Implications of dressing-related trauma and pain in patients with diabetes

Neil Baker

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Article points

1. Patients with diabetes may feel pain. For those with ischaemia, this may be severe and even those with neuropathy or neuroischaemia can feel pain.
2. As a result of the misconception that patients with diabetes do not feel pain, patients with, or at risk of diabetic foot ulcers, may be treated inappropriately.
3. Delayed or inappropriate treatment can lead to poor outcomes and can have an impact on healthcare expenditure.
4. Pain can impact negatively on patient quality of life and increase pyschological stress, which in turn can delay healing and increase treatment costs.
5. Recognition of the presence and impact of wound-related pain for patients with diabetes is growing, although this is a poorly researched area.

Neil Baker is the Clinical Lead for Diabetic Foot at Ispwich Hospital NHS Trust, Suffolk, UK

It is a misconception that patients with diabetes do not feel pain. Clinical investigations have shown that a high proportion of patients with diabetes do have pain related to their wound or to a procedure. As a result of this misconception, patients with, or at risk of diabetic foot ulcers, may be treated inappropriately. This article focuses on the issue of preventing dressing-related trauma and pain in patients with diabetes and emphasises why it is a significant aspect of care that demands careful attention by clinicians.

Diabetic foot ulceration is an advanced manifestation of long-term diabetes-related complications affecting between 15–25% of patients with diabetes (Singh et al, 2005). It is significantly more common in patients who have peripheral sensory neuropathy and its management is demanding both in terms of resources and expertise (LeMaster and Reiber, 2006).

Delayed or inappropriate treatment can often lead to ulcer chronicity complicated by recurrent infection, depression and lower extremity amputations (NICE, 2011). A recent publication by NHS Diabetes has highlighted and reported several disturbing issues, including the financial burdens placed upon the health economy of the United Kingdom with £1 in every £150 spent in the NHS being spent on diabetic foot related issues (Kerr, 2012).

It is well recognised that addressing poor arterial supply, controlling infection and removing trauma leads to successful diabetic foot ulcer outcomes (NICE, 2011; Lipsky et al, 2012). Management depends on regular debridement and cleansing, treatment of any infection, consideration of revascularisation and protection of the wound by dressings and off-loading (Jeffcoat, 2012).

Although there is a common misconception that pain or discomfort does not occur in either neuropathic or neuro-ischaemic foot ulceration, this is not entirely true for all patients, who despite having peripheral neuropathy, may report severe and frequent pain (Bradbury and Price, 2011). The potential for patients to experience specific pain from diabetic foot ulcers is an important consideration when performing procedures such as sharp debridement or dressing changes as it could be wrongly assumed that these procedures can be performed without causing pain (Bradbury and Price, 2011).

An important consideration in the management of diabetic foot ulcers should

include strategies to prevent trauma to the wound and minimise wound-related pain at dressing procedures (WUWHS, 2007a).

An overview of pain and neuropathy

Pain is a complex subject that is influenced by many different factors (Wulf and Baron, 2002). Painful stimuli detected by pain receptors or nociceptors in the tissues are relayed by various different types of nerve fibres to either specialised tissue in the spinal cord or within the brain. Usually these are an inflammatory response to either tissue damage or a direct noxious stimulus and, as such, are acute and transient, although they may last for several days (Kidd and Urban, 2001). This is different to the pain due to persistent tissue injury or peripheral or central nerve dysfunction as is the case with diabetic painful neuropathy (Marchettini et al, 2006).

Sensory nerve impulses are relayed to the thalamus and brainstem via primary afferent neurons arising from the tissues. Painful stimuli are usually transmitted to the dorsal horn of the spinal cord via unmyelinated C and thin myelinated A afferent nerve fibres. Many of the C fibres are multifunctional, while some only become active during tissue inflammation (Wulf and Baron, 2002).

C-fibre nociceptors remain dormant until activated by either direct injury or inflammation. When this occurs they release pain and inflammatory mediators. These decrease nerve fibre firing thresholds and increase the sensitivity of both the C and A fibres. The increase in neuron sensitivity to repeated stimulation over time can lead to small stimuli being perceived as very painful — this is called 'hyperalgesia' (Wulf and Baron, 2002).

