The use of honey in wound management

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Summary

Honey has been used as a wound treatment for more than 2,000 years. Greater scientific understanding of how it works, particularly as an antibacterial agent, has led practitioners to reconsider the therapeutic value of honey. Once honey is commercially available as a regulated product in the UK, practitioners will have access to an effective, alternative wound treatment. Specific, sterilised honeys intended for wound care will provide a safe natural product to manage colonised or infected wounds that would otherwise remain unresponsive to treatment.

Historical background

In recent years, practitioners in wound management have seen significant progress in understanding the healing process and treatments available. There has been renewed interest in two 'ancient' remedies – larval therapy (maggots) and honey – which with the application of modern scientific methods have been accepted as valuable treatments. According to Zumla and Lulat (1989): 'The therapeutic potential of uncontaminated, pure honey is grossly underutilised. It is widely available in most communities and although the mechanism of action of several of its properties remains obscure and needs further investigation, the time has now come for conventional medicine to lift the blinds off this "traditional remedy" and give it its due recognition.'

Honey has been a valued part of wound treatment for many centuries. It was first documented as a wound treatment by the Egyptians in 2000BC (Gelbart 1999). In the Middle Ages, a document from 1392 details wound care practices including the use of honey (Naylor 1999). More recently, honey has become a topic of clinical and scientific research in wound care. In Nigeria, Efem (1988) used undiluted honey on a variety of wounds including Fournier's gangrene and burns. He found that honey reduced the number of positive swab cultures and used it to debride sloughy and necrotic tissues. Exudate levels decreased and 'foul-smelling wounds were rendered odourless within one week' using sterilised honey treatments. In India, Subrahmanyam (1998, 1999) used honey to treat burns, and in the UK, Dunford *et al* (2000) successfully treated chronic infected meningococcal skin lesions with honey.

Curative properties of honey

Antibacterial activity of honey Efem (1988) suggests that the hygroscopic properties and the low pH (3.6) of honey are antibacterial, and that the barrier honey forms on the wound surface prevents bacterial penetration and colonisation. Laboratory studies have shown that honey has significant antibacterial activity against the major wound-infecting species including methicillin-resistant *Staphylococcus aureus* (MRSA) (Cooper 1998, Molan 1999). This activity is independent of the water effect. Sugar solutions and pastes have a high osmolarity and can bind water and so inhibit bacterial growth. When used on wounds, the presence of exudate dilutes sugar and paste preparations so they quickly lose their effect. This is not, however, the case with honey.

The antibacterial effect of honey results from the presence of hydrogen peroxide – an oxidising agent released by the action of the enzyme peroxidase that is added by bees to the nectar they collect (Molan 1992a). While this compound has been found to be harmful to wounds when added as a rinse solution, honey continuously provides a consistent antibacterial, non-toxic level that is approximately 1,000 times lower than in rinse solutions (Bang and Molan 2000). Additional antibacterial agents, which are plant-derived chemicals, for example bioflavonoids, are present in honey. Variations in antibacterial agents and in the amount of hydrogen peroxide produced explain the wide ranging effects of honey from different plant sources (Molan 1992b). Honey from the Leptospermum species in Australia and New Zealand has been found to have, in some batches, very high levels of activity owing to a plant-derived antibacterial component.

Deodorising action A deodorising action has been reported on using honey in wound dressings

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(Molan 1999) and has been identified as a valuable benefit of treatment (Dunford *et al* 2000). Deodorisation of a wide range of acute and chronic wounds, such as abscesses, diabetic foot ulcers and leg ulcers, is due to the antibacterial action of honey on the organisms that cause odour. In some recent cases of fungating wounds, honey was the only effective agent in controlling malodour (Dunford 2000). Foul smells are generated by anaerobes such as bacteroides and clostridium species, and Gram-negative rods such as pseudomonas and proteus species are inhibited by honey.

