

# The value of honey dressing in the treatment of diabetic foot infections

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## Abstract

**Background:** Diabetic foot ulcer is one of the commonest complications of DM. Honey could be used effectively on diabetic foot ulcers.

**Objectives:** The aim of the present study was to assess the effect of use of honey in treating diabetic foot ulcer on Saudi diabetic patients.

**Methods:** Thirty-two diabetic patients with diabetic foot infections were included in this study. Initial assessment was done for the diabetic foot ulcer and follow up assessment for three months was done for the site, size, grade and stage of ulcer and for the presence of inflammatory signs after application of honey dressing.

**Results:** Of the participants, 56.6% were males, 90.6% had diabetes type 2, 40.6% had an ulcer at the plantar fore foot, and 46.9% had an ulcer size of 6-10 cm<sup>2</sup>. A significant decrease was found in the mean ulcer size after one (22.18 ± 32.66), two (15.32 ± 24.44) and three months (10.47 ± 19.55), compared to its mean size at the base line (27.19 ± 37.24). Most patients had an ulcer grade and stage of (1-b) at the base line, after one-month (59.4%) had the (2-a) stage, after two months (53.1%) had the (1-a) ulcer grade, and after the third month, (46.9%) had the (0-a) stage. A significant difference was found between the presence of ulcer inflammation signs at the base line (43.8%), and after one month (9.4%).

**Conclusion:** The study proved that honey can be used as an effective, cheap, easily available, non-toxic adjuvant without adverse side effects in treatment of diabetic foot infections.

**Key words:** value, honey, dressing, treatment, diabetic, foot

## Introduction

Honey was used in ancient times in medicinal purposes and was mentioned for healing purposes in the Holy books (1). The economic benefit of honey in wound dressing could be a direct cost saving through the rapid healing rates compared to conventional treatments (2).

In diabetes mellitus (DM) foot, soft tissue infections are considered the most common soft tissue complications (3). Wound size, existence of dead tissue and infection, the extent of vascular compromise, quality of diabetic management, and degree of patient compliance to treatment should be taken into consideration in management of diabetic foot ulcer (4).

Honey dressing was found to draw lymph out of interstitial tissues, a matter that enhances edema relief and better healing through better blood supply (osmosis) (14). Osmosis also delivers a moist healing environment and granulation and epithelialization activity, leading to ultimate rapid healing with negligible scarring (5). Another property of honey is its ability to stimulate the immune system activity, through enhancing the proliferation of peripheral blood B and T lymphocytes and activate phagocytes. That is why honey was found to be effective against antibiotic-resistant bacteria; as it prevents bacterial growth even if wounds are heavily infected (6). With honey, there is no dressing adhesion; no pain or tissue damage on changing the dressings (7).

In 2011, a study found that the use of honey-coated bandages improved the outcome of malignant wounds (2). Another study done in 2013, titled "Efficacy of honey gel in the treatment of chronic lower leg ulcers: A prospective study" found that honey-based dressings appear to be an efficient and easy to use treatment for leg ulcers (8).

In 2013, Yaghoobi et al., found that Honey has almost equal or slightly superior effects when compared with conventional treatments for acute wounds and superficial partial thickness burns (9). A systematic review published in 2016 found that honey dressing is safer for treatment of diabetic foot ulcer but there is insufficient good quality data to realistically conclude on the efficacy of honey on diabetic foot ulcers (10).

A study done in 2015 found that honey has a proven safety for use when compared to glucose and sucrose as it has lower glycemic and incremental indices in type I DM patients. It was reported in this study that honey has simple sugars that are absorbed directly into bloodstream without digestion and can serve as an athletic aid (1).

Another study published in 2015 found that honey used in wound-care products can withstand dilution with substantial amounts of wound exudate and still maintain enough activity to inhibit the growth of bacteria. In addition, the study stated that honey has bioactivities that stimulate the immune response (thus promoting the growth of tissues for wound repair), suppress inflammation, and bring about rapid autolytic debridement (5).

In the Kingdom of Saudi Arabia (KSA), a prospective double-blind, randomized clinical trial was conducted at the King Abdul Aziz Specialist Hospital in Taif city in 2013. The aim of this study was to compare the efficacy of Manuka honey combined with conventional modalities to that of conventional treatment alone in the treatment of diabetic foot ulcers.

