

Enhancing primary healing post ray amputation in a diabetic patient: efficacy of natural honey

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Abstract:

Ray amputation is a common surgical procedure performed on diabetic patients suffering from osteomyelitis-complicating diabetic foot ulcers. This report seeks to introduce a novel alternative to the range of existing wound dressing materials commonly used to manage post ray amputation wounds. Post-amputation, and after flushing the wound with normal saline and using a scalpel to perform proper sharp debridement, natural honey was applied. Following the application of natural honey, a sterile gauze was applied and the dressing was changed on a daily basis. Four weeks after applying natural honey on a daily basis, the wound had completely healed, by secondary intention. Using natural honey can promote wound healing by secondary intention and therefore provides a natural, efficacious, and cost effective alternative to the existing expensive wound dressing materials available on the market. This is important since Type 2 diabetes, and its complications such as diabetic foot ulcers, is already a huge public health burden in developing countries.

Key words: Primary Healing, Natural Honey, Post Ray Amputation

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INTRODUCTION

Foot ulceration and infection are the leading cause of hospital admission among diabetic patients.¹ Additionally, almost 50% of all lower extremity amputations are performed in diabetic patients.² Pedal ulcers affect 15% of diabetic patients worldwide.³ Furthermore, the average cost of healing a single ulcer is \$8,000, an infected ulcer is \$17,000, and a major amputation is \$45,000.⁴

Toes are involved in the majority of diabetic foot ulcerations⁵, and if the ulcer and/or infection of the toe spreads into the joint, and its distal and proximal bony components, amputation of the affected bone is unavoidable. Therefore, amputation of the toe at the level of the distal metatarsal

head (i.e., partial ray amputation) or with total removal of the whole metatarsals (i.e., complete ray amputations) is a common surgical procedure for diabetic foot ulcers.

We describe a case of a diabetic patient who had two complete ray amputations involving the right second and third metatarsals. Post-operatively, the patient was sent to our health center for further management because the patient had difficulties continuing follow-up at the hospital. While at the hospital, the wound was healing slowly; there an alginate dressing was used, consisting of hyaluronic acid alginate, carboxymethylcellulose, and silver-coated nylon fibers. After an initial consult with an attending consultant,

who had a special interest in the diabetic foot, the patient opted for natural honey as the dressing agent to help the wound heal by secondary intention.

THE USE OF NATURAL HONEY

The medical literature of Egypt, Greece, and the Ayurvedic traditions of India have extensively referred to honey for its wound healing properties.⁷ The Koran also praises the virtues of honey for its healing properties.⁸ However, despite its use as a traditional remedy for burns and wounds, the potential for its inclusion in modern medical care has not been recognized.⁹ Natural honey is still considered a less attractive option in many institutions, especially in the West. More expensive wound dressings such as alginate, foam, hydrocolloid, and hydrogel are generally preferred.

Honey has been shown to exert antimicrobial activity against a range of bacteria and fungi, including multi-drug resistant organisms such as Methicillin-resistant *Staphylococcus aureus* (MRSA). The antibacterial activity of honey is related to its lower water content (0.56-0.59); low pH (3.2-4.5); and release of hydrogen peroxide, flavonoids, and phenolic acids.^{10,11}

The physiochemical properties of honey (e.g., pH and viscosity) not only contribute to its antibacterial activity but also provides an ideal medium for fibroblast proliferation, migration, and organization of collagen. Furthermore, the viscous nature of honey works as a sealant for wounds, thereby preventing external bacteria from attacking the newly granulating tissues. Honey is thought to have anti-inflammatory properties in histological and clinical observations,¹² attracting immunocompetent cells (e.g., monocytes) within the wound bed.^{13,14}

Honey enhances wound healing by providing a moist environment since 20% of honey is water. Honey also creates an osmotic gradient, which results in drainage of fluids from lymph and capillaries, thereby helping cells such as fibroblasts to proliferate and migrate.