Diabetic peripheral neuropathy

Neuropathy can be described as the inability of nerves to receive, transmit, or react to stimuli with the first recorded description of diabetic neuropathy being attributed to Rollo in 1798 (Rollo, 1798). The aetiology of neuropathy is a matter of some debate, but principally, there are two schools of thought regarding its pathogenesis. One relates to metabolic abnormalities in nerve tissues as a result of changes in glycaemic control (Cameron et al, 2001). The other is related to abnormalities in the blood supply to the nerves and supporting tissues leading to nervous tissue anoxia (Tesfaye et al, 1994). Irrespective of this, it is known that the longest and smallest nerves are affected first, including both myelinated and unmyelinated fibres. Diabetic peripheral neuropathy is characteristically symmetrical and distal, affecting all sensory, autonomic and motor nerves (Marchettini et al, 2006).

Clinically, sensory neuropathy is detected when patients are unable to detect light touch/pressure from a 10g nylon monofilament, reduced vibration sense from a 128 Hz tuning fork and the inability to clearly distinguish between hot and cold (Abbott et al, 2002). Patients may also describe sensations such as pins and needles, walking on cotton wool or numbness (Tesfaye et al, 2006). Where there is small nerve fibre damage and the sensory nerves are intact, patients may develop symptoms of painful neuropathy which include sharp, stabbing, burning, shooting, or electric shock type pains, or skin hypersensitivity for example, which are usually worse at night and may disrupt sleep, leading to reduced quality of life (Malik et al, 2010).

One of the most common and relevant manifestations of peripheral neuropathy is the loss of sensation, especially the inability to determine pain, thus putting the patient at risk from mechanical, chemical and thermal trauma (Boulton, 2006). This may also have a devastating consequence when infection goes unrecognised. While individuals who have intact sensation are more likely to detect new pain associated with infection, those with painful neuropathy but intact sensation may dismiss trauma or infection associated pain as increased symptoms of their existing condition (Malik et al, 2010).

The presence of autonomic nerve dysfunction in patients with diabetic neuropathy is characterised by very dry, warm skin with easily palpable foot pulses (Baker et al, 2005). The dryness of the skin, which is due to the denervation of sweat glands, in addition to the loss of tissue elasticity, may lead to deep skin fissures, which can become infected (Pendsey, 2010).

Page points

1. Tissue damage and inflammation sensitises nerve endings that transmit pain signals.
2. Injury to the peripheral nerves is often associated with abnormal sensory function, causing a marked increase in patients' response to pain.
3. Diabetic neuropathy affects peripheral nerves, including pain fibres, motor neurons and the autonomic nervous system.

Page points

1. One of the most common and relevant manifestations of peripheral neuropathy is the loss of sensation, especially the inability to determine pain.
2. Those patients with peripheral neuropathy and intact sensation, may dismiss new pain associated with complications such as infection as increased symptoms of their existing condition.
3. For patients reporting diabetic foot ulcer pain, this may be described as sharp, stabbing, burning, shooting or electric shock type pain.
4. Consideration should be given to dressings that maintain an optimal moist wound environment, are atraumatic to the wound and surrounding skin, and do not cause pain.

Motor nerve dysfunction occurs in late neuropathy and is characterised typically by a weight-bearing high arch foot with clawed lesser toes and visible muscle wastage in the plantar arch and on the dorsum between the metatarsal shafts (hollowed out appearance). In the advanced states gait changes are noticeable by ataxia and the foot 'slapping' on the ground. Deformities to the architecture of the foot mean that joints and digits are placed in mechanically unfavourable positions, making them highly vulnerable to injury (Simoneau et al, 1996).

Foot ulceration and dressings

Diabetic foot ulcers require an integrated, multidisciplinary management programme that treats the whole patient and combines effective wound care with pressure offloading and diabetes control (NICE, 2011).

They are classified into either neuropathic or neuro-ischaemic ulcers due to the main underlying components of their aetio-pathogenesis (Pendsey, 2010). These underlying pathologies have a significant bearing upon basic approaches to management. While, both of these types of foot ulcers are problematic to treat due to a wide range of confounding factors, the main considerations are sensory loss and ischaemia (NICE, 2011).

A neuropathic ulcer is characterised principally by sensory loss with ulceration occurring upon weight-bearing areas of the foot. A neuro-ischaemic ulcer is characterised by a degree of sensory loss and reduced arterial supply with ulcers typically occurring at the margins of the foot (Apelqvist et al, 2000).