The study found that the mean time to eradicate infection and the hospital stay were significantly reduced in the honey treatment group compared to control group (11). Another study was done in 2014 to assess the role of honey in wound dressing in diabetic foot ulcer in Al-Noor Specialist hospital, Holly Makkah city. The study found that the use of honey significantly reduced rate of amputation and improved wound healing when used for wound dressing in chronic diabetic foot ulcers (12).

As studies about the effect of honey dressing in the treatment of diabetic foot infections in KSA are limited, this study aimed to investigate the value of honey as a topical treatment of diabetic foot infections. And to study its affect on diabetic wound healing in duration of diabetes, type of diabetes and anti-diabetic therapy.

## Methods

The collection of data and management for the studied group started at the beginning till the end of the study duration. At each visit, the time of data collection and dressing technique ranged between 30-45 minutes for each patient.

At the initial meeting, assessment of patient's condition was done where personal data was gathered, and physical examinations, and laboratory investigations were done. Wound care was done every visit. Each patient was assessed for general condition and sign of septicemia: (i.e. fever, shivering). The old dressing was removed slowly and the occurrence of pain during dressing removal was noted.

Assessing the condition of the foot for pulsation, skin colour, hotness and swelling were done. Assessing the wound was done for: Site of the ulcer which was determined by dividing the foot into: dorsum and plantar, heel, mid foot, medial and lateral malleolus and fingers. Size of the ulcer was measured by tracing the dimension of the wound by using transparent ruler. Grade of ulcer was assessed according to the University of Texas Diabetic Wound Classification (7).

Type of the tissue of the floor of ulcer was examined and was determined if closed (resurfaced), healthy granulation tissue, epithelial tissue, yellow or gray or white (slough, necrotic tissue) or black (gangrenous) tissue.

Assessment of the surrounding area of the ulcer for the presence of signs of inflammatory response (redness, hotness, tenderness, swelling and loss of function) was carefully done. Debridement of all necrotic tissue (if present) and removing calluses around the ulcer by

scalpel blade until the floor of ulcer bled and the edges oozed, was done. Then the wound was washed with normal saline solution 0.9% and drying of the wound and surrounding area with dry sterile gauze.

**Honey application:** The honey was applied on absorbent dressing prior to its application. Sheets of cotton gauze that lay vertically were put loose in a jar of honey with their ends overhanging the jar rim. Any depressions or cavities in the wound bed were filled with honey using honey-impregnated gauze. This was to ensure the antibacterial components of the honey diffuse into the wound tissues. Honey was inserted into cavities and sinuses. Honey dressings were extended beyond the inflamed area surrounding the wound if present. Finally, it was covered with appropriate dressing and secured in place by regular bandage. The frequency of dressing changes depended on how rapidly the honey was being diluted by exudates, if there were no exudates, dressing was changed once daily till complete healing or for 3 months.

At the end of the study the evaluation of the healing of the ulcer was done if complete healing (resurfaced wound), partial healing (healthy granulation tissue, for spontaneous healing in small wound (> 2 inches) or preparing for skin graft in the larger wound) or no healing (unhealthy granulation tissue; presence of severe infection and or massive necrotic tissue).

**Data analysis:** Data were analyzed using (SPSS) version 25. Qualitative data were presented as frequencies and percentages and Chi squared test was applied to assess the relationship between variables. Quantitative data were expressed as mean and standard deviation and Wilcoxon test was applied to assess the relationship between related variables. A p-value of <0.05 was considered as statistically significant.

**Ethical considerations:** Written and verbal consent was obtained from patients before inclusion in the study and each patient was informed about the purpose of the study.

## Results

Table 1 shows that in the present study, among the studied 32 participants, 56.6% were males, 53.1% were unemployed, 40.6% were illiterate, and 12.5% were smokers. Among the patients, 90.6% had diabetes type 2, 62.5% had diabetes duration more than ten years, and most of them (62.5%) were on both insulin and oral hypoglycemic drug therapy. About 9% (9.4%) of patients had diabetes complications, and 12.5% had chronic vascular disease. Dorsalis pedis pulse was palpable in 87.5% of patients and posterior tibial pulse was palpable in 93.8% of them. All studied patients had palpable popliteal and femoral pulse. All vital signs (temperature, pulse and respiratory rate) were normal with a mean value of ( $36.86 \pm 0.27$ ,  $74.5 \pm 7.2$ , and  $15.68 \pm 1.63$  respectively). All patients had normal abdominal and chest examination and only one patient (3.1%) had abnormal cardiac examination. Figure 1 shows that most patients (40.6%) had an ulcer at the plantar fore foot, and most of them (46.9%) had an ulcer size of 6-10 cm<sup>2</sup>.

