Honey Treatment for Wounds - Why it is the best and how to use it
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THE STORY OF HONEY

Raw honey has been used for centuries for wound cleansing and healing, until the antibiotic era. Interestingly, after centuries of use, there is no reported resistance to the antimicrobial effects of honey. The honey must be raw, not pasteurized (pasteurization process denatures active enzymes within the honey) or unpasteurized (unpasteurized suggests heat applied but not high or long enough, for pasteurization). The scientific support for the use of honey is multifactorial. One aspect is the low water content (or high osmolality) that honey creates in the wound which inhibits bacterial growth. The water requirements for microorganisms (and all other forms of life) can be defined in terms of water activity (a_w) of substrate. Every microorganism has a limiting a_w below which it will not grow. The minimum a_w for most bacterial pathogens (E. coli, Pseudomonas, Klebsiella, Corynebacterium, Clostridium perfringens and other clostridia and streptococcal sp) is 0.91 or more but for Staph. aureus is 0.86. Bacterial growth is inhibited at an a_w of 0.858. Other mechanisms associated with wound cleansing are decreased inflammatory edema, attraction of macrophages with further cleansing of the wound, accelerated sloughing of devitalized tissue, formation of a protective layer of protein on the wound and formation of a healthy granulation bed.

Particular antimicrobial substances in honey are termed inhibines; hydrogen peroxide, flavonoids and the phenolic acids [antioxidants] to name a few. Extensive research into many aspects of the wound healing properties of honey has been performed in the New Zealand manuka (Leptosperum sp) honey. Manuka honey contains an inhibine which has an end-product of hydrogen peroxide. Inhibine is produced by the natural glucose oxidase in honey; glucose oxidase produces gluconic acid (gluconolactone) and hydrogen peroxide from glucose. While hydrogen peroxide is mainly responsible for the antibacterial property of some honey, it is present at harmlessly low levels being continuously produced by the activity of the glucose oxidase enzyme present in honey, which is only activated when diluted. The concentration of hydrogen peroxide accumulating in one hour is approximately 1000 times less than that in the solution of hydrogen peroxide (3%) that is commonly used as an antiseptic (and toxic to tissue). The generation of low levels of hydrogen peroxide have been shown to stimulate angiogenesis and the growth of fibroblasts. The benefit of increased angiogenesis is improved oxygen delivery to tissues which is a limiting factor for tissue generation. After an extensive survey of the antibacterial activity of some New Zealand honeys, some have antibacterial activity independent of the hydrogen peroxide action. Manuka honey, for example, also has high levels of methylglyoxal, which is reported to confer its potent antimicrobial effects. In addition, the high levels of antioxidants in honey protect wound tissues from oxygen radicals that may be produced. The pH of honey is 3.6-5.6 which increases its antibacterial effect and promotes healing. Topical acidification of wounds has been shown to promote healing. The rate of granulation tissue formation and epithelialization of wounds, in addition to the antibacterial effects, may be enhanced by the various constituents of honey. Honey is an excellent cellular energy source; has a hygroscopic effect which reduces edema and provides a viscous barrier to wound invasion.

WOUND HEALING

Based on the above, honey fulfills all the important criteria for optimal effect on the major stages of wound healing. Wounds heal through four overlapping stages of tissue repair beginning immediately after tissue injury. Initially, the coagulation phase forms a fibrin plug, release of growth factors and cytokines. This is immediately followed by inflammation, stimulated by the presence of pro-inflammatory cytokines resulting in formation of granulation tissue. In the third stage migration and proliferation of keratinocytes and extracellular matrix occurs resulting in wound contracture. In the fourth stage, the collagen is remodeled and tensile strength of the new tissue is increased. As infection interferes with all stages of this healing process, honey’s antimicrobial activity treats and prevents infection. In addition, there is no concern for cytotoxicity, antimicrobial resistance or delayed healing, which may be associated with antibiotics and some biocides.

As an example of efficacy of local honey, in vitro studies of Ontario, Canada honey performed at the Ontario Veterinary College have shown efficacy against common bacterial pathogens, multi-drug resistant (MDR) E.coli and methicillin-resistant staphylococcus aureus, at dilutions of 12.5% and 6.25%. With efficacy at
these dilutions, the antibacterial activity will still prevail in a wound diluted with wound fluids. When used clinically to treat an MDR Enterococcus faecium infection in a very large post-surgical wound, the infection was irradiicated in 48 hours. The antimicrobial effects of honey are also effective against Candida albicans. We have also used honey in dogs and cats with streptococcal necrotizing fasciitis, major degloving and severe burn injuries where the cleansing and debriding action of honey was excellent. In several human studies, all wounds were sterile one week after beginning treatment with honey. In all patients, sloughing, necrotic and gangrenous tissues gradually separated from the floor and wall of the wounds or ulcers so that they could be lifted with a pair of forceps with no pain. The surrounding edema subsided, weeping ulcers were dehydrated, and foul-smelling wounds were rendered odourless also within a few days of dressing with honey. The chemical debridement action of honey spared these patients surgical debridement of the wounds. The sloughs and necrotic tissue were rapidly replaced with granulation tissue and advancing epithelialization.

At the stage of healthy granulation tissue, the wound is surgically closed using various techniques based on wound size and location. Otherwise, epithelialization is allowed to continue until secondary healing has occurred.