Wound dressings play a significant role in the management of diabetic foot ulceration (Hilton et al, 2004). Ideally dressings should alleviate symptoms, provide wound protection and encourage healing (Hilton et al, 2004). Factors to consider when selecting an appropriate dressing include absorbency levels to manage exudate effectively, as well as the ability to encourage granulation or epithelialisation (Baker, 2002). A clear understanding of the different dressing types is essential to avoid inappropriate use that may cause further tissue destruction and discomfort (Baker, 2002). Consideration should be given to the use of dressings that not only maintain an optimal moist wound healing environment, but are atraumatic to the wound and surrounding skin and do not cause pain or induce an allergic response (WUWHS, 2004). Issues such as ease of application, ability to stay *in-situ* and intact throughout wear time, comfort and dressing fit should also be important considerations (Meuleinere, 2008). This is especially so if the patient is of working age or a carer who needs to continue his/her daily activities.

Clinical implications in patients that have pain sensation

Recent research indicates that more than 50% of patients with diabetic foot ulcers may experience wound-related pain (Bengtsson et al, 2008). A proportion of these patients may suffer from accentuated pain perception (allodynia or hyperalgesia), such as those with critical limb ischaemia. Others may have partially intact sensations, such as those with neuro-ischaemia (Marchettini et al, 2006).

Pain has a negative effect on patients, impacting on quality of life and increasing the level of stress (Bradbury and Price, 2011). This can lead to delayed healing of acute and chronic wounds, and reduce a patient's immune response, increasing the risk of infection (Cole-King and Harding, 2001).

Particular care should be taken during procedures, such as dressing changes, as patients with increased sensitivity are likely to find the additional pain from a procedure excruciating (WUWHS, 2004). Procedural pain must be managed using appropriate interventions, such as analgesia, to avoid further complications and distress (WUWHS, 2007a).

'Loud' dressing discomfort/pain

In patients who do have pain sensations associated with the wound and/or procedural pain, it is important to minimise discomfort through the use of appropriate dressings that provide an optimal moist wound environment, do not adhere to the wound and are easy to remove (Meuleinere, 2008). Special attention should be paid to dressing technique to avoid damaging the wound bed or surrounding skin, to reduce discomfort

and trauma, as well as frequency of removal to minimise procedural trauma and pain and reduce anxiety and stress (WUWHS, 2004).

Dressing technique

Applying dressings to the foot is not easy due to its shape, three-dimensional contouring and intrinsic variance of size. Another major problem with dressings applied to feet is that they are walked upon and have to be accommodated within footwear (Baker, 2002). The toes and the heel area are arguably one of the most difficult places to apply dressings and as such it is not uncommon for them either to be applied too tight or too large. Bulky or tightly applied dressings (eg absorbent wound pads, combination dressings) can lead to considerable discomfort for those who are able to feel pain and can cause points of increased tissue pressure or ulceration particularly between or around the toes if too bulky (Baker, 2002).

Leaving small creases in a dressing is also a common cause of discomfort and this usually occurs when a dressing is fitted around tightly curved structures, eg lateral border of 5th metatarsal head. This can be likened to walking all day with a crease in your sock over a high pressure area, which the wearer would soon smooth out. However in patients with partial neuropathy by the time discomfort is felt, tissue damage could be very significant (Boulton, 2010).

Using a dressing to pack a fistula or sinus can give rise to significant discomfort and pain. This usually occurs when the dressing is packed too tightly or where the surface of the packing dries and acts as a plug preventing drainage, which leads to trapped exudate and maceration of the surrounding tissue (Baker, 2002).

Securing dressings

Hypersensitivity of the nerve endings in the area surrounding a wound can make adhesive tapes and dressings painful to remove (WUWHS, 2004). Retention bandages need to be applied carefully and regularly rechecked as oedema formation may lead to constriction and additional trauma. The author has heard many patients say "I had to remove the dressing early because it was too tight and hurting me".

Care should be taken with adhesive tape as this can cause stripping of the uppermost layer of the stratum corneum on removal, particularly when the skin is thin or frail (Rippon et al, 2007). This is not only very painful for the patient, but it can create a new wound, which may lead to ulceration.