Figure 2 shows that in comparison between the ulcer size at the base line and during the follow up period (3 months), a highly significant difference was found between the ulcer size at the base line and its size after one, two and three months ( $p < 0.001$ ). Most patients at the base line had an ulcer size of 6-10 cm<sup>2</sup>, after one month 34.4% of them had an ulcer size of 6-10 cm<sup>2</sup>, while 15.6% showed complete healing. After 2 months, 34.4% of patients had an ulcer size of less than 5 cm<sup>2</sup> and 25% showed complete healing. After 3 months, 25% of patients had an ulcer size of less than 5 cm<sup>2</sup>, while 46.9% showed complete healing.

Table 2 shows that in comparison between the ulcer size at the base line and during the follow up period (3 months), a highly significant decrease was found in the mean ulcer size after one ( $22.18 \pm 32.66$ ), two ( $15.32 \pm 24.44$ ) and three months ( $10.47 \pm 19.55$ ), compared to its mean size at the base line ( $27.19 \pm 37.24$ ) ( $p < 0.001$ ).

Figure 3 shows that a significant difference was found between the ulcer grade and stage at the base line and during the follow up period (3 months). Most patients had an ulcer grade and stage of (1-b) at the base line, and after one month the majority (59.4%) had the (2-a) stage ( $p=0.042$ ). After two months most of the patients (53.1%) had the (1-a) ulcer grade ( $p=0.036$ ), and after the third month, (46.9%) had the (0-a) stage ( $p=0.029$ ).

Figure 4 shows that significant difference was found between the presence of ulcer inflammation signs at the base line (43.8%), and after one month (9.4%) ( $p=0.39$ ).

Variable	No (%)
Age (mean±SD)	63.37 ±5.93
Gender	
- Male	21 (56.6)
- Female	11 (34.4)
Employment	
- Employed	15 (46.9)
- Unemployed	17 (53.1)
Education	
- Illiterate	13 (40.6)
- Read and write	11 (34.4)
- Basic and secondary	3 (9.4)
- University	5 (15.6)
Smoking	
- Smoker	4 (12.5)
- Non-smoker	28 (87.5)
(mean ±SD) of smoked packets	2 ± 0.81
Diabetes type	
- Type 1	3 (9.4)
- Type 2	29 (90.6)
Diabetes duration	
- < 10 years	12 (37.5)
- > 10 years	20 (62.5)
Type of diabetes therapy	
- Insulin	7 (21.9)
- Oral hypoglycemic drugs	5 (15.6)
- Both	20 (62.5)
Presence of diabetes complications	
- Yes	3 (9.4)
- No	29 (90.6)
Presence of chronic vascular disease	
- Yes	4 (12.5)
- No	28 (87.5)
Dorsalis pedis pulse	
- Palpable	28 (87.5)
- Not palpable	4 (12.5)
Posterior tibial pulse	
- Palpable	30 (93.8)
- Not palpable	2 (6.3)
Result of blood analysis	
- Fasting blood glucose	98.81 ±10
- RBCs count (mcl)	5.28 ±1.67
- WBCs count (mcl)	8968.75 ± 2206.79
- Hemoglobin level	14.47±1.95
- SGOT level (unit/L)	41 ±10.49
- SGPT level (unit/L)	42.9± 8.62
- Urea level (mg/dl)	15.69± 3.54
- Creatinine level	0.91± 0.11
- Albumin level	4.35± 0.5
- Blood (Na) level (mEq/L)	139.84± 2.59
- Blood (K) level (mEq/L)	4.29 ±0.47

**Table 1: Disruption of the studied patients according to their demographic characters and conditions related to their diabetic status, pulsation status, and results of blood analysis**

Figure 1. Disruption of the studied patients according to their ulcer site and size at the base line (cm<sup>2</sup>)

