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Comparison between topical honey and mafenide acetate in treatment of auricular burn

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Abstract The auricle is a frequently injured part of the head and neck during thermal injury leading to ear deformity. The burned ear represents one of the most difficult problems for reconstructive surgeons. Mafenide acetate is a topical agent used routinely for these patients, but it has some disadvantages including painful application and allergic rash. Some authors have reported the healing effect and antibacterial activity of honey. The study reported here was undertaken to compare the effect of honey and mafenide acetate on auricular burn in rabbit. In our study, although the pathologic score of the honey group was better than that of the mafenide group both on 14 and 21 days after burning, it was not statistically significant. In the mafenide acetate group, deep complication of burn (chondritis) was significantly lower than that of the honey group. In conclusion, in contrast to healing and antibiotic activity reported for honey, it may have failure in preventing deep bacterial complications of wound (like chondritis). So in deep wounds, the use of honey as dressing is not recommended.

1. Introduction

The auricle is a frequently injured part of the head and neck during thermal injury leading to ear deformity. The burned ear represents one of the most difficult problems for reconstructive surgeons because of the dense scarred tissue that usually surrounds it [1]. From an anatomical point of view, the ear has no subcutaneous tissue to protect the cartilaginous framework. This cartilaginous framework, once exposed or injured, is particularly susceptible to infection [2].

Auricular deformities can be a result of both direct thermal injuries and subsequent chondritis, which is a severe complication of ear burns that can even destroy the unburned cartilage if not recognized early [3]. Auricular chondritis secondary to bacterial invasion of the cartilage is prevented by the routine use of topical mafenide acetate on all burned ears [4].

Mafenide acetate is a topical agent with a broad spectrum of activity because of its sulfa moiety. It is particularly useful against resistant *Pseudomonas* and *Enterococcus* species. It can also penetrate eschar. Its disadvantages include painful application on the skin, for example, in second-degree wounds. It can also cause an allergic rash, and it has carbonic anhydrase inhibitory characteristics that can result in metabolic acidosis when applied over large surfaces. For these reasons, mafenide acetate is typically reserved for small full-thickness injuries [5].

Honey has been used for medicinal purposes since ancient times. It was used topically in ayurvedic medicine during 2500 BC, and Egyptians, Greeks, and Romans used it as well. Hippocrates prescribed honey for various indications including the management of wounds and gastritis. In addition, the wound-healing properties of honey were mentioned in the Qur'an and the Bible [6].

It has been proposed that the healing effect of honey could be due to various physical and chemical properties. The high osmolarity and acidity of honey are among the physical characteristics that contribute to its antibacterial activity. Hydrogen peroxide, volatiles, organic acids, flavonoids,

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beeswax, nectar, pollen, and propolis are important chemical factors that provide antibacterial properties to honey [7].

The antibacterial activity of honey has been confirmed in numerous studies [6,8,9]. White et al has reported that the major antibacterial factor in honey is hydrogen peroxide, which is produced by glucose oxidase originating from hypopharyngeal glands of honey bees. In addition, there is catalase in honey, which originates from pollin. The level of hydrogen peroxide in a given honey is determined by relative levels of glucose oxidase and catalase [10].

Likewise, most phytochemical factors withstand dilution in wound fluids. Overall, honey has a restraining influence on the growth of most bacteria, including some methicillin-resistant *Staphylococcus aureus* strains. This makes honey attractive for the prevention and treatment of infections in chronic wounds [11,12], as well as for the treatment of acute wounds. Unlike most conventional local chemotherapeutics, honey does not lead to the development of antibiotic-resistant bacteria, and it may be used continuously [6]. Rapid clearance of infections, rapid suppression of inflammation, minimization of scarring, and stimulation of angiogenesis as well as tissue granulation and epithelium growth were reported with using honey for dressing [7].

All these physical and chemical factors give honey unique properties as a wound dressing. This study was undertaken to compare the effect of honey and mafenide on auricular burn in rabbit.

2. Materials and methods

Experimental design and treatment of animals were approved by the Animal Care Committee of Shiraz University of medical sciences. Fifteen male white rabbits (3.4 ± 0.4 kg) were used for the evaluation of ear burn wounds. Ketamine (25 mg/kg) and xylazine (1 mg/kg) were injected intramuscularly into the rabbits to induce sedation before a heated iron stamp was applied on the back of the auricles. The heated stamp (in boiling water 95°C ± 2°C) was applied for 8 seconds to form a dermal burn wound (burn area, 3.8 cm^2). All left auricular wounds underwent daily application of topical mafenide, and all right auricular wounds were treated with daily topical honey after the wound had been irrigated with normal saline (unprocessed honey obtained from Dena Mountains).

The biopsy samples were taken on day 14 from 5 rabbits and day 21 from the remaining 10 rabbits, and the healing was evaluated macroscopically and histopathologically. Photographs were taken of the wound areas on days 7, 14, and 21.

