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Assessing the Effects of Honey Dressing on Diabetic Foot Ulcers: An Observational Prospective Study

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ABSTRACT
Since antiquity, honey has been recognized as a potent wound dressing. Due to the financial burden of modern dressings and the emergence of resistant strains, honey has been reintroduced as a cost-effective dressing, especially in developing nations. Its clinical effectiveness in diabetic foot wound infections is indicated by its suitability for all stages of wound healing. A random selection was made of forty infected diabetic foot lesions from patients who presented to the Surgery Department of Late Shri Lakshi Ram Agarwal memorial medical college and Hospital Raigarh., India. Wounds were dressed with honey for three months, or until healing, grafting, or treatment failure occurred. Weekly records of surface area and changes in grade and stage of ulcers, as classified by the University of Texas Diabetic Wound Classification, were maintained. The bacterial burden prior to and subsequent to honey dressing was assessed. Complete healing was achieved in 44.9% of the ulcers. A notable reduction in size and maintenance of healthy granulation tissue was noted in an additional 44.9% of patients. All ulcers exhibited a substantial reduction in bacterial burden following the initial week of honey dressing. A treatment failure rate of 7.8% was observed for the ulcers. This study demonstrates that commercial clover honey is a clinically effective and cost-effective dressing for diabetic wounds in developing nations. Its ubiquitous nature and alignment with cultural values render it a prototypical environmentally conscious approach to address these conditions.

INTRODUCTION

The development of DFUs is an important contributor to morbidity and disability. Amputations of the lower extremities are a common consequence of these conditions, particularly when accompanied by neuropathy and/or ischemia[1,2].

Foot ulceration is a frequent condition that affects 6.9% of patients with diabetes at some point in their lives[3].This applies to patients with DM nationwide. Furthermore, ulceration is the most prevalent cause of hospitalization and the precipitating factor in 80 percent of lower-limb amputations[4]. Despite recent developments in antimicrobial treatment, foot infections continue to be a significant problem worldwide. Despite the fact that antibiotics and other agents, both topical and systemic, have been tried, both singly and in combination, to remove this resistant infection, they have continued to exist. Furthermore, the use of these medications has resulted in the development of resistant bacterial strains, which has led to the rapid expansion of these strains, as well as pharmacological side effects and organ-specific toxicity[5-7].

Honey has been known to possess medicinal effects since ancient times[8]. It was applied to wounds to treat infected wounds and to promote the healing process.Recent research has demonstrated that it is effective against antibiotic-resistant strains of bacteria; it inhibits the growth of germs even in severely infected wounds[9-11]. Even in cases where it was ineffective, it never led to the development of strains that were resistant to treatment[12]. Several characteristics, such as osmotic action, naturally low pH and hydrogen peroxide formation, have been credited with contribute to the antibacterial activity of bee honey[13-15]. As a result, it appears that honey has been resurrected as a dressing for wounds that are resistant. The purpose of this study was to examine the efficacy of the topical application of honey in diabetic foot ulcers. Furthermore, to maximize the effectiveness of honey dressing, an analysis was conducted on wound variables and patient criteria that affect its outcome.

MATERIALS AND METHODS

This investigation included 40 patients who presented to the Surgery Department at Late shri Lakshi ram Agarwal Memorial Medical College and Hospital, Raigarh, with complaints of foot ulcers. Study period from Dec 2014 to Nov 2015. This study comprised participants of both sexes and age groups. The present study included all patients who presented with foot ulcers, irrespective of their depth, area affected, or presence of infection. The patient selection process involved the random allocation of patients who presented to the Surgery Department, either through inpatient consultations or outpatient visits, until the required sample size of 40 patients was reached. This was completed after six months.

Patients with pending amputation (as a result of severe vascular compromise and/or toxemia) and immunocompromised patients (e.g., those undergoing chemotherapy or corticosteroid therapy) were excluded.

There was no requirement for a control group, as all patients who visited the Surgery Clinic had resistant wounds (defined as those that have either ceased progression or worsened over the past three months). This omission rendered the control group unnecessary, as the patients themselves were deemed to be in the control group prior to the implementation of the honey dressing. Furthermore, the study adhered to the same regimen as in the previous period, except for the use of honey as a topical dressing. This was done to ensure consistency in the implementation of all wound management factors during both periods, concerning the culture and sensitivity of the damage. If the lesion initially exhibited indications of an invading infection, a five-day course of treatment consisting of ciprofloxacin and metronidazole was initiated. Antibiotic treatment should an infection manifest during the course of the investigation, would be administered in accordance with the findings of the most recent culture.

In light of our conviction that honey processing could compromise its efficacy by altering the proportion of its constituent parts, this study utilized unprocessed, unadulterated, raw commercial honey (without any additives, pasteurization, or manipulations). To guarantee the utmost quality and purity of honey, the supply firm was provided. Honey was applied in the form of impregnated gauze. Method for producing honey-impregnated gauze.

This study employed non-sterile gauze with medium pores. The length of the gauze piece was determined in accordance with the incision surface area (for a single piece, it should cover the entire wound and hang over the edges in two layers). The quantity of pieces required was determined by the depth of the incision (gauze should completely encircle the wound to a level above the adjacent skin).