Ulcers located in difficult-to-dress areas (eg the heel) may benefit from an adhesive dressing to avoid slippage and friction from footwear. Specially shaped conformable dressings that allow for gentle and atraumatic, sustained skin adhesion should be considered for such areas (Meuleinere, 2008).

Appropriate selection

Correctly matching the parameters of a dressing to the state of the wound and surrounding tissues can help to manage pain (WUWHS, 2004). The use of low or non-adherent dressings (preferably those that have been clinically proven to be atraumatic) in the management of diabetic foot ulcers should be considered to be best practice, particularly in clean granulating wounds with low to moderate exudate levels or in dry necrotic wounds (Meuleneire, 2008). Atraumatic dressings should also be considered for wounds associated with high levels of exudate. The rationale for this is to provide a high oxygen tension to facilitate epithelial migration, but also to prevent adherence of the dressing to the wound (Baker, 2002). Infected wounds tend to have high exudate levels that needs to be controlled to prevent maceration of the periwound skin (Hilton et al, 2004) (Figure 1). There may be considerable odour, increased pain and delayed healing with extension of the wound. This can be distressing and unpleasant and a dressing should aim to alleviate symptoms, be comfortable and acceptable to the patient (WUWHS, 2007b).

Page points

1. A high proportion of patients do have pain sensations associated with the wound and/or procedural pain.
2. Patients may also suffer from allodynia or hyperalgesia, which may exacerbate pain during procedures.
3. Dressing-related procedures may be problematic in the degree of suffering caused to the patient.

Figure 1: Dressing-induced periwound maceration

Page points

1. Procedural pain can be caused by the use of in appropriate dressings.
2. Reconsider dressing choice/frequency if soaking is required or removal is causing bleeding/trauma to the wound or surrounding tissue.
3. Irrespective of whether a patient feels pain or no pain, it is important to consider dressings that promote moist wound healing and are known to be atraumatic on removal.

Once exudate levels are controlled and the wound has reached an appropriate moisture level, the wound must be reassessed and a more appropriate dressing chosen. This will prevent cell dessication and dehydration of the wound bed, which may cause adherence of the dressing (Dowsett and Newton, 2005).

Dressing removal

In a survey that examined pain associated with dressings it was cited that both pain and trauma most commonly occurred at the time of dressing changes due to adherence of the dressing to the wound and periwound tissues (Moffatt et al, 2002). Gauze-type dressings were reported as mainly responsible for having a major damaging effect on wounds due to their tendency to dry out and adhere to the wound (Moffatt et al, 2002).

Adherence of dressing material to the wound bed and periwound skin can damage newly forming cells and cause distress to the patient. Dykes and Heggie (2003) found repeated application and removal of adhesive dressings can lead to damage to the skin's surface and can strip the stratum corneum. This initiates an inflammatory skin reaction, oedema and pain (Lawton and Langeøn, 2009).

Exposure of the wound bed at dressing changes may cause pain due the sensitivity of nerve endings on the wound surface (Butcher and White, 2011). Consideration should be given to dressings that stay intact and offer longer wear times to avoid frequent removal (WUWHS, 2004).

Figure 2: Subtle dressing-induced erythema on periwound skin

If pain becomes a feature at dressing change, this can elicit an anticipatory pain response prior to dressing change, which can increase patient anxiety and should be managed appropriately using analgesia and other interventions (WUWHS, 2004; 2007a).

Increased pain at dressing change is associated with increased costs due to the additional requirement for analgesia (Butcher and White, 2011). The authors conclude that this may be avoided or reduced through the selection of atraumatic dressings that are less painful to remove and do not cause harm to the wound or surrounding skin (Butcher and White, 2011).

Dressing sensitivity/allergy

Clinicians should aim to avoid selecting wound care products that can cause contact dermatitis. This may occur due to sensitivities to irritants in the dressing or an allergic reaction (Ratcliffe, 2001). Dressing allergies are rare and may present with widespread clinical features such as itching and generalised skin rashes (Baker, 2002). Dressing sensitivities may be more common and are recognised by itching or burning type pains (Ratcliffe, 2001). They are associated with erythema that extends over the contact area of the dressing product (Figure 2). In the author's experience this is most frequently seen with foam sheet and iodine type dressings.