Antibiotic resistance A consensus on the clinical significance of micro-organisms in wounds is not yet clearly established. However, antimicrobial strategies are indicated where infection develops or where beta-haemolytic streptococci or pseudomonas colonise wounds that require skin grafts. The emergence of microbial strains with multiple patterns of antimicrobial resistance has reduced the efficacy of conventional therapies and forced the re-evaluation of traditional remedies in the search for appropriate antimicrobial agents (Cooper and Molan 1999). Laboratory testing has demonstrated the ability of honey to inhibit a range of wound pathogens (Cooper 1998, Molan 1999), especially those with the potential to develop antibiotic resistance such as *Staphylococcus aureus* (Cooper *et al* 1999) and pseudomonas (Cooper and Molan 1999). Recently beta-haemolytic streptococci, MRSA and vancomycin-resistant enterococci (VRE) have been shown to be sensitive to honey (Allen *et al* 2000, Cooper *et al* 2000). Honey can inhibit antibiotic-sensitive and antibiotic-resistant strains of wound pathogens *in vitro*.

Clinical evidence

Evidence is accumulating on the positive effect of honey on key wound healing stages: angiogenesis (the ability to evoke blood vessel formation), granulation and re-epithelialisation. There are published case and cohort studies and controlled clinical trials using honey in the treatment of acute and chronic wounds. Many of these are included in a comprehensive review by Molan (1999).

Although physicians in ancient Greek recognised that specific types of honey were best for therapeutic use (Molan 2000), most studies in recent times have used 'generic' honey, that is honey of unspecified source. In a detailed case study, Dunford *et al* (2000) used a manuka honey, selected for its good antibacterial activity (Allen *et al* 1991), to treat haemorrhagic lesions associated with meningococcal septicaemia. Manuka is the local Maori name for the New Zealand tea tree *Leptospermum scoparium*. The Leptospermum genus comprises subtropical evergreen shrubs native to Australasia.)

They found that the mixed infection of pseudomonas and enterococcus cleared from the lesions within just two weeks. Pseudomonas colonisation and infections are known to reduce the take rate of skin grafts in haemorrhagic lesions and burns. The capacity of honey to reduce oedema through its anti-inflammatory action lowers the risk of lesions becoming necrotic (Dunford *et al* 2000).

Efem (1988) studied the effect of honey on 59 patients with a variety of ulcers and burns, which were not responding to conventional treatment. He found that treatment with honey reduced infection and colonisation by pathogens (except mycobacteria) as well as promoting debridement and healing in 'most' wounds.

A randomised controlled clinical trial compared an undefined honey with silver sulphadiazine (SSD) (a topical antimicrobial) in the treatment of partial thickness burns (Subrahmanyam 1998). In this study, 25 patients were randomised to each treatment. Of the wounds treated with honey, 84 per cent showed satisfactory epithelialisation after seven days, and this rose to 100 per cent after 21 days. This compared favourably with the SSD treatment which showed 72 per cent and 84 per cent epithelialisation, respectively. Histology reports showed an early reduction in inflammation, better infection control and quicker healing in the group treated with honey.

In a subsequent study, Subrahmanyam (1999) compared early tangential excision and grafting with honey dressings in partial- and full-thickness burns. The findings showed that excision and grafting were superior to honey in terms of sepsis, contractures and healing rates. He concluded that honey is better suited to the treatment of partial thickness burns.

Guidelines for practice

Most honey available on the UK market is not intended for application to wounds. Honey that is for consumption is not sterilised and cannot be recommended for use on wounds. The British Pharmacopoeia (1993) has published a monograph on purified honey but in this context, honey is intended as a sweetening agent or demulcent. Commercial honeys intended for use on wounds are available; they have standardised antibacterial activity and are sterilised by gamma irradiation. In the UK, honey is not currently licensed under pharmaceuticals or medical devices. It is strongly advised that practitioners exercise caution before using any unregulated, unlicensed treatment. Local pharmacies might prepare dressings impregnated with honey, but although this would add authority to the product,

it would not overcome the problem of sterility unless prepared aseptically from sterilised honey or gamma-irradiated after preparation. There is also the problem of getting the honey to flow on to the wound. The fluidity can be increased by gently warming the honey in lukewarm water (30-35°C), but excessive heating will compromise its antibacterial activity (Molan 1992a). Dressings impregnated with honey under controlled conditions and sterilised by gamma irradiation are available commercially in Australia and New Zealand. These dressings have helped to address may of the problems associated with the application of honey.

