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Honey dressing in pediatric burns

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ABSTRACT

The medicinal properties of honey have been recognized since antiquity. Although used as an adjuvant method of accelerating wound healing from ancient times, honey has been sporadically used in the treatment of burns. Honey acts mainly as a hyperosmolar medium and prevents bacterial growth. Because of its high viscosity, it forms a physical barrier, and the presence of enzyme catalase gives honey an antioxidant property. Its high-nutrient content improves substrate supply in local environment promoting epithelialization and angiogenesis. In pediatric burn patients no exclusive study has been conducted using honey as a burn dressing. An attempt is being made to evaluate the effect of honey in the management of burns in pediatric patients.

KEY WORDS: Honey, Inhibine, Wound healing

Despite recent advances in antimicrobial chemotherapy and wound management, infection continues to be an important problem in the treatment of burns. A variety of topical agents such as silver sulphadizine,[1] 5% silver nitrate,[2] and sulphamylon[3] have been used, but none have eliminated the problem of infection.

The medicinal properties of honey have been recognized since antiquity. The mention of its healing properties is found in the Bible, the Koran, the Vedas, and the Torah. The use of honey is also found recorded in the Edwin Smith papyrus dating from the 17th century BC, and is again referred to by Hippocrates and Democritus in ancient Greece, Galen in ancient Rome, and Avicenna in medieval times.[4] Ayurvedic stalwarts such as Charaka and Sushruta included honey in their dressing aids to purify sores and promote the healing of fistulous tracts. Honey paste on wounds was Sushruta's method of burn treatment.[5] Although used as an adjuvant method for accelerating wound healing from ancient times, honey has been sporadically used in the treatment of burns.[6],[7] Work on the antibacterial activity of honey has been going on since the 18th century. Various researchers have shown that honey exerts an antibacterial activity against various organisms, including both Gram-positive and Gram-negative bacteria. The antibacterial activity of honey is mainly due to inhibines in honey. These inhibines consists of hydrogen peroxide, flavinoids, and phenolic acids, plus many other unidentified substances.[8],[9] A number of reasons for this have been suggested: shrinkage disruption of the bacterial cell wall due to the osmotic effect of the sugar content, induction of an unfavorable environment with low-water activity, thereby inhibiting bacterial growth, a low pH of 3.6 and the fermentation of honey producing alcohol. *In situ* honey acts as a highly viscous barrier preventing bacterial penetration and colonization of the wound surface.[10]–[12]

The antimicrobial effect of honey may well be an answer to the question of a cheap, easily available, nontoxic, nonirritant, antibacterial agent for burn dressing in a developing country like India.

PATIENTS AND METHODS

Sixty-four patients less than 12 years of age, who had sustained superficial thermal burns involving less than 50% of the body surface area, were treated over the period, January 2001 to December 2003. A detailed history was obtained regarding the mode and time of injury. A thorough physical examination was performed with emphasis on type and extent of burns [Table 1]. Two groups A and B were formed and patients assigned to it randomly. All patients were given a thorough bath, twice daily, with tap water and detergent (Lifebuoy soap). This was followed by sponging and a gradual peeling of the dead skin. Patients in Group A were dressed with honey, while those in Group B had silver sulphadiazine application on the burnt surface. Culture swabs were taken from the burnt surface on admission, before any treatment was instituted

Table 1: Extent of Burns

Percentage of Burns	Number of Patients	
	Group A	Group B
< 10%	05	03
11 - 20%	02	05
21 - 30%	07	08
31 - 40%	16	15
41 - 50%	02	01
TOTAL	32	32

and repeated after 48 h and, thereafter, every 72 h until the wound healed.

RESULTS

In this study, out of 64 patients treated, 48 were males and 16 females [Table 2]. Nine patients were under 1 year of age, and the youngest patient treated was 6-month old. Fifty-six patients suffered injury due to wet burns, while eight patients had burns caused by dry heat.

Twelve patients had sustained facial burns and 20 patients had burns on their extremities, while the remaining 32 patients had burns on their trunk and abdomen.

Twenty-eight patients were brought to the hospital within 6 h of injury, while 15 patients got admitted between 6 and 12 h of injury. Ten patients who were admitted had sustained burns 12–24 h before admission, and 11 patients reported for admission after 24 h of injury [Table 3].

The time taken for wound healing [Table 4] differed significantly between the two groups ($P<0.001$). Healthy granulation tissue appeared within 8 days (mean = 6.7 days) of treatment with honey in Group A. Wound healing took 10 days in 26 patients belonging to Group A, while in six patients it took 2 weeks or more to heal. In Group B, patients treated with silver sulphadiazine, healthy granulation tissue appeared in 2 weeks' time

Table 2: Age and Sex Distribution

Age Group	Number of patients					
	Group A		Total	Group B		Total
	Male	Female		Male	Female	
< 1 year	03	02	05	03	01	04
1 – 5 years	14	04	18	18	03	21
> 5 years	06	03	09	04	03	07
Total	23	09	32	25	07	32

Table 3: Time of Presentation

Time of Presentation	Number of Patients	
	Group A	Group B
< 6 hours	15	13
6 - 12 hours	07	08
12 - 24 hours	04	06
> 24 hours	06	05
Total	32	32

Table 4: Mean Time of Healing

Time of Presentation	Number of patients	
	Group A	Group B
< 6 hours	10 days	14 days
6 - 12 hours	10 days	15 days
12 - 24 hours	12 days	18 days
> 24 hours	14 days	21 days