The biopsies of the skin samples were fixed in a 10% formalin solution, then embedded in paraffin block and sectioned to 4-μm increments. The sections were positioned on a slide and stained with hematoxylin-eosin.

A histologic scale adapted from Singer et al was used (Table 1). Each item was graded by pathologist according to a semiquantitative approach as absent (0) and present (1) without the knowledge of the specimen groups.

Table 1
Histologic assessment scale

	Score
Hyperkeratosis	
Absent	1
Present	0
Epidermal hyperplasia	
Absent	1
Present	0
Hair follicles	
Absent	1
Present	0
Apocrine gland	
Absent	1
Present	0
Smooth muscle	
Present	1
Absent	0
Collagen orientation	
Normal	3
Abnormal collagen in the papillary dermis	2
Abnormal collagen in the upper reticular dermis only	1
Fibroplasia (increased no. of fiberocytes)	
Absent	1
Present	0
Vascular	
Absent	1
Present	0

Best total score is the sum of individual scores (0–10), where the best possible outcome is 10 and the worst outcome is 0.

Histologic results were analyzed using the nonparametric Wilcoxon rank sum test. A $P < .05$ was considered as statistically significant.

3. Results

Mean histologic scale on day 14 for the mafenide group was 5.6 (range, 4–7; SD, 1.34), and for the honey group, it was 6.4 (range, 5–8; SD, 1.14), not being statistically significant. Mean histologic scale on day 21 for the mafenide group was 5.2 (range, 4–7; SD, 1.13), and for the honey group, it was 5.5 (range, 4–7; SD, 1.43). These differences were not statistically significant.

Table 2 shows histologic items score 21 days after burning. Fig. 1 shows the frequency of mafenide and honey's total pathologic score 21 days after burn.

Clinical chondritis (pus, discharge, erythema in association to perforation) was detected in 5 auricles of the mafenide group and in 12 auricles of the honey group 14 days after burning. It was statistically significant. The mean size of maximum auricular perforation size in the honey group was 1 cm (SD, 0.97), and in the mafenide group, it was 0.6 cm (SD, 0.65). However, this differences was not statistically significant.

Fig. 2 shows auricular perforation in the mafenide and the honey group's auricles.

Table 2
It shows pathologic items score 21 days after burn

	Hyperkeratosis	Epidermal hyperplasia	Hair follicles	Apocrine gland	Smooth muscle	Collagen orientation	Fibroplasia	Vascular
Mafenide	0	0	1	0	0	2	1	1
	0	1	0	0	0	1	1	1
	0	1	0	0	0	3	1	1
	1	1	0	0	0	0	1	1
	1	0	0	0	0	1	1	1
	1	0	1	1	0	2	1	1
	1	0	1	1	0	3	0	0
	1	1	1	1	0	1	1	1
	1	0	1	0	0	0	1	1
	1	0	1	1	0	3	0	0
Honey	1	0	1	1	0	3	0	0
	0	1	0	0	0	1	1	1
	1	1	1	0	0	1	1	1
	1	1	0	0	0	0	1	1
	1	1	1	1	0	2	1	1
	1	1	1	0	0	2	1	1
	1	1	1	1	0	2	1	1
	1	0	1	1	0	3	0	0
	1	0	0	0	0	2	1	1
	0	0	0	0	0	2	1	1

4. Discussion

The medicinal and antimicrobial properties of honey in relation to wound treatment has been recognized for approximately 4500 years, where for instance, Prince Hal was treated with rose honey by John Bradmore, a London surgeon [3]. Honey was subjected to laboratory and clinical investigations during the past few decades [6,8,13]. We aimed in this study to compare the topical effect of this traditional medicine with mafenide acetate in the auricular burn outcome.

Antibacterial activity is related to 4 properties of honey. First, honey is a supersaturated sugar solution [14]; second, the pH of honey (between 3.2 and 4.5) [15]; and third, hydrogen peroxide is probably the most important antibacterial component. Finally, several phytochemical factors for antibacterial activity have been identified in honey [11].

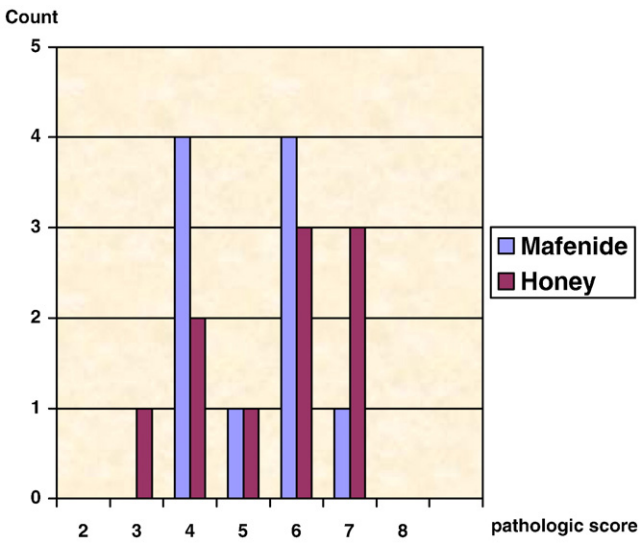

Fig. 1. This chart shows frequency of mafenide acetate and honey pathologic score after 21 days of burn.