A typical dressing would consist of an absorbent pad with about 25-35g of active honey added. This is placed on the wound and secured in position with a secondary dressing. Care must be exercised when selecting the secondary dressing, particularly if the peri-wound skin is friable, or if heavy exudate levels dictate that dressing changes should be frequent. As honey is likely to be used in the treatment of burns and skin lesions resulting from meningococcal septicaemia, extra care should be taken not to damage the skin around the lesion. Adhesive tapes and dressings should be used with caution. In many cases, the honey dressing can be kept in position using tubular dressings or bandages.

The antibacterial activity of honey, and consequently its clinical efficacy, has been shown to vary with the plant source (Molan 1992a). It is, therefore, important to select a honey that has potent antibacterial effects. A honey 'activity rating' scale has been devised based on the level of antibiotic activity (Allen *et al* 1991, Molan 1999). Honeys from the Leptospermum species, for example, manuka, have an exceptionally high level of plant-derived antibacterial components. Any honey used on infected wounds should have antibacterial properties. At present only Leptospermum honeys are being sold with standardised levels of antibacterial activity. The producers of manuka honey use a unique manuka factor, or UMF, rating equivalent to the concentration of phenol (carbolic), which has the same antibacterial activity against *Staphylococcus aureus*. Dunford *et al* (2000) used UMF 13 honey in their case study.

Having selected the appropriate honey, the method of application to the wound is the next step. Honey varies in consistency according to the amount of crystallisation. Solid honeys can be liquefied by gently warming (to no more than 37°C) before application. Ambient body (wound) temperature may be sufficient to liquefy some honeys and cause dependent leakage. This usually occurs if too much honey is applied to the dressing or if it has not been fully absorbed into the dressing.

Where it is compatible with the condition of the surrounding skin and the location of the wound, an adhesive, waterproof film secondary dressing will solve the problem of leakage provided there is not too much exudate. The osmotic effect of honey – drawing fluid out of the skin – will reduce the likelihood of maceration under occlusive dressings.

The specific honeys designed for wound care are not yet available in the UK market. Evidence suggests that these 'new' honeys are effective in wounds where overt infection is present, or where there is delayed healing. Wider use on all wounds will depend on evidence from clinical research.

Case studies

The following case studies illustrate how the use of Leptospermum honey has influenced healing in two different wound types. As honey does not have a product licence in the UK, each case study was undertaken with consent from the patient, GP and the Salisbury Health Care NHS Trust.

Case study 1 Sonia is 20 years old and has a four-year history of self-harm. She uses razor blades to incise her forearms and remove tissue. She has multiple scars to both arms as a consequence. The last episode of self-harm took place in May 2000, when she created a wound approximately 4cm x 4cm on her right forearm; this was on top of previous scar tissue. The wound was treated on a daily basis using paraffin gauze dressings. Sonia was also prescribed a course of antibiotics when signs of infection became apparent.

A few weeks later Sonia threw herself off a bridge and was admitted to hospital with an unstable fracture of the lumbar spine and a dislocation and fracture of the right ankle. This required the insertion of Harrington rods into the spine and pins were used to stabilise the ankle.

The wound on her right arm had not healed and became very sloughy. The slough was removed using a variety of moist wound healing products. Unfortunately, the wound did not

Fig. 1. Self-inflicted wound showing little evidence of healing

Box 1. Clinical advantages of using honey on wounds

- Creates an antibacterial moist environment
- Bacterial barrier prevents cross-infection
- Rapid clearance of infecting bacterial, including antibiotic-resistant strains
- Removes malodour
- Anti-inflammatory action reduces oedema
- Debrides the wound
- Prevents scarring and hypertrophy
- Promotes healing through stimulation of tissue regeneration
- No adverse effects on the healing wound tissues
- Minimises need for grafting
- Non-adherent

(Source: Molan 1999)