Prior to the dressing session, the gauze length was trimmed to the desired dimensions, plus approximately 10 cm. It was then submerged in a deep container until it could be folded effortlessly into multiple layers. The opposite edge is allowed to hang over the perimeter of the container. Honey was allowed to completely saturate the gauze during the preparation of the incision bed. Particularly, in incisions with excessive honey loss, gauze was passed between the firmly opposed middle and ring fingers to remove excess honey. During the initial visit or while the patients

were hospitalized, families and close friends were instructed on the method for preparing and administering the gauze impregnated with honey.

Patients were managed in an outpatient clinic, except for cases where admission was warranted, such as those involving inadequate vascular function, surgical debridement, or poor glucose control. Upon resolution of the hospitalization indication, patients were promptly referred to an outpatient clinic for subsequent care. With care, the lesion was debrided (occasionally while under anesthesia) and washed extensively with normal saline (antiseptic was not utilized). Following debridement, heavily infected wounds were rinsed with tepid tap water. Following the debrided lesion, gauze saturated with honey was applied. By utilizing scissors, the non-impregnated portion of the gauze was severed for use.

A fluffy dressing was positioned over the gauze and secured in position using a bandage. The frequency of dressing changes was determined by the quantity of exudates; the dressing should be replaced using the same method each time it became saturated. After the patient achieved a single daily dressing and all other parameters were met, they were discharged and scheduled for weekly follow-up at the outpatient clinic.

For life, every patient was administered vitamin B complex. All patients were provided with health education. The educational program placed significant emphasis on the following: clinic follow-up, appropriate footwear, foot hygiene, nail care, adhering to a nutritional regimen and managing newly healed foot ulcers.

Statistical Analysis: Statistical analysis would be carried out using the most recent version of IBM SPSS. To compare the means of variables linked with two different groups, use the Unpaired t-test. An analysis of variance (ANOVA) is performed on the data by the writers when comparing the medians of multiple groups. We will apply the Pearson correlation to find out how the two variables are related to each other. Statistical significance is achieved at the 0.05 level.

RESULTS AND DISCUSSIONS

In Table 1, demographic information regarding the patients who took part in this research is presented. With a mean age of 53.4 years, the majority of our patients (47.8%) were in their sixth decade of life. Males constituted two-thirds of our patient population. 57.8% of the smokers in this study were male. Type II comprised thirty-eight patients.

Twenty patients had had diabetes for over ten years (67.8%). Insulin-treated patients had a lower percentage of control (65.8%) than those taking oral hypoglycemic medications (93.4%). In terms of peripheral neuropathy (PN), a mere nine patients (31%) did not present with PN. Only six patients in this study were free of vascular disease. In 38 patients, the ulcer size decreased at rates that were statistically significant; the remaining two patients (7.8%) were at risk of amputation.

Table 1: Throughout the duration of the follow-up, the size of the ulcer

Follow-up time	Range (cm^2)	N = 40	Chi-square
At initial visit	1-5	10	0.02
	6-10	20	
	11-15	2	
	16-20	1	
	21-105	7	
After one month	1-5	6	<0.05
	6-10	8	
	11-15	20	
	16-20	1	
	21-105	5	
After two months	1-5	10	<0.05
	6-10	5	
	11-15	3	
	16-20	2	
	21-75	5	
After three months	1-5	6	<0.05
	6-10	0	
	11-15	0	
	16-20	1	
	21-26	1	

Table 2: How many and what kinds of exudates are present in the wound

Nature of Discharge	Initial visit	First month	Second month	Third Month
Not characteristic	0	0	22	24
Foul or purulent	36	0	0	0
Serosanguinous	11	32	12	0
Chi-square		<0.05	<0.05	<0.05

The grade and stage progression of the incisions over the course of the entire study are grade and stage (G and S) ulcer improvement was substantial throughout the duration of the investigation. At the conclusion of the investigation, 16 patients exhibited the highest frequency in G and S of 1-a. Two patients had the lowest G and S of 2-a.

Initial examination revealed indications of inflammation in all ulcers. Following a period of one month, 37 patients exhibited noteworthy progress, while only two patients continued to exhibit inflammatory symptoms (two patients required amputation).

Since the second month, there have been no indications of inflammation in the ulcer of any patient. The visual representation and characteristics of exudates in the incision are presented in Table 2. An overall improvement in both the quantity and characteristics of discharge was observed over the duration of the study. On initial examination, putrid and copious ulcer exudates were detected in 36 ulcers. After one-month, serosanguinous moderate exudate was observed most frequently in 32 lesions.

In the second month, serous exudates were limited in thirteen ulcers. The study concluded that all ulcers exhibited minimal serous exudate. Throughout the trial, the kind and amount of exudate varied dramatically each month. Table 3 displays microorganism differentiation percentages in ulcers

Table 3: The number of microorganisms found in the sample both before and after honey dressing

Micro-organisms	Before (N = 40)	After (N = 40)
No	0	0
Staphylococcus aureus	16	0
Staphylococcus epidermidis	8	37
Echerichia coli	6	0
Proteous	4	0
Klebsiella spp.	3	0
Provedentia	1	0
Pseudomonas aeruginosa	2	3

before and after honey dressing. At both the first assessment and the end of the research, no ulcer was entirely sterile.

