Minimising wound-related pain: A discussion of traditional wound dressings and topical agents used in low-resource communities

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ABSTRACT

The concepts of moist wound healing, minimising trauma to the wound bed during wear time and at dressing change and addressing wound bed preparation principles are all local strategies and considerations that can minimise wound-related pain (WRP). Such strategies include the management of moisture, infection and chronic inflammation. Despite the limited access to advanced wound care products in low-resource communities, these same principles of wound management can be used in the selection and development of wound dressing and topical wound care products in these settings. This article discusses the aetiology of WRP, management strategies associated with improving the experience of background and procedural WRP, and the efficacy of traditional wound care products in promoting pain minimisation in low-resource communities.

Keywords: Wound-related pain, neuropathic pain, traditional, low resource, wound dressings.

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INTRODUCTION

For pain to be managed it must first be acknowledged and understood by health care professionals, and an assessment conducted to identify the pain type, aetiology, and individual's unique experience. This, in turn, will guide appropriate pharmacological and non-pharmacological interventions. This article will explore one component of wound-related pain (WRP) management strategies — wound dressings and topical interventions available in low-resource settings to address and/or minimise background, incident and procedural WRP.

UNDERSTANDING PAIN AND WOUNDS

Pain is a universal human reality described as "an unpleasant sensory and emotional experience associated with actual or potential tissue damage, or described in terms of such damage"[1,p.3]. The mechanisms of pain are referred to as nociceptive (non-neuropathic) and neuropathic (NeP) in nature. Non-NeP pain is caused by the activation of peripheral nociceptors within a functioning somatosensory nervous system[1]. Local sensitisation of nociceptors in the injured tissue can lead to both primary and secondary hyperalgesia. This pain is described as gnawing, sharp, tender, aching and throbbing[2]. Non-NeP is considered an appropriate physiological response to a painful stimulus because non-NeP pain informs the body of injury and promotes immobilisation and protection.

Local tissue damage and the acute inflammatory process of acute wounds initiate a nociceptive response to painful stimuli. Activities of daily living, wound dressing procedures and treatment interventions can stimulate the somatosensory system. However, this pain type will subside and dissipate as the stimuli are reduced or removed[3].

In contrast, NeP is caused by a lesion or disease affecting the somatosensory system[1] by contributing to dysfunction of the peripheral and/or the central nervous system, including the ascending and descending pathways of the nociceptive system[4,5]. In contrast to non-NeP, NeP is considered to be a "maladaptive" response of the nervous system to a primary pathology[6].

Neuropathic pain is considered an important mechanism in the development of chronic pain, a complex pathology in its own right[7]. Paraesthesia symptoms include numbness, tingling, pins and needles and prickling, along with dysaesthesia including burning, shooting (electrical shocks), stabbing (lancinating) and stinging — all sensory descriptors used to describe NeP. Sensitisation mechanisms in the central and peripheral nervous systems can manifest as allodynia, where non-painful stimuli is perceived as painful. Spontaneous and evoked pain can be persistent, intermittent or paroxysmal, with nocturnal worsening[8].

Inadequate or inappropriate interventions to manage acute nociceptive pain, persistent tissue injury or inflammation, and/or ongoing traumatic dressing procedures can contribute to persistent painful sensory inputs[9]. This can lead to neurogenic changes specific to the central nervous system's response to the persistent stimuli, and can contribute to the transition of acute non-NeP to chronic NeP and a "mixed" pain experience[3,10].

WOUND-RELATED PAIN

Pain related to acute and chronic wounds is reported as a common lived experience and symptom[11], yet is often described as underestimated and poorly managed by health care professionals[12]. To raise awareness about this unique pain experience, the term WRP has been defined as "a noxious symptom or unpleasant experience directly related to an open skin ulcer"[2,p.1]. WRP can be intermittent (acute) — "incident", "procedural" or "operative". In addition, persistent (chronic) WRP, also referred to as "background" pain, can be experienced. This understanding highlights the individual nature and burden of pain for those living with a wound, and their risk of acute and chronic pain experiences[2,13,14].

WRP has also been described as a psychological stressor[9,13,15,16] that can negatively impact on clinical outcomes[17-21] and create a primary obstacle to healing[13,22]. In addition to the clinical and fiscal consequences of failing to assess and manage WRP, it is essential that the human "cost" and individual lived experience and suffering not be overlooked or ignored[23-26].

