



RESEARCH ARTICLE

EFFICACY OF HIGH VOLTAGE ELECTRICAL STIMULATION VERSUS HONEY THERAPY ON LOWER LIMB PRESSURE ULCER

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ABSTRACT

Background: Pressure ulcer is a serious problem that faces the medical team especially the plastic surgeon, physical therapists and other health care providers, Pressure ulcers also affect quality of life and lead to more frequent hospitalization. **Aim of Study:** To determine and compare effects of high voltage electrical stimulation and honey therapy on wound healing of lower limb pressure ulcers: **Subjects and Methods:** In the current study, efficacy of high voltage electrical stimulation versus honey therapy in the treatment of lower limb pressure ulcer were investigated. The study involved thirty patients suffering from lower limb pressure ulcer were selected randomly from INPATIENT Department of El Helal Hospital, their age ranged from 30 to 50 years. Patients who had psychological or mental disorders, cardiac disorders, any systemic disease that may interfere with study, blood or auto immune disease and diabetes mellitus were excluded from this study. These patients were divided randomly into two equal groups in number; Group A(High Voltage Electrical Stimulation Group): Fifteen patients with lower limb pressure ulcer who treated with HVES three times per week, for 24 sessions or until healing and regular wound care. Group B (Honey Therapy Group): Fifteen patients with lower limb pressure ulcer who treated with Honey Therapy three times per week, 24 sessions or until healing and regular wound care. Data obtained from both groups pre and post treatment regarding ultrasonographic ulcer depth (UUD) were statistically analyzed and compared. **Results:** Finding of the current study showed that there was significant decrease in (Ultrasonographic Ulcer Depth) UUD before and after treatment in both groups. There was no significant difference in the UUD between the group A (High Voltage Electrical Stimulation Group) and group B (Honey Therapy Group) post treatment. **Conclusion:** Application of High Voltage Electrical Stimulation (HVES) and Honey therapy in the treatment of lower limb pressure ulcers had a valuable healing effect. But there was no significant difference in the ultrasonographic ulcer depth (UUD) between group A (High Voltage Electrical Stimulation) and group B (Honey therapy) post treatment.

INTRODUCTION

A pressure ulcer, also known as a pressure sore, decubitus ulcer, or bedsore, is defined as a localized injury to the skin/and or underlying tissue occurring most often over a bony prominence and caused by pressure, shear, or friction, alone or in combination (1). The treatment of pressure ulcers usually involves a wide range of interventions, including use of a support surface and application of moisture-retentive dressings. If the ulcer fails to respond to standard care, guidelines suggest direct contact (capacitive) electrical stimulation (ES) should be considered in the management of recalcitrant Stage II, Stage III, and Stage IV pressure ulcers. Other physical modalities that may be used for pressure ulcers not responding to appropriate moist wound care strategies include negative pressure wound therapy (for Stage III and Stage IV ulcers only), ultrasound, ultraviolet light, and electromagnetic therapy (2).

Electrical stimulation is believed to be capable of reinitiating or accelerating the healing process of wounds by transcribing the electrical current that occurs when the skin is broken. High voltage electrical stimulation (HVES) has shown significant results in healing chronic ulcers based on its intrinsic mechanisms. Bearing in mind the difficulty involved in healing chronic ulcers, the objective of the present study was to describe the effects of HVES on the treatment of chronic ulcers of the lower limbs (3). Honey has been used as a traditional medicine for centuries by different cultures for the treatment of various disorders and is a promising agent for local treatment of complicated wound. Honey offers broad spectrum antimicrobial properties and it promotes rapid wound healing. It has been assumed that antibacterial action of honey has its main impact on the healing process of chronic wounds and burns. Honey eliminates pathogens from wounds and provides appropriate moist environment for proper wound healing (4).

Subjects and Methods

Subjects: This study was carried out on 30 patients who was diagnosed by surgeon as lower limb pressure ulcer. They were selected from inpatient Department of El Helal hospital, their ages ranged from 30 to 50 years.

Inclusion criteria

- The patients' age ranged from 30-50 years.
- The patients were chosen from both sexes.
- All patients who entered the study had their informed consent.
- All patients were chosen from Inpatient Department and ICU of El Helal hospital and post traumatic cases.

Exclusion criteria

- Patients who suffered from psychological or mental disorders.
- Patients who suffered from cardiac disorders.
- Patients who suffered from any systemic disease that may interfere with study.
- Patients who had blood or auto immune disease.
- Patients who had diabetes mellitus.

MATERIALS

Local Ultrasonography and Doppler examination for measuring the ulcer depth: Ultrasound imaging and Doppler examination system was used for measuring the ulcer depth for two groups. The instrument combines a scanning transducer and a computer in a single instrument that used at a patient' bed side producing high-resolution images of human tissue.

High Voltage Electrical Stimulation: Amperage and voltage. In some studies, amperage of current ranges between 200 and 