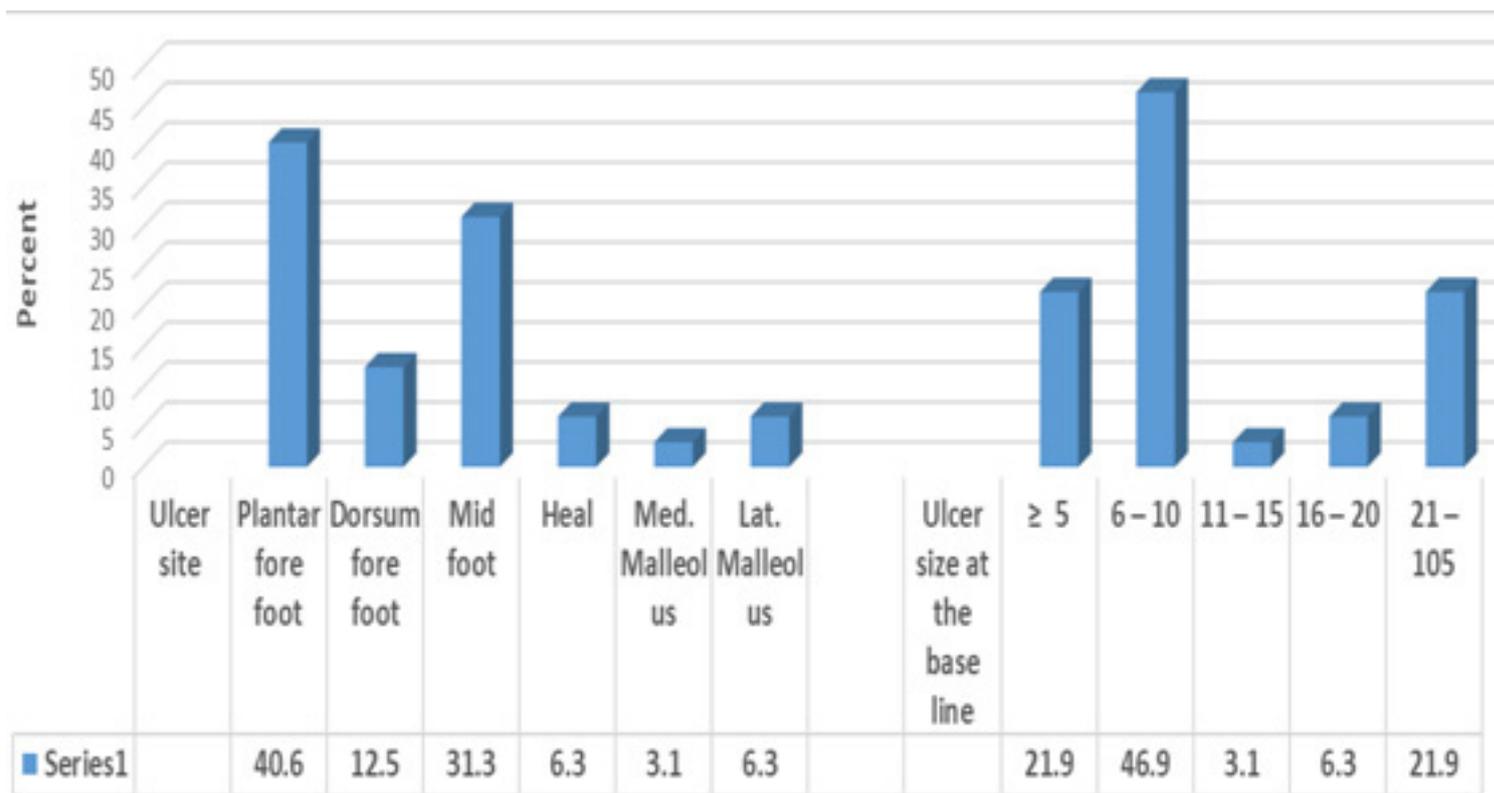