INTERNATIONAL CHALLENGES

In 2010, the inaugural International Pain Summit supported by members and representatives of 126 countries for the International Association for the Study of Pain (IASP) supported the Declaration of Montreal: "*that access to pain management is a fundamental human right*"[27].

Identified international challenges include[27]:

1. Inadequate access to treatment for acute pain caused by trauma and disease and failure to recognise chronic pain as a serious chronic health problem.
2. Knowledge deficits of health care professionals regarding the mechanisms and management of pain.
3. The World Health Organization (WHO) estimates that five billion people live in countries with low or no access to controlled medicines, and have no or insufficient access to treatment for moderate to severe pain.

SELECTION OF WOUND DRESSINGS AND TOPICAL AGENTS IN LOW-RESOURCE COMMUNITIES

Irrespective of wound aetiology, selection of an appropriate topical therapy and dressing for the wound is an important component in the prevention and management of WRP. A particular challenge in many low-resource communities is access to both health care and wound care supplies. In low-resource communities such as African and Asian countries, up to 80% of the population rely on traditional medicine options for health and wound care needs[28,29]. Due to financial cost and geographic location, most low-resource communities have minimal to no access to modern wound products and devices. Health facilities and wound clinics rely on traditional wound dressings such as gauze, lint and cotton wool, used in conjunction with cotton bandages[30].

For a variety of reasons, access to health services is often very limited, either due to geographic isolation from services or financial barriers (for example, limited transportation, inability to take time out from work). As discussed, health services usually have extremely restricted access to advanced dressing products; however, even access to basic wound care supplies can be constrained. Sterile solutions, and indeed potable water, may not be readily accessible. As a result, it may not be possible to attend to wounds and change wound dressings within an optimal time frame.

The above factors contribute to wound dressing attendance often being a highly painful experience, with basic wound dressings that have adhered to the wound bed over time being removed with less than ideal equipment and pain relief. In part to address such issues, low-resource communities have developed local wound dressing options that promote principles of wound care that are associated with less pain, while maintaining low costs and easy access. The wound dressings and topical agents discussed below have their origin in plant products that are local to the areas in which they are used. While some of the wound care strategies have been developed more recently, most of the preparations and materials have been used in health and wound care for centuries[28]. More recent bench and clinical research has provided evidence on their effectiveness in wound care, and provided theoretical models for their efficacy in promoting healing and relieving WRP.

REDUCING WOUND BED TRAUMA WITH LOW-RESOURCE WOUND DRESSINGS AND TOPICAL AGENTS

Selecting a low-adherent wound dressing allows the wound dressing to be removed more easily. Wound exudate, which has a high content of proteins and electrolytes[31], becomes

adherent as it dries. When wound exudate is absorbed by a traditional dry dressing such as a gauze pad, the result is adherence of the wound dressing to the wound bed[32]. When attempting to remove a wound dressing that has adhered to the wound bed, the newly formed granulation and/or epithelial tissue is damaged, disrupting the wound healing process and contributing to procedural WRP. To avoid this outcome, low-adherent dressings, including soft silicone wound dressings, alginates, hydrocolloids and foam wound dressings, are commonly used in high-resource communities[33].

Two traditional dressings have been developed in low-resource communities with consideration to finding low-cost, natural wound dressing solutions with low-adherence properties. Potato peel dressings and banana leaf dressings are used throughout India and Thailand as a low-adherent, waterproof wound covering that individuals report to be less painful during wound dressing changes than gauze alternatives[34-36].

Potato peel dressings, prepared by using starch paste to adhere clean potato peels to a roller bandage, prevent desiccation of the wound surface and promote optimal epithelial regeneration[37-39]. After dressing sterilisation, the inner surface of the potato peel is applied to the wound[38]. The water content of the potato peel creates a moist interface that reduces adherence in comparison to wound dressing alternatives in low-resource communities. Several clinical trials have reported the efficacy of potato peel dressings in promoting healing in split-skin grafts, biopsy sites and full-thickness wounds[39-41]. One of these clinical trials explored the WRP experience associated with the removal of potato peel dressings. Favourable outcomes were reported, with 90% of individuals experiencing tolerable pain levels during wound dressing changes[42]. Potato peel dressings are changed second daily[40]. Although this is frequent compared to the longer wear time of many contemporary wound dressings, when considered in the context of simple gauze dressings that are often changed multiple times daily, potato peel dressings can decrease environmental wound exposure and interference in the wound healing process.