Clinical implications of patients with no pain sensation

Patients who do not feel pain are at increased risk from traumatic insult due to the loss of protective pain sensation (Boulton, 2010). The consequent vulnerability to trauma increases the risk of foot ulceration sevenfold (Singh et al, 2005). Pain is also usually an early marker for infection and, if this is not identified by the patient and/or clinician, it can lead to serious consequences, with increased risk of amputation and mortality (Lipsky et al, 2012).

'Silent' dressing discomfort/pain

Patients who have sensory peripheral neuropathy may present with a slight diminution or a total loss of sensation. Such patients may have 'silent'

KEY STRATEGIES TO MINIMISE DRESSING-RELATED PAIN IN DIABETIC FOOT ULCERATION

1. Select a wound dressing that maintains a moist wound environment, has a good absorbency capacity, offers a long wear time and stays intact, with a low allergy potential and does not cause pain and trauma on removal.
2. Apply dressings using appropriate techniques (eg avoiding creases, being too bulky) and take care when dressing weight-bearing areas or the toes.
3. At dressing removal, check wound and surrounding skin for evidence of tissue trauma and/or infection at dressing change.
4. At dressing changes avoid unnecessary manipulation of the wound and use appropriate analgesia if required.
5. Do not use strong adhesives or tapes to secure dressings and avoid tight retention bandages.
6. Use atraumatic dressings to minimise pain and trauma during wear and at dressing removal.
7. Do not ignore reports of pain or discomfort in patients with neuropathy as this may be an early warning sign of infection.
8. Use validated tools to assess the patient's pain status. This will help to identify the clinical challenges in relation to wound care and treatment.

dressing discomfort/pain. This means that dressing-related pain can be varied and it is important to be aware of the patient's ability to experience pain using an appropriate assessment tool (WUWHS, 2004). In a recent study, 43% of subjects with a diabetic foot ulcer had signs and symptoms of painful neuropathy, while only 18.2% sought treatment. Patients were often more concerned about their visible ulcer, rather than the invisible pain, ignoring the symptoms of neuropathic pain (including tingling, redness, burning and sensitivity to the touch) (Yunus and Rajbhandan, 2011).

Even in diabetic foot wounds that are not painful, it is still important to use a dressing that does not cause trauma to the wound and the surrounding skin as this type of trauma may go unnoticed, resulting in further damage to the wound and periwound areas (WUWHS, 2004).

Pain is usually an early manifestation of sub-clinical infection where the classical signs of redness, heat and swelling are not yet evident (Lipsky et al, 2012). In the absence of pain, or altered sensation, other early signs of infection may be visible and include increased exudate, darkening of granulation tissue, which may look more granular, and there may be a deepening or sudden irregularity in the ulcer base contour (Lipsky et al, 2012). These signs are important markers for infection and should not be ignored and, even if pain or discomfort is felt in those with sensory loss, the symptoms described will almost certainly not be commensurate with the tissue damage sustained. Any discomfort or pain reported to a clinician by a patient with neuropathy is a significant danger sign that must be investigated and acted upon immediately (Lipsky et al, 2012).

Conclusion

In summary, pain has a complex physiology and can be influenced by many biological, chemical, psychological and extrinsic factors. Nerve damage due to diabetes is equally complex and not fully understood; irrespective of this it is important for clinicians dealing with diabetic foot related conditions, and especially ulceration, to understand the implications of altered nerve function. This may lead to increased pain sensations or loss of sensory feeling. Identification of the patient's pain status is vital when treating patients with diabetic foot ulceration and addressing the challenges of either pain or no pain. However, the concept of pain associated with inappropriate dressing selection is

Page points

1. Patients who do not feel pain are at increased risk from traumatic insult due to the loss of protective pain sensation.
2. Pain in the wound is an early symptom of infection. If this is not identified by the patient and relayed to the clinician, this may lead to serious complications such as amputation.
2. Identification of the patient's pain status is vital when treating patients with diabetic foot ulcers and addressing the challenges of either pain or no pain.

often overlooked or dismissed (Butcher and White, 2011). The true cost of pain at dressing change is currently underestimated (Butcher and White, 2011) and there is a need to raise awareness about appropriate dressing selection. It is hoped that this brief article will challenge readers to at least reconsider this important issue and help improve diabetic foot ulcer management for those afflicted with this devastating late complication of diabetes. This can have a significant impact on improving clinical outcomes and patient quality of life, while reducing the overall costs of care.

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