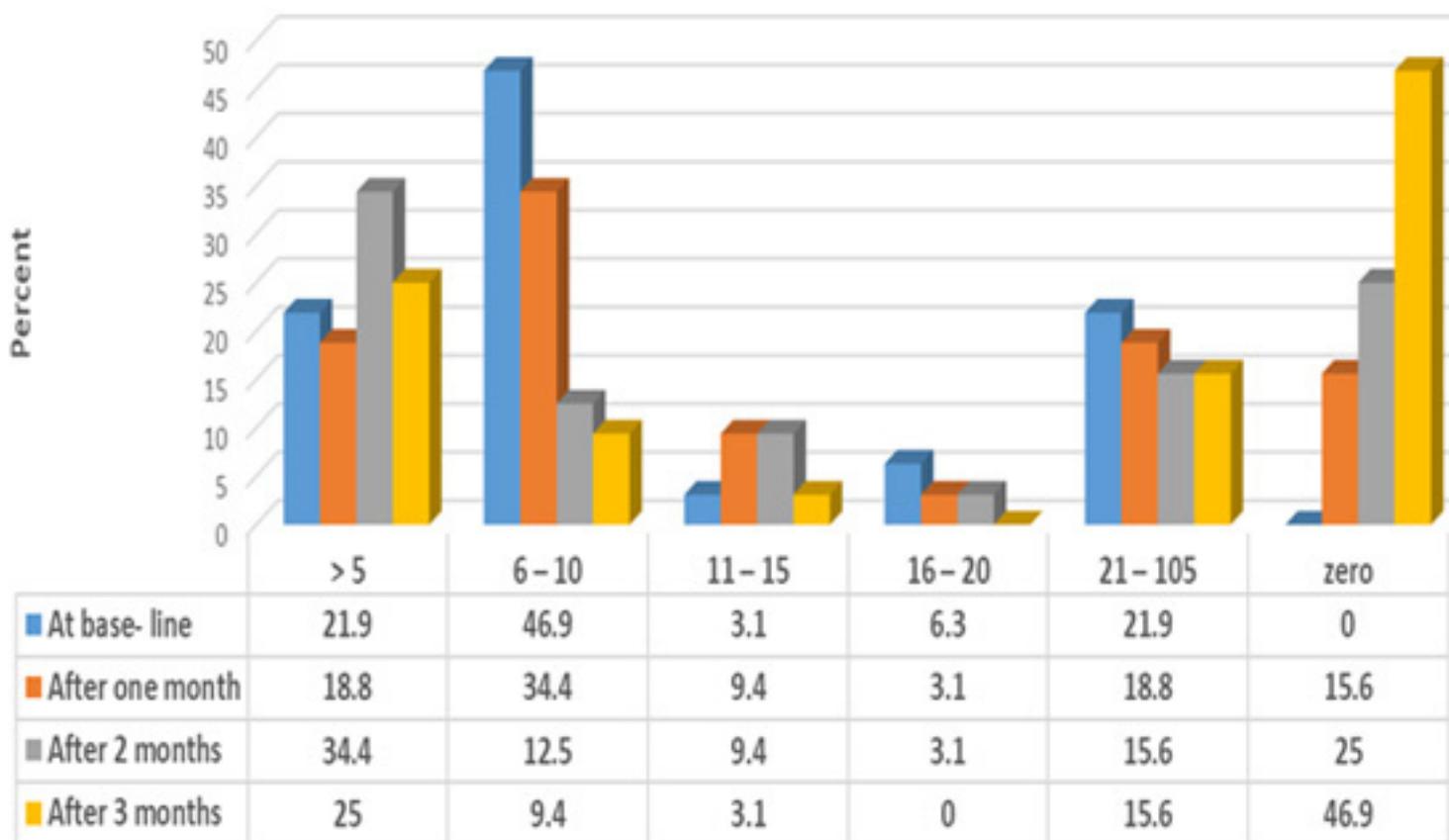