Rinse solutions, including hydrogen peroxide,

can be harmful to uninfected healthy granulation tissue. However, hydrogen peroxide released by honey (as a result of the enzyme glucose oxidase) is diluted by 1,000 times in comparison to rinse solutions, thereby exerting bacteriostatic and bactericidal activity against a variety of bacteria without damaging the healthy granulation tissue the body is trying to build. This makes honey an ideal wound dressing. The physiologically-generated hydrogen peroxide is also important in contributing to the growth modulation of adjacent non-inflammatory cells such as fibroblasts at the site of inflammation.¹⁵

CASE HISTORY

In May 2010, a 60-year-old man suffering from Type 2 diabetes mellitus came to the Umg-wailinah health center, Doha, Qatar complaining of a swollen, hot right foot with drainage. History taken from the patient revealed that he developed an infected ulcer one month prior to this presentation but ignored it and was dressing it at home with Merbromin. This is a commercially available over the counter antiseptic solution, which is usually used for minor cuts and abrasions. It is no longer available in the U.S. market due to its mercury content, although it is sold worldwide as a cheap antiseptic solution.¹⁶ Upon initial examination, the patient was in good general condition, his temperature was 38.5 degrees Celsius, and his blood pressure was 135/83 mmHg. In addition, his random blood sugar was 14 mmol/l and erythrocyte sedimentation rate (ESR) was 75 mm/h. Roentgenographic examination showed bone resorption, focal osteopenia with multiple lucencies in the cortex, and medullary bones of the 2nd and 3rd toes.

Foot examination revealed a swollen right foot with bright red discoloration secondary to the application of Merbromin, and underlying cellulitis extending above the level of the medial malleolus. The plantar surface revealed a Wagner stage 3 ulcer with oozing pus and probing to bone. The ulcer was 3cm wide and 2cm long with a depth of 0.6 cm just distal to the 2nd and 3rd toes which demonstrated a sausage like appearance. Neurologic examination

revealed an insensate foot with loss of protective sensation evidenced by lack of sensation in the 1st, 3rd, and 5th metatarsal heads using the 5.07/10 gram Semmes-Weinstein monofilament. Vascular examination revealed non-palpable dorsalis pedis, posterior tibialis, and popliteal arteries. As a result, the patient was referred to the main general hospital with diagnoses of suspected osteomyelitis, cellulitis, and vascular insufficiency.

In this case the signs and symptoms were quite obvious, and osteomyelitis was diagnosed primarily on clinical grounds by the presence of a plantar ulcer surface area of more than 2cm², a depth of more than 0.5cm, and a positive probe to bone test. However, the high ESR value of 75mm/h is quite significant since it has been demonstrated that an ESR value of more than 40mm/h is associated with almost a 12-fold increased likelihood of osteomyelitis in a prospectively studied series of patients referred with possible osteomyelitis.^{17,18} Although plain film findings are not pathognomonic for infection, a diagnosis of probable osteomyelitis can be made when classic changes are found in the presence of such typical clinical findings. Plain radiography has a 60% sensitivity and 66% specificity with a 74-87% positive predictive value for identifying osteomyelitis.¹⁹ Nonetheless, many patients suffering from diabetic foot ulcerations and osteomyelitis may present with a subclinical course due to diabetes related vascular insufficiency, peripheral neuropathy, and leukocyte dysfunction.²⁰ Yet, on occasion signs and symptoms may progress rapidly in hours or days in a limb threatening situation.²¹

Subsequently, this patient underwent a femoral-popliteal bypass followed by complete excision of his 2nd and 3rd rays. The surgery sequence was necessary since successful revascularization reduces the major amputation rate in diabetic patients presenting with critical ischemia.²² Several studies have suggested improved outcomes of transmetatarsal amputations performed after revascularization procedures.^{23,24} Since bone biopsy is the standard for an osteomyelitis diagnosis, an intra-operative