Banana leaf dressings are prepared in a similar fashion to potato peel dressings, with the leaves having their mid-rib removed before being pasted on to roller bandages and sterilised. The banana leaf has a waxy, waterproof surface that prevents the dressing adhering to the wound bed and promotes a moist, warm healing environment. Effectiveness of the banana leaf dressing in promoting healing in skin graft sites, surgical wounds and partial thickness burns has been reported in randomised trials[35,36] and observational studies[43,44]. The banana leaf dressing has been shown to be associated with less pain than some other wound dressing alternatives used in low-resource communities. When compared with a paraffin gauze for managing skin donor sites, two studies established that the banana peel dressing was associated with less pain in general ($p<0.05$) and on removal of the wound dressing ($p<0.05$)[34,35]. A banana leaf dressing remains in situ for up to eight days (in the absence of wound infection), which significantly reduces the frequency of wound dressing changes compared with local alternatives such as dry gauze, while reducing the pain experience of dressing changes due to its low-adherent, waxy surface.

PROMOTING MOISTURE BALANCE WITH LOW-RESOURCE WOUND DRESSINGS AND TOPICAL AGENTS

Wound dressings that promote moist wound healing not only increase the rate at which healing occurs[45,46], but also reduce the severity of WRP. Minimising sensory stimulus to the wound bed and surrounding skin during wound procedures reduces the experience of WRP[13]. By preventing drying of the wound bed and providing an appropriate level of exudate (moisture) management, a wound dressing designed to facilitate moist wound healing supports and protects angiogenesis and formation of new tissue, and prevents tissue dehydration[45]. Wound dressings that promote moisture balance can be removed with minimal interference to the healing wound bed, reducing the potential for tissue damage and resulting WRP[13].

In low-resource communities without access to advanced wound products, moist wound healing can still be achieved

Aloe vera plant (photo Emily Haesler)

using natural botanical products. One example is aloe vera gel, which is produced from the leaves of the aloe vera plant. Careful preparation of the leaves through removal of the outer rind exposes an inner fleshy pulp with gel-like consistency. Its use as a wound healing agent has been well documented in bench and clinical research. The efficacy of aloe vera in managing wounds in geographic areas without access to advanced wound care products is related to its high water content — the gel is approximately 99% water. This quality promotes moist wound healing. Contemporary wound management products have similarly high water content, for example, hydrogels are 80–90% water[47]. The high water content of aloe vera gel is also recognised as a characteristic associated with its analgesic properties through providing a cooling effect. Additionally, aloe vera dressings are more easily removed than wet-to-dry dressing alternatives, reducing potential wound bed trauma.

The theoretical basis for reduction of wound pain through use of aloe vera has been supported by research in clinical settings, particularly in the management of burns. The efficacy of aloe vera in reducing WRP has been explored in two randomised controlled trials (RCTs)[48,49], both conducted in populations in India with major burns. In both studies, aloe vera was applied to full-thickness burns in the treatment group, while the control group was treated with 1% silver sulfadiazine cream. In the first study, the individuals treated with aloe vera gel achieved a pain-free state significantly faster (mean 21 days versus mean 26 days, p=0.01)[48]. In the second study, individuals treated with aloe vera gel had more significant reduction in their pain at day seven (p=0.014) and day fourteen (p=0.05) compared with the control group[49]. A recent non-randomised trial[50] comparing aloe vera gel to nitrofurazone (antibiotic) ointment for non-infected superficial burns showed similar results. In this trial, individuals with multiple burns received each of the trial treatments to burns on different parts of the body. Within 24 hours of treatment, the blinded participants rated the burns receiving aloe vera gel as having significantly less severe pain (p=0.0001) and this effect remained consistent throughout three days of treatment[50].

MANAGING INFECTION AND INFLAMMATION WITH LOW-RESOURCE WOUND DRESSINGS AND TOPICAL AGENTS

In delayed healing wounds, the chronic inflammatory response contributes to WRP. This inflammation is perpetuated by local infection and/or chronic disease processes. Inflammation can decrease the threshold of peri-wound nociceptors, which increases their sensitivity to stimulus at the peri-wound[51]. In high-resource communities, topical or systemic use of antiseptic and/or non-steroidal inflammatory medication can be utilised to address the cause of the inflammation and manage the associated WRP[51-53]. However, these options are generally unavailable in low-resource communities, and local resource wound care products with antiseptic/anti-inflammatory properties are used to promote healing and decrease WRP.