Figure 2. Relationship between ulcer size at the base line, after one, two and three months among the studied patients (cm<sup>2</sup>)



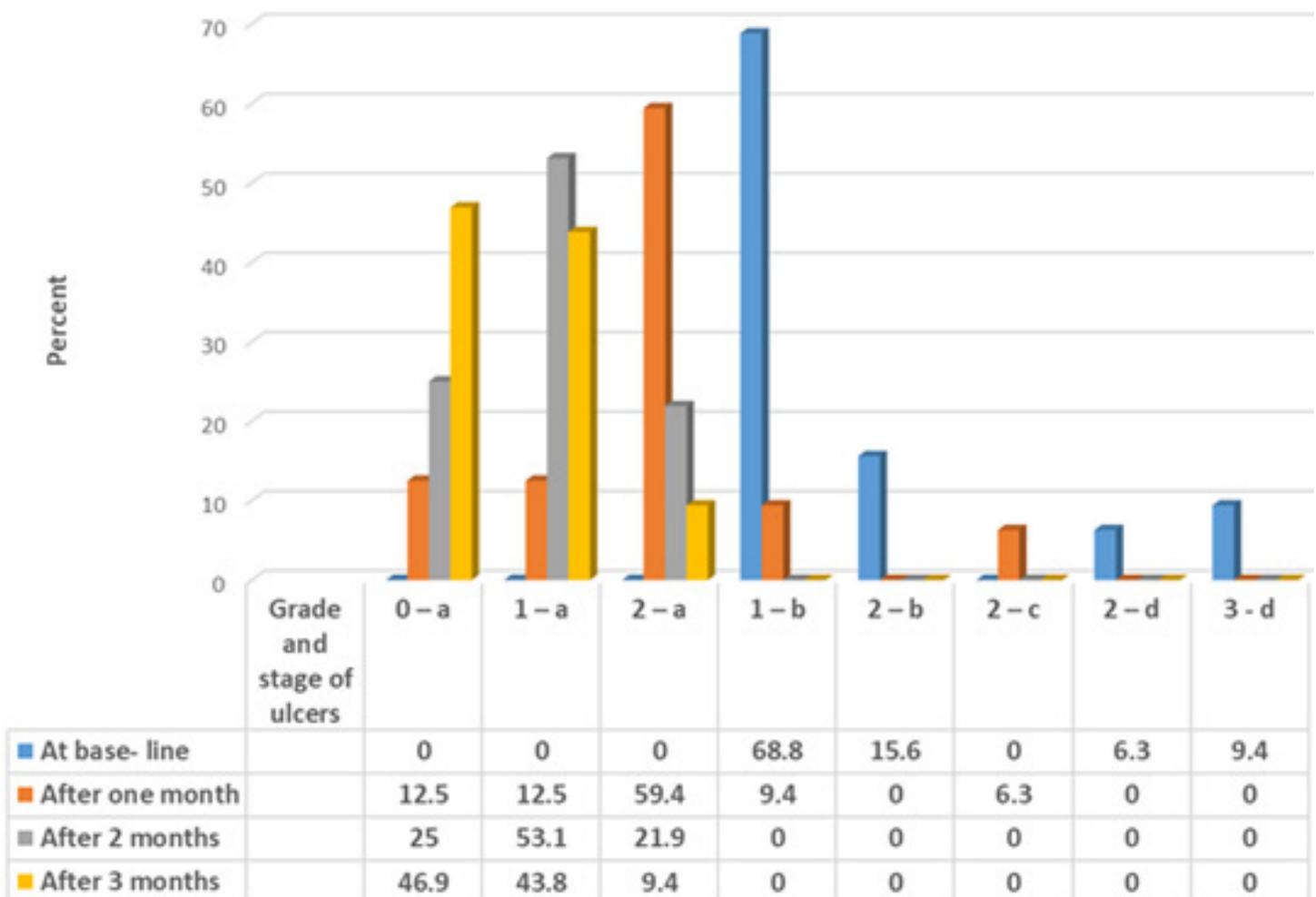
N.B.: Between ulcer size at the base line and after one month ( $\chi^2= 87.06$  & p-value = <0.001)  
 N.B.: Between ulcer size at the base line and after one month ( $\chi^2= 65.14$  & p-value = <0.001)  
 N.B.: Between ulcer size at the base line and after one month ( $\chi^2= 54.94$  & p-value = <0.001)

**Table 2: Comparison between the mean ulcer size at the base line and its mean after one, two and three months (cm<sup>2</sup>)**

Variable	Ulcer size after one month (cm <sup>2</sup> )	Test* (p-value)	Ulcer size after 2 months (cm <sup>2</sup> )	Test* (p-value)	Ulcer size after 3 months (cm <sup>2</sup> )	Test* (p-value)
Ulcer size at base line (cm <sup>2</sup> ) (Mean SD) (27.19± 37.24)	22.18±32.66	4.82 (< 0.001)	15.32± 24.44	4.93 (< 0.001)	10.47 ± 19.55	5.13 (< 0.001)