bone biopsy was sent to the lab for culture and sensitivity.²⁵

In this case, surgery was aimed at decompression and drainage of the involved compartment followed by radical debridement of all necrotic tissues. Since the soft tissue infection was associated with underlying osteomyelitis of two metatarsal heads, ray amputations were necessary. Furthermore, due to the presence of acute osteomyelitis including edema, redness, foul smelling discharge, and an ulcer with positive probe to bone sign, the surgeons elected for the wound to heal by secondary intention. During his stay in the hospital, the wound was cleaned daily with a povidone-iodone rinse solution followed by an alginate dressing for three weeks. The wound was not healing with this therapy, and as a result, against medical advice, the patient asked to be discharged to have the dressings done at the local health center. Often it is inappropriate management of the foot and co-morbidities that are the main factors responsible for faulty wound healing.²⁶

Upon the patient's arrival at the health center, a consulting family physician, with a special interest in diabetes, examined him. On presentation, the right foot showed a surgical wound with a surface area of 10 cm x 4.5 cm containing necrotic tissue, slough, and macerated edges. (**Figure 1**) His pedal pulses were palpable with



Figure 1. Initial presentation at primary health care; post-surgery wound showing macerated edges, necrotic tissue, and islands of granulation tissue

normal skin color surrounding the wound. After counseling the patient about different dressing materials, the patient opted to use honey as the dressing. Currently, there is insufficient evidence to suggest that any one particular wound dressing is superior in the management of diabetic foot ulceration or wounds.²⁷ However, any optimal dressing should be non-adherent, thus minimizing the risk of tissue damage on removal, have an antiseptic property, be cost effective, and be aesthetically acceptable to the patient. It should also provide a moist environment for cells to proliferate, migrate, and prevent exogenous pathogens from attacking the wound.

Initially, the wound was irrigated using a 10cc syringe to flush out any colonizing pathogens. Colonization is defined as the presence of multiplying bacteria with no overt host immunologic reaction.²⁸ However, if the multiplication of bacteria reaches a stage of 'critical colonization,' where the host defenses are unable to maintain a balance, a delay in the wound healing process is the ultimate result.^{29,30} The wound edges, which were macerated, were swabbed with a povidone-iodine rinse solution to dry up the edges, prevent further skin breakdown, and decrease the local bacterial count.³¹ Natural honey was applied on the wound and covered with sterile gauze that was changed on a daily. Two weeks later, the wound had improved by 60%. (**Figure 2**)



Figure 2. Sixty percent reduction in the size of the ulcer, showing healthy granulation tissue and minimal maceration

Ongoing daily honey dressing provided an ideal wound healing environment, including nutrition in the form of lactulose and fructose which promoted rapid epithelialization³² and improved wound pH balance. This enhanced fibroblast activity,³³ and provided anti-inflammatory properties through monocyte action within the wound. By the third week, the wound reduced in size by 90%. (**Figure 3**) This method of honey application is similar to other such studies in the medical literature, which advocate honey application either once daily or every two days.¹² After the fourth week, the wound had completely healed. (**Figure 4**)



Figure 3. Ninety percent reduction in ulcer size showing normal skin



Figure 4. Complete healing of the wound by week four

COMMENTS AND CONCLUSION

We managed to heal the ulcer using a very cost effective and aesthetically acceptable wound dressing in the form of natural honey. This form of management will certainly provide a viable and effective alternative to the list of commercially available wound dressing materials in the market.

The successful management of wounds does not signify the end of the problem, as around 50% of diabetic patients suffer from recurrent ulcers within 2 years.³⁴ Hence, the need for a holistic approach can easily be provided by the family physician who has an interest in diabetic foot management. Accordingly, the physician can

provide counseling, promote metabolic control, screen for peripheral vascular disease and peripheral neuropathy, manage the high risk foot, treat depression, and provide dietary advice.

The management of diabetic foot conditions is not only costly in economic terms but also in human suffering. Hence, the challenge is to provide patients with an alternative wound dressing that can be efficacious, aesthetically acceptable, and cost effective. This is especially important in developing countries where the burden of diabetic foot ulcerations, and associated complications, are increasing at an alarming rate.

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