Turmeric (active ingredient curcumin) is a spice that is traditionally ground, mixed with oil and applied directly to the wound bed as a paste[54]. The curcumin spice inhibits inflammatory processes through suppression of nuclear factor-kB and cyclooxygenase (COX) enzyme pathways, both of which are associated with facilitating the inflammatory response after injury[55]. Although demonstrated to have anti-inflammatory properties, there are few clinical trials of turmeric in wound management, and none report its efficacy in reducing wound pain. Its theoretical potential in reducing pain in burns and wounds has been described in detail, and numerous animal studies support its analgesic effect[56]. Additionally, human studies have shown efficacy of turmeric in reducing pain associated with other clinical conditions, including inflammatory conditions of the oral mucosa[57,58]. The available bench and clinical research suggests that the anti-inflammatory properties of turmeric are likely to contribute to some pain relief when it is used in the management of wounds[56].

Honey has been used for over 2,000 years as a topical agent to manage wound infection and inflammation, and is popular in low-resource settings with access to honey products[59,60], including India, Kenya and Bangladesh[61,62]. The antibacterial properties of honey are attributed to hydrogen peroxide concentration within honey in some honey species. In honey types that lack hydrogen peroxide activity (for example, Australian *Leptospermum* species), phytochemicals are the source of antibacterial properties[63,64]. Direct anti-inflammatory effects of honey have also been demonstrated[65]. In high-resource countries, wound-related honey products are gamma-irradiated and classified as medical-grade; however, in low-resource countries, natural honey is used with similar effects as those reported in the literature. Numerous studies[61,62,66-71] have explored WRP associated with honey products in both acute and chronic wounds. While some studies have found an increase in pain/stinging on application of honey to the wound bed[66], other studies report reduction in WRP over time in wounds treated with honey[67-70]. Some comparative studies have indicated that WRP can be lower when using honey in comparison to other topical agents, including povidone iodine[61] and paraffin tulle gras[71]. When WRP increases on application of honey, this is thought to be a transient, short-term effect due to sensitive nociceptors responding to the acidic pH of honey[60]. With minimal access to medical-grade honey preparations, in low-resource areas natural honey is applied directly to the wound bed, or in more novel ways such as combined with ghee to increase the viscosity and promote better contact of honey with the wound bed in a warm environment[62]. As with other topical agents discussed above, honey provides a warm and moist environment for healing, and the risk of WRP from disruption of healing with removal of the wound dressing is minimised.

Another traditional agent used to manage wound infection and inflammation is tea tree oil[14]. Bench research and

Melaleuca *species: oil distilled from the leaves is used to manage wound infection. (photo Emily Haesler)*

small clinical trials have demonstrated that this oil, which is derived from the plant species *Melaleuca alternifolia*, is active against *Staphylococcus aureus* and common gram-negative bacteria[72]. In low-resource settings, gauze is soaked in diluted (concentrations from 1% to 10%) tea tree oil and applied to the wound bed. The oil is associated with reduction in inflammation of the wound and peri-wound skin when used to manage a range of wound types, including full-thickness pressure injuries[73], surgical wounds[74], necrotic wounds[73] and spit skin grafts[75]. Although these studies provide a growing body of evidence on the efficacy of tea tree oil in reducing infection and promoting healing, evidence on the effect of tea tree oil as a soothing agent that can be used to reduce WRP is minimal and primarily anecdotal. However, a pilot study[76] conducted in Australia with 14 individuals with leg ulcers of mixed aetiology that explored the use of tea tree oil as a wound irrigation and cleansing agent, did provide an objective evaluation of the role of tea tree oil in reducing WRP. In this study, the inflammatory and antibacterial properties of tea tree oil were not only associated with demonstrated reduction in wound size and eradication of methicillin-resistant *Staphylococcus aureus* (MRSA), but WRP was reduced for over half the participants[76].

CONCLUSION

The minimisation and management of WRP is a universal right for those living with acute or chronic wounds, regardless of the setting, which includes low-resource communities. WRP is a unique experience for each individual that can include persistent background, and intermittent incident and procedural pain. The selection of wound dressing and topical agents can influence moisture balance, wound-related trauma risk and local chronic infection/inflammation, thereby contributing to both positive and negative experiences and outcomes. As this body of evidence increases, some traditional wound products, including turmeric, aloe vera, tea tree oil and natural honey are being recognised internationally. In both low- and high-resource settings, these traditional products have been incorporated into wound dressings and topical agents that promote characteristics associated with wound healing with minimal WRP. Appropriate 'dressing' and local management of the wound that contributes to a reduction in WRP is just one intervention that all health care professionals need to address in their everyday practice — no matter the setting or resources availability.

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