ulcer, they should focus on a holistic approach to dealing with the diabetic patient.

The diabetic patient with a foot ulcer should not be treated in isolation, and the management of the diabetic patient requires the involvement of an interdisciplinary team of practitioners, including a diabetic physician, surgeon (general or vascular), wound care practitioner, podiatrist, nutritionist and orthotist.

It is important to remember that the ulcer has developed as a result of the underlying diabetes and to manage the wound effectively the diabetic condition and associated complications with the disease need to be managed as well.

Sites of and causes of diabetic foot ulcers

Diabetic foot ulcers usually develop in areas of the foot that are exposed to either friction and sustained pressure, and/or areas of the foot that are exposed to repetitive trauma e.g. rubbing of toes on the stitching of a shoe. The most common foot ulcer sites are:

- The heel
- On the underside of the toes
- The tips of any prominent toes (usually the 1st or 2nd toe)
- The tips of deformed toes (e.g. tips of hammer toes)

There are many factors that contribute to the development of diabetic foot ulcers, but it is widely accepted that the loss of sensation and poor blood supply (arterial disease) are the main contributing factors.



Figure 1: Ulcer to tip of a prominent 2nd toe



Figure 2: Deformity of the foot (Charcot Foot) with resultant increase in focal foot pressure, resulting in ulceration



Figure 3: Diabetic foot ulcer with significant necrosis and tendon involvement. This patient requires referral to a wound care specialist, podiatrist or medical practitioner for further treatment



Figure 4: Diabetic foot ulcer with a callus to the peri-wound requiring debridement

The loss of sensation in the foot is directly related to nerve damage. Non-diabetics have the ability to feel pain when they stand on sharp objects e.g. thorns/glass, which alerts them to the damage that has occurred (called protective sensation). Diabetics, due to progressive nerve damage and the loss of protective sensation, are unable to feel pain when they hurt themselves and are often unaware of foot problems and injuries go unnoticed and untreated for long periods of time.

Nerve damage also affects foot control and movement, since the small muscles of the foot are no longer able to receive the nerve signals that control foot function and movement. Therefore abnormal pressures are applied to areas of the foot that would not normally be exposed to these pressures. This can lead to callus and ulcer formation.

Poor blood flow to the diabetic foot leads to the bones in the foot losing their integrity, increasing the risk of dislocation and the collapse of the foot bone structure, either spontaneously or as a result of slight trauma.

Often multiple fractures to the foot go unnoticed, which may lead to foot deformities. This in turn leads to increases in pressure to areas of the foot that were previously not exposed to pressure, and this in turn leads to callus formation and ulcer development.

All diabetics have varying degrees of arterial disease. The risk of peripheral vascular disease (PVD) is four times higher in diabetic patients than in non-diabetic patients. The severity of the disease in the diabetic patient will greatly influence whether or not an ulcer develops, or the ability of the ulcer to heal.

Decreased blood flow leads to delayed healing in the diabetic, due to a decrease in the delivery of oxygen and nutrients, and white blood cells to the wound. This directly affects the ability of the wound to heal, to respond to and

manage bacterial bio-burden, as well as the delivery of antibiotic agents.

Poor blood supply also increases the risk for the development of gangrene and ultimately amputation.

Prevention of Diabetic Foot Ulcers

Primary prevention is the aim of diabetes management, but secondary prevention is the goal of effective foot ulcer care. The recurrence rates are high and ulcer healing must be accompanied by a well-coordinated program of secondary prevention. These prevention strategies should include:

- Optimal glycaemic control which can dramatically reduce the recurrence of foot ulcers
- Meticulous attention to foot care and proper management of foot injuries
- Daily inspection of the feet
- Gentle cleansing with a mild soap and water
- Application of topical moisturisers which helps to maintain healthy skin, which is better able to resist breakdown and injury
- Wearing correct, well-fitting footwear that provides adequate support
- Appropriate management of minor wounds and referral for any minor non healing wound
- Avoid walking barefoot.

Managing the diabetic foot ulcer

The diabetic patient must be managed holistically - meaning that problems associated with diabetes (e.g. PVD) must be identified and managed.

The following questions should be asked before the initiation of treatment

- Where is the ulcer situated?
- Has there been a recurrence of an ulcer? How long ago?
- What was the cause of the previous ulcer?
- What caused the current ulcer?
- What does the ulcer look like?
- Can one see bone?

The answers to these questions will help to guide treatment. Should the ulcer be reoccurring and a new ulcer has developed in the same location there may be a more sinister reason for this occurrence. (e.g. underlying osteomyelitis, presence of a foreign body). An ulcer that has opened up spontaneously or the presence of black or discoloured toes or feet may indicate a blood flow problem. In all the above cases it would be advisable that the patient is referred to an interdisciplinary team including a physician, a surgeon, a wound care specialist, and podiatrist/orthotist for further treatment.