At the initial assessment, Staphylococcus aureus was found in 16 patients. 37 ulcers were colonized by Staphylococcus epidermidis, while 1 were infected by Pseudomonas aeruginosa. By the end of the trial, 26 wounds were totally closed or showed good granulation and surface area reduction in 26 patients.

Amputation occurred in three cases. Graft was performed in twocases during the third month, with healthy granulation tissue, as the ulcer size was not predicted to heal spontaneously. An additional instance was grafted according to patient desire in the second month.

The outcomes demonstrated that honey was a user-friendly debriding agent. The lesion was expeditiously cleansed of debris using gauze impregnated with honey, obviating the necessity for extensive mechanical, chemical, or enzymatic debridement. In eight patients, the wounds completed debrided by the tenth day. Through the third week, every lesion had been thoroughly debrided. Additionally, honey-impregnated gauze was simple to prepare and apply (even by the patients or their family members). It effortlessly flaked off, causing neither discomfort nor harm to the nascent granulation tissue. In addition, it filled cavities and sinuses within the deep diabetic foot ulcers flawlessly.

All patients in this study experienced a rapid resolution of inflammatory symptoms (including erythema, heat and edema) within ten days. This was partially attributable to its antimicrobial and anti-edema properties[15,16]. The majority of the lesions in our study achieved sterility by the conclusion of the initial month following honey application. A Study Al-Waili[17] discovered that honey exhibited efficacy against twelve out of the thirteen most prevalent organisms responsible for infecting wounds.

Additionally, honey was discovered to be effective against MRSA (methicillin-resistant Staphylococcus aureus) by the study[12].

Despite the presence of *P. aeruginosa* in 6.7% of the lesions examined, no clinical inflammatory manifestations were observed. Moniruzzaman *et al*.[18] elucidated this discovery by inhibiting the adhesion of microorganisms (*P. aeruginosa* in particular) to host cells prior to the establishment of the infection; as a result, their activity in the wound was halted, even when it was severely contaminated.

We did not identify any hospital-acquired infections throughout our entire series. This may be attributed to the barrier-forming effect of honey's viscosity, which effectively averted the spread of infection[9].

All of these elements, along with the enhancing impact of honey on granulation tissue and epithelialization[19], led to expeditious elimination of edema (from the wound and its environs), reduction in discharge and wound deodorization by the conclusion of the initial week. This abrupt and dramatic reaction could potentially account for the complete adherence of patients throughout the entire duration of the research, as clinically demonstrated by the lack of attrition.

The psychological aspect plays a significant role in determining whether patients' immunity and healing capacity are enhanced or hindered[20-23]. Honey is widely recognized as a sacred remedy in all oriental cultures, including Egypt. This makes it an ideal dressing derived from natural sources, which aligns with the cultural and religious beliefs of patients and promotes healing.

Consequently, the recovery duration observed in this research was considerably brief (mean of 2.3±0.94 weeks) in comparison to alternative modalities[24-26]. In addition to cultural and communal beliefs, positive psychological factors account for the variation in honey's clinical efficacy, as noted by a study[9].

The ubiquitous availability and inexpensive cost of honey are two significant benefits. This was demonstrated through direct cost reductions in comparison to traditional and contemporary dressings; 3 kg of honey, which is sufficient for three months of dressing, cost the same as one liter of Povidone Iodine, which is only used for wound cleansing for less than one month. Another significant aspect of cost reduction was the technique's simplicity and rapid healing rates (patient relatives or household members performed dressings without the necessity of visiting clinics or bringing in a medical professional). In all instances, additional cost savings were realized by discontinuing antibiotic use after one week and by shortening the length of hospitalization. The reduction of debridement sessions, especially those performed under general anesthesia, skin grafts and amputations, resulted in additional cost savings.

This research demonstrated that honey dressing had no significant effect on exposed bone ulcers. Both amputated patients were categorized as 3-d. As the manifestations of inflammation persisted, osteomyelitis ultimately developed. Likewise, in cases

of severe vascular insufficiency, honey exhibited no discernible impact.

Notwithstanding this, honey dressing demonstrated an exceptional response to this form of wound following revascularization. Honey dressing was significantly less effective due to inadequate blood glucose control, poor compliance and poor psychological condition, despite the positive response.

CONCLUSION

In conclusion, diabetic foot ulcers treated with honey dressing have shown encouraging results. Honey's anti-inflammatory and antioxidant characteristics promote healing after injury or illness and its antibacterial characteristics assist fight infections. In addition, honey dressing is easily accessible, cheap and practical for treating diabetic foot ulcers. Because every patient is unique and every ulcer is different in severity, it is crucial to talk to healthcare providers before using honey dressing as the only treatment. In conclusion, honey dressing is an effective supplemental treatment for diabetic foot ulcers that needs to be studied more and included into comprehensive wound care programs.

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