N.B.: Test is Wilcoxon test

**Figure 3. Relationship between ulcer grade and stage at the base line and during the follow up period among the studied patients**

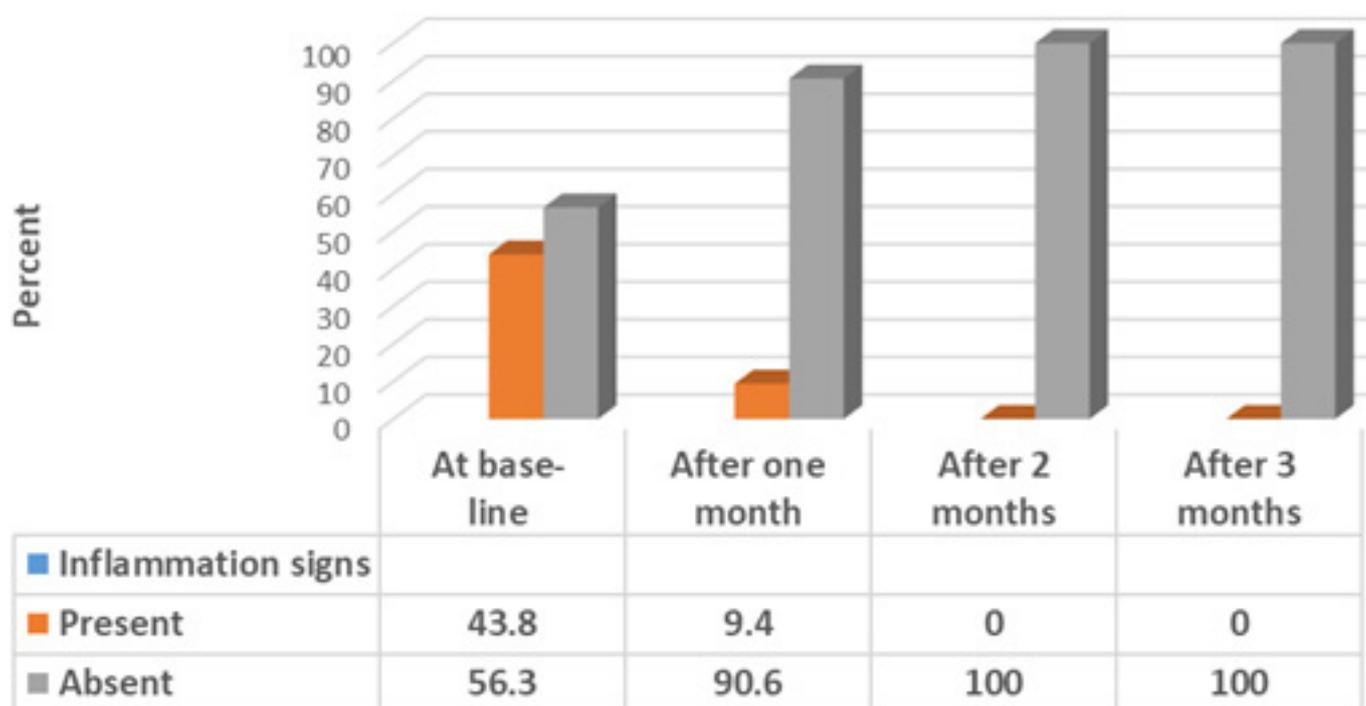


N.B.: Between grade and stage at the base line and at the base line and after one month ( $\chi^2 = 20.43$  & p-value = 0.042)

N.B.: Between ulcer size at the base line and after one month ( $\chi^2 = 13.5$  & p-value = 0.036)

N.B.: Between ulcer size at the base line and after one month ( $\chi^2 = 14.02$  & p-value = 0.029)

**Figure 4. Relationship between the presence of ulcer inflammation signs at the baseline and during the follow-up period among the studied patients**



**N.B.:** Between grade and stage at the base line and at the base line and after one month ( $\chi^2= 4.25$  & p-value = 0.039)

## Discussion

In the present study, most patients were males. The increased incidence in males might be contributed to the fact that males are more active; working in manual work and some of them work as teachers, guard and drivers which lead to continuous pressure on feet (13,14). In addition, men are at risk of developing lower extremities problems much more than females (13, 14,15,16).