Box 2. Disadvantages of using honey on wounds

- Becomes more fluid at higher temperatures, might liquefy at wound (ambient) temperature
- Risk of liquefaction restricts body site – dependent leakage a possibility
- Preparation of impregnated dressings is difficult and non-sterile
- Remote risk of botulism from non-sterilised product (Molan and Allen 1996)
- In some patients a 'drawing' or stinging sensation in the wound can cause discomfort

reduce in size despite having a clean base. On close examination, it became evident that there were no capillary buds present in the wound bed, indicating the absence of granulation tissue (Fig. 1). Honey dressings were commenced to see what effect they would have on stimulating wound healing. An active Leptospermum honey was applied directly on to the wound on a daily basis with a simple non-adherent secondary dressing. Granulation and epithelial tissues were visible within one week of starting the honey treatment. Significant healing took place within three weeks (Fig. 2). The wound healed completely after six weeks' treatment with honey and has remained healthy. This case study demonstrates the ability of honey to promote angiogenesis, an important prerequisite for the formation of granulation tissue and re-epithelialisation.

Case study 2 Maureen is an obese woman weighing over 150kg. She has severe chronic lymphoedema in both lower limbs, congestive cardiac failure and hypothyroidism, and as a result has become immobile.

She knocked her left lower leg in January 2000, which resulted in two large haematomas. Despite commencing antibiotic therapy and having the haematomas drained, she developed severe cellulitis in her leg and required hospital admission. The haematomas subsequently broke down to form two large cavities, which were sloughy and had an offensive odour. These were debrided in theatre and covered with split skin grafts, harvested from donor sites on the left thigh. Unfortunately the grafts failed, probably because of the presence of pseudomonas and *Staphylococcus aureus* in the wound sites. Maureen remained in hospital following surgery. The cavity wounds deteriorated and the donor sites failed to heal completely (Figs 3 and 4). Wound swabs confirmed the presence of MRSA. A number of antiseptic products had been used but with little effect. The decision was made to use active Leptospermum impregnated dressings in an attempt to eradicate the infection and reduce the oedema and odour. The dressings were applied daily to the lower leg with a Gamgee pad impregnated with a Leptospermum honey (manuka UMF 13) to help contain the exudate. This dressing regimen was combined with strict leg elevation. Honey dressings were also applied to the donor sites on alternate days.

The honey proved beneficial in all wound areas. The donor sites were the first to heal. Granulation tissue and epithelialisation were evident in the ulcer wound beds within a couple of weeks. By week five, significant healing had taken place (Fig. 5) and MRSA had been eliminated. The lower ulcer healed completely after

Fig. 2. Significant healing within three weeks of using honey dressings

Fig. 3. Ulcer on lower leg and thigh donor site

Fig. 4. Pseudomonas evident (green coloration) in wound site

approximately eight weeks. Exudate levels decreased, but this might have been heavily influenced by leg elevation. Wound odour was also eliminated. Maureen experienced some pain when the honey was first applied, but this eased within 20 or 30 minutes. She described a 'drawing' sensation in the wounds. This was probably not due to the high osmolarity of honey, since sugar solutions with the same osmolarity have not caused pain in other patients who have found honey painful. It is more likely that certain wounds are sensitive to the acidity (low pH) of honey. Patients who have tried using pH-neutralised honey have not found it painful.

Following discharge from hospital, Maureen experienced another major fall and has found it difficult to maintain leg elevation at home. Further ulcers have now developed on her other leg as a consequence.

Fig. 5. Granulation and epithelialisation of ulcers within five weeks of honey treatment

Advantages and disadvantages

The advantages of using honey to treat wounds are listed in Box 1. Many of these advantages could contribute to cost-effective wound management. For example, *Staphylococcus aureus* and MRSA were eradicated from the wounds in case study 2 using topical application of honey without systemic antibiotics. The disadvantages of using honey-based dressings (Box 2) can be overcome by using manufactured sterile honey-impregnated dressings. The only contraindication is known allergy to honey.

Conclusion

The use of honey to treat a variety of wounds is well documented. No toxic effects have been reported in the literature. Many studies support the clinical safety and efficacy of generic and specific honeys. There are significant experimental data to demonstrate the antibacterial properties and histological effects of honey on the healing process. However, honey is not licensed or 'CE' marked for medical use in the UK. Once the regulatory requirements have been satisfied, practitioners and patients will be able to enjoy the benefits of a valuable and effective addition to the range of wound treatments. Anyone contemplating the use of honey in wounds is advised to use sterilised honey with standardised antibacterial activity under medical supervision and to obtain local research ethics committee approval

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