Case presentations of large wounds will be discussed (seeing is believing!). The use of honey is used in many countries in human patients with contaminated wounds. Decubitus ulcers, traumatic wounds, and diabetic ulcers have healed with the use of honey. Recently, medical grade honey has been produced and proved to be superior to other traditional dressings in refractory, poorly healing wounds.

**General Wound Management**

Prevention of further wound contamination is of utmost importance. To this end strict aseptic technique must be followed. Surface areas used for bandage change must be cleaned with antiseptic spray with a dwell time of ~ 15 mins prior to wiping clean. Showerhead and taps should also be cleaned. It is these surface areas that contaminate the wounds during dressing change. Hand washing, sterile gloves (powder-free gloves may reduce the potential for foreign body reactions) and sterile instrumentation is mandatory. Hair must be tied back and jewelry should not dangle near the wound. A clean coat or gown should be worn to protect the wounds from hospital contaminants (the major concern for wound infection is multi-drug resistant organisms in hospitals). Irrigation of honey from the wound is performed using tap water under gentle pressure (shower on the sink). Likewise infected wounds contaminate the operator’s clothes, etc, and the hospital environment. It is essential that the lavage solution be tested on the clinician’s palmar aspect of the wrist; the ideal temperature is when you can barely feel the fluid (37°C, 97F is too hot, room temp is too cold). A gentle, not high-powered lavage is also required to reduce pain. If saline in plastic bottles is used, make several holes with an 18ga needle in the cap, squeeze the bottle directing onto the wound. Aseptic surgical technique (including cap and mask) and wound flushing with sterile saline, is required during final cleansing prior to closing the wound. Culture and susceptibility testing of the wound should be performed prior to surgical closure to potentially identify any bacteria within the wound.

**Dressing Technique Using Honey**

Various types of injuries, burns, infected or necrotic areas, are all managed in a similar manner. Initially, grossly contaminated wounds are lavaged with body temperature tap water, with a kitchen-type spray nozzle, over a stainless steel grate to allow drainage. In large, dirty, infected wounds, up to 50 litres of lavage fluid may be required in large breed dogs, hence the use of tap water. Once completed, the wound is patted almost dry with sterile towels. Resection of grossly obvious necrotic tissue of a traumatic or surgical wound should be performed prior to the application of honey. However, where viability of tissue is questionable, do not remove, the debridement action of honey will remove questionable areas but allow viable tissue to thrive. The dressings are excellent for debriding dead skin and embedded particulate matter from the wound area. The amount of honey required will vary with wound size. Soaking a piece of gauze, strips of bandage or an absorbent dressing pad such as a laparotomy sponge in the honey prior to application makes wound dressing simpler than pouring honey onto the wound, although this is wound dependent. Raw honey will progress from a liquid to a paste over time which may be easier to apply to certain wounds than the liquid. The honey does not reduce the absorbency of the dressing material so large amounts of wound exudates can still be contained within the dressing. Sterile absorbent towels (which are re-used following laundering and sterilization) for large dogs, or sterile lap sponges for small dogs and cats, are used as the primary bandage layer. A large ‘volume’ of absorbent material is required to absorb the fluid. A secondary bandage layer is added to hold the absorbent material in place. This is
covered with an adhesive tertiary layer. Initially when wounds are infected and edematous, the honey is diluted rapidly by wound fluid, especially in large wounds, requiring daily changes. A guideline to bandage change timing is the presence or absence of honey in the wound. The lack of honey indicates the need for more frequent changes, whereas the presence of a good covering of honey indicates that change interval can be lengthened. After removal of the covering bandage material at the bandage change interval, the wound is gently lavaged with body temperature tap water, using a shower head, patted almost dry and again honey is applied. The bandages are changed if at any time strike through has occurred. Bandage changes can be reduced to daily or alternate days as granulation tissue is forming and strike through doesn’t occur. The wound is clean usually after 2-4 days in moderately infected wounds; five days or more may be required for large, severely infected wounds. Continue honey treatment as long as is required in the individual patient.

During the first few days of bandage changes, analgesics are necessary but as the granulation tissue starts to develop many cases no longer need analgesics to facilitate routine bandage changes. A healthy granulation bed begins to form in 2 days. As the bandages are changed it will become very evident which tissue is viable and going to survive and that which will not. At this time sharp dissection of devitalized tissue may be performed or, to prevent a general anesthetic, allow the honey to debride over a day or two. During the period of heavy exudation (edema fluid), the hydration status and protein levels, in animals with large wounds, should be monitored frequently. The duration of honey therapy is dependent on the wound. Once a healthy granulation bed has formed, infection is eliminated and all pockets have closed, the wound can be surgically closed where adequate skin is available, or skin grafting techniques may be used. Alternatively, with smaller wounds, these are allowed to heal via epithelialization and secondary healing.

Commercial medical grade honey is available in dressings or gel and in a tube (like toothpaste) for application into ‘pocket’ areas or for application onto the wound. This medical grade honey is easier to apply than raw honey in many situations. These products may be used for all acute or chronic wounds, for all stages of wound healing - from start to finish. Honey products may also be used on diabetic patients, and in fact, improves healing of diabetic ulcers in human patients.

In conclusion, honey is excellent for topical dressings in treating open, especially contaminated/infected, wounds. Advantages are rapid antibacterial action, enhanced granulation tissue formation and epithelialization, accelerated wound healing, decreased cost and ready availability.

References
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