This study showed that most patients had type II diabetes more than ten years, a finding that agrees with other studies reporting increased risk of foot ulceration and amputation with type II diabetes and longer duration of diabetes (13, 17).

The most common sites of ulcers in the studied group were in the plantar aspect of the foot. This was consistent with other studies testifying the increase of plantar foot pressure is the leading cause of ulceration in the diabetic population (13, 18).

The highest percentage of ulcer size in the studied group ranged from 5 – 10 cm<sup>2</sup>, a result that is consistent with other studies where the classical diabetic foot ulcer measures 10 cm<sup>2</sup> or less in surface area on the plantar surface of the foot (forefoot) due to elevated pressure on the foot and neuropathy (13).

In the present study, a highly significant decrease in the ulcer size was found between the ulcer size at the base line and its size after one, two and three months. It was

reported that honey stimulates the formation of clean, healthy granulation tissue and re-epithelialization, and provokes the healing process in chronic wounds (10, 19). (Mohd 2007), reported effective use of honey dressing in converting diabetic foot infected ulcers into sterile ones (20).

The present study showed that most patients had an ulcer grade and stage of (1-b) at the base line, and after one month the majority (59.4%) had the (2-a) stage, after two months most of the patients (53.1%) had the (1-a) ulcer grade, and after the third month, (46.9%) had the (0-a) stage. This finding could be explained by the ability of honey dressing to draw lymph out of interstitial tissues, a matter that enhances edema relief and better healing though better blood supply (osmosis) (5). Honey was found to prevent bacterial growth (6) and stimulate new tissue growth as it contains bee proteins, pollen, and enzymes, and it was found to prevent infection; absorb pus, and relieve pain, irritation and odour (21).

Studies have found that the application of honey topically allows clearance of the infected wound and fast healing of deeply infected wounds (19). It was reported that honey endorses autolytic debridement to allow rapid development of a clean wound bed (22). In addition, through its osmotic action, it creates a moist wound environment through drawing out lymph from wound tissues. This osmotic action allows the rapid painless debridement through production of proteases enzymes at the wound bed (23).

Oluwatosin reported the advantage of topical honey in the treatment of chronic leg ulcers when compared to the phenytoin effect (24) a matter that was observed in another

study (25). Another study done in 2013 found that honey-based dressings appear to be an efficient and easy to use treatment for leg ulcers (8). A systematic review published in 2016 found that honey dressing is safer for treatment of diabetic foot ulcer (10).

A study done in 2015 found that honey has a proven safety for use as it contains simple sugars that are absorbed directly into the bloodstream without digestion and can serve as an athletic aid (1). The present work showed that a significant difference was found between the presence of ulcer inflammation signs at the base line (43.8%), and after one month (9.4%), with complete disappearance of inflammation signs in all patients during the second month. Sugar in honey provides a high osmotic pressure around microorganisms and thus eliminates them from water and prevents their growth. In honey, the enzymatic oxidation of glucose produces hydrogen peroxide, and when used topically, the release of hydrogen peroxide and phenolic acid has an antiseptic effect (13).

The results of this study demonstrate the powerful action of honey even in the presence of infection. This is supported by the findings of another study which found that honey provides a moist healing environment and at the same time it prevents bacterial growth even when wounds are heavily infected (26). It is a very effective means of quickly rendering heavily infected wounds sterile, without the side effects of antibiotics. This was constant with reports that used generic honey as a topical application to clear existing wound infection rapidly (13).

### Limitations

The cross-sectional nature of the present study could reveal the associations between variables without assessing the causal relationships.

### Conclusion

The present study revealed that a highly significant decrease in the ulcer size was found after the application of honey when comparing its size at the base line and during the follow up period. A significant difference was found between the ulcer grade and stage at the base line and during the follow up period as most of patients had an ulcer grade and stage of (1-b) at the base line, and after one month the majority (59.4%) had the (2-a) stage ( $p=0.042$ ). After two months most of the patients (53.1%) had the (1-a) ulcer grade, and after the third month, (46.9%) had the (0-a) stage. A significant difference was found between the presence of ulcer inflammation signs at the base line (43.8%), and after one month (9.4%). The study showed that honey can be used as an effective, cheap, easily available, non-toxic, extremely useful, and reliable adjuvant without any adverse side effects in the treatment of diabetic foot infections.

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