If the wound is relatively superficial and does not involve any major underlying structures, good local wound bed

preparation principles should be followed when managing the local wound environment.

Standard treatment for diabetic foot ulcers involve regular 'moist' dressing changes involving good wound bed preparation principles. The diabetic foot can be seen to be T-I-M-E dependant and includes the following areas of wound bed preparation:

- T - Tissue: debridement of necrotic tissue and calloused wound edges
- I - Inflammation/infection: reducing the bacterial wound burden and achieving bacterial balance
- M - Moisture: ensuring that the moisture in the wound bed achieves a moisture balance
- E - Epidermal margin: if all the above factors are in balance then the epidermal margins will progress and the wound closure will be achieved over time.

T of TIME: Debridement

Removal of dead or devitalised tissue is vital when managing the diabetic foot ulcer, since this tissue will not regenerate and will prevent the formation of new healthy tissue.

Surgical debridement may be performed by a medical practitioner, for the removal of necrotic tissue from the wound bed as well as the removal of callus from the wound edges.

If the wound is relatively superficial with no bone or tendon involvement, but with yellow mildly adherent slough present, the wound can be debrided using either an enzymatic debrider such as IruXol® or by relying on autolytic debridement (using an amorphorous hydrogel, such as Intrasite Gel® and Intrasite Conformable®).

Autolytic Debridement occurs naturally in the presence of wound fluid and moisture. Wound exudate contains autolytic enzymes and white blood cells that facilitate the removal of devitalised or dead tissue from the wound. This natural process although slow, can be assisted through the application of an amorphorous hydrogel.

Enzymatic debridement speeds up the process and an ointment is applied to the wound, which contains special enzymes to accelerate the removal of the devitalised or dead tissue from the wound bed.

Note: When treating a diabetic foot ulcer one is also treating a chronic underlying disease, and the continual build-up of necrotic tissue is high. Therefore the use of agents that facilitate debridement (both autolytic and enzymatic) should be considered whenever indicated throughout the treatment regime.

I of TIME: Bacterial balance

The risk of infection in a diabetic foot ulcer is high and practitioners must be especially vigilant. The increase in the risk of infection is due to:

A diabetic patient has a lowered ability to fight infection; especially if their diabetes is poorly controlled.

Poor blood flow to the affected limb decreases the delivery of white blood cells and antibiotic agents to the wound.

To add to the challenges, the classic signs and symptoms of infection are often absent or muted in a diabetic patient. In addition many diabetics that present with a severe infection may have no pain or pyrexia and symptoms of infection are often missed.

Should there be any doubt regarding the presence of infection in a patient presenting with a diabetic foot ulcer, referral to an experienced team of medical practitioners is highly recommended.

If there are no obvious clinical signs of infection, application of a topical antimicrobial dressing is recommended as it will help to facilitate wound healing by protecting the wound from further microbial contamination and infection. Bactigras® is an ideal antiseptic agent, containing chlorhexidine, to manage low levels of bacterial contamination, while Iodosorb® cadexomer iodine and Acticoat® nanocrystalline silver is recommended for wounds that are highly colonised or locally infected.

Recent clinical trials have shown that Iodosorb® is also effective at managing Biofilms, which are commonly associated with chronic wounds such as diabetic foot ulcers and venous leg ulcers.

M of TIME: Moisture balance

Diabetic foot ulcers are often dryer wounds and very often require the application of an amorphous hydrogel (Intrasite Gel® and Intrasite Conformable®) to maintain a moist wound healing environment.

Concerns over the use of highly adherent dressings in the treatment of diabetic foot ulcers have been raised. They should be avoided to limit trauma to the surrounding skin.

Hydrocellular foams (Allevyn®) are a good option to treat diabetic foot ulcers and dry dressings (e.g. gauze) should be avoided at all costs. Allevyn® dressings create an ideal wound healing environment which encourages both wound healing and re-epithelialisation.

A pivotal point in managing the diabetic foot ulcer is *off-loading pressure* to the affected area. Many diabetic patients continue to walk on the affected foot/ulcer because they feel no pain or discomfort. Allevyn® dressings are clinically effective in reducing pressure in sensitive areas.

Continued walking on the affected foot will delay healing due to the sustained and continual pressure. This will increase the development of necrotic tissue in the wound bed and the risk of bacteria being forced into the deeper tissue increases.

Referral to a podiatrist/orthotist for modifications to shoes, total contact casting or merely elevation may be of benefit to off load pressure to the affected foot in order to facilitate healing.

E of TIME: Edge

If the epidermal margins are not progressing please re-visit T, I and M.

Conclusion

Managing the diabetic foot is a complex process and it is important to identify when the patient requires referral for more specialised care.

One of the most important aspects to take into consideration when managing the diabetic patient with a foot ulcer is patient education. The diabetic patient must understand the rationale behind their treatment and they also need to be aware of the role they play in preventing further ulceration and limb deterioration.

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