(mean = 12.8 days). Wound healing took 3 weeks or more in 19 patients belonging to Group B. Forty-nine (Group A = 25 and Group B = 24) patients had swab culture positive at the time of admission. Out of 28 patients presenting within 6 h of injury, only 14 (50%) (Group A = 8 and Group B = 6) patients had positive swab culture [Table 5]. Ninety-three percent[14] patients presenting between 6 and 12 h of injury had positive swab culture. All patients presenting after 12 h of injury had their swab culture positive. In Group A, 25 patients who had positive swab cultures at the time of admission, 23 were sterile after 1 week of treatment with honey. Two patients in this group showed persistent infection. In Group B, only three patients had sterile swab culture after treatment for 1 week and the remaining 21 patients had persistence of infection. The organisms isolated in 49 ($P < 0.001$) positive swab cultures from both the groups were *Pseudomonas*,[8] *Klebsiella*,[7] *Staphylococcus aureus*,[13] *Streptococci*,[12] and *E. coli*.[9]

Amongst the patients treated, seven (two from Group A and five from Group B) developed burn contractures and they required surgical correction later on. One patient from Group A developed hyper-granulation tissue, which required treatment with 3% hypertonic saline. During treatment with honey, it was observed that there was decrease in edema and wound exudates and no eschar formation was seen in any of these patients. However, pain immediately after the application of honey was a significant finding in all patients; it lasted for 30 min to 1 h in most of these patients. Injectible analgesics were used to overcome this side effect. No allergic reaction was noticed during this study.

DISCUSSION

Burn injury to the integument causes cellular death, capillary damage in varying degrees, and coagulation of pro-

Table 5: Time of Presentation and Positive Swab Cultures

Time of presentation	Total Number of Patients	Number of Patients With Positive Swab Cultures		
		Group a	Group b	Total
< 6 HOURS	28	08	06	14
6-12 HOURS	15	07	07	14
12-24 HOURS	10	04	06	10
> 24 HOURS	11	06	05	11
TOTAL	64	25	24	49

teins. The loss of protective function of the skin as a barrier to microorganisms results in infection. Although it is true that immediately after burns the wound is sterile, within a very short time, bacteria contaminating the wound surface begin to multiply and proliferate in the area of the burn, necrotic tissue being an excellent culture medium.

Management of the burn wound still remains a matter of debate and an ideal dressing for burn wounds has not been discovered.[13] Bee products have been extensively studied for their healing powers and have become part of cosmetic preparations and folk medicine.[14] Clinical observations indicate that honey may initiate or accelerate the healing of chronic wounds and has, therefore, been claimed to have anti-inflammatory properties.[15] Although honey has been used as a traditional remedy for burns and wounds, the potential for its use in mainstream medical care is not well recognized.[16] Honey, a natural product of bees of the genera *Apis* and Meliponinae, is a mixture of sugars prepared by the bees from the natural sugar solution called nectar obtained from flowers. By inverting sucrose in the nectar, the bee increases the attainable density of the final product and thus, raises the efficiency of the process in terms of caloric density.[4],[13]

Honey, unprocessed and undiluted, as obtained from beehives was found to be sterile and inhibits the growth of Gram-positive and Gram-negative organisms.[17],[18] A supersaturated sugar solution, honey results in a strong interaction between the sugar molecules and water molecules. This 'osmotic' effect, thus, leaves very few water molecules for growth support of microorganisms. The rate of inhibition of growth depends on the species of the bacteria and concentration of honey.[19],[20]

The antibacterial property of honey was first recognized in 1892 by Van Ketel.[21] The fact that the antibacterial properties of honey are increased when diluted, was clearly observed and reported in 1919. The explanation for this apparent paradox came from the finding that honey contains an enzyme that produces hydrogen peroxide when diluted. This agent was referred to as 'inhibine' before its identification as hydrogen peroxide.[11],[22]

Hydrogen peroxide is a well-known antimicrobial agent, initially hailed for its antibacterial and cleansing properties, when it was first introduced into clinical practice.[11] Although the level of hydrogen peroxide in honey is very low, it is still effective as an antimicrobial agent. It has been reported that hydrogen peroxide is more effective when supplied by continuous generation with glucose oxidase than when added in isolation.[23],[24] The harmful effect of hydrogen peroxide is further reduced because honey sequesters and inactivates the free iron, which catalyses the formation of oxygen-free radicals produced by hydrogen peroxide and its antioxidant components help to mop up oxygen-free radicals.[25] Histologically early attenuation of acute inflammatory changes, control of infection, and early reparative activities were seen with honey treatment as compared to patients treated with silver sulphadiazine.[26]

The clearing of infection when honey is applied to a wound may reflect more than just antibacterial properties. Recent research shows that the proliferation of B- and T-lymphocytes in cell cultures is stimulated by honey at concentrations as low as 0.1% and phagocytes are also activated by honey at the same concentration.[27] Honey at concentration of 1% also stimulates monocytes in cell cultures to release cytokines, tumor necrosis factor (TNF) -alpha, interleukin (IL) -1, and IL-6, which activate immune response to infection.[15],[25] In addition, the glucose content of honey and the acid pH (typically between pH 3 and 4) may assist in the bacteria-destroying action of macrophages. This chemical debridement action of honey, apart from accelerating wound healing, spares the necessity for surgical debridement under general anesthesia.[28]

CONCLUSION

Honey acts mainly as a hyperosmolar medium and prevents bacterial growth. Because of its high viscosity, it forms a physical barrier and the presence of enzyme catalase gives honey an antioxidant property. Its high-nutrient content improves substrate supply in local environment promoting epithelialization and angiogenesis. These properties of honey make it an ideal and cost-effective dressing for burn patients.

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