It has been proposed that the healing effect of honey could be due to various physical and chemical properties. Subrahmanyam [16] reported that honey has a better epithelialization effect in comparison to silver sulfadiazine in burn wounds. In our study, although the pathologic score [17] of the honey group was better than that of the mafenide acetate both 14 and 21 days after burn, it was not statistically significant. Therefore, another study with a larger sample size may be required for evaluation of these differences.

Mafenide acetate is a sulphonamide with quick and deep penetration into burn eschar and excellent antibiotic properties [5,18]. These characteristics make it ideal for areas of the face where cartilaginous framework is exposed such as the ears. Its antibiotic cover includes both Gram-positives and Gram-negatives, with minimal antifungal activity [19].

Despite some antibiotic activities of honey reported by some previous studies, in this study, clinical chondritis was observed more in the honey group, and it was statistically significant. This shows better action of mafenide acetate in preventing deeper infectious complication of burn (chondritis). It can result from deep penetration into burn eschar of mafenide acetate. In a previous study, the effect of honey on wound with deep complication and its penetration to eschar were not evaluated carefully. So, healing and antimicrobial property of honey may be limited to more superficial burn, and it is not recommended in wounds in which deep complications might be come a problem.

Fig. 2. It shows auricular perforation in a mafenide acetate group (upper) and a honey group (lower) auricles.

5. Conclusion

In conclusion, this study demonstrated that honey might have a better healing effect and epithelialization of the superficial wound than some topical antibiotics like mafenide acetate, but it needs more in vivo studies.

In contrast to antibiotic activity reported for honey, it fails in preventing deep bacterial complications of wound (like chondritis). So, in deep wounds, the use of honey as dressing is not recommended.

References

[1] Bhandari PS. Total ear reconstruction in post burn deformity. Burns 1998;24:661-70.
[2] Ibrahim SM, Salem IL. Burned ear: the use of a staged Nagata technique for ear reconstruction. J Plast Reconstr Surg Nurs 2008;61: S52-8.
[3] Maeda Y, Loughrey A, Earle JA, et al. Antibacterial activity of honey against community-associated methicillin-resistant Staphylococcus aureus (CA-MRSA). Complement Ther Clin Pract 2008;14:77-82.
[4] Fink MP, Abraham E, Vincent J-L, et al, editors. Textbook of Critical Care. 5th ed. Philadelphia (PA): Elsevier Saunders; 2005.
[5] Townsend J. Burns: sabiston textbook of surgery. 18th ed. Philadelphia (PA): Saunders; 2007. p. 572-3.
[6] Emsen IM. A different and safe method of split thickness skin graft fixation: medical honey application. Burns 2007;33:782-7.
[7] Basualdo C, Sgroy V, Mónica S, et al. Comparison of the antibacterial activity of honey from different provenance against bacteria usually isolated from skin wounds. Veterinary Microbiology 2007;124: 375-81.
[8] Zumla A, Lulat A. Honey—a remedy rediscovered. J R Soc Med 1989;82:384-5.
[9] Efem SEE, Udoh KT, Iwara CI. The antimicrobial spectrum of honey and its clinical significance. Infection 1992;20:227-9.
[10] Taormina PJ, Niemira BA, Beuchat LR. Inhibitory activity of honey against foodborne pathogens as influenced by the presence of hydrogen peroxide and level of antioxidant power. Int J Food Microbiol 2001;69:217-25.
[11] Wahdan HAL. Causes of the antimicrobial activity of honey. Infection 1998;26:26-31.
[12] Cooper R, Molan PC. The use of honey as a antiseptic in managing *Pseudomonas* infection. J Wound Care 1999;8:161-4.
[13] Allen KL, Molan PC, Reid GM. A survey of the antibacterial activity of some New Zealand honeys. J Pharm Pharmacol 1991;43:817-22.
[14] Molan PC. The role of honey in the management of wounds. J Wound Care 1999;8:415-8.
[15] Obaseiki EE, Afonya TCA. Preliminary report on the antimicrobial activity of honey distillate. J Pharm Pharmacol 1983;35:748-9.
[16] Subrahmanyam M. A prospective randomised clinical and histological study of superficial burn wound healing with honey and silver sulfadiazine. Burns 1998;24:157-61.
[17] Singer AJ, Thode H, McClain S. development of a histologic scale to quantify cutaneous scar after burns. Acad Emerg Med 2000;7:1083.
[18] Villapalos JL, Jeschke MG, Herndon DN. Topical management of facial burns. Burns 2008;34:903-11.
[19] Shuck JM. Mafenide acetate solution dressings: an adjunct in burn wound care. J Trauma 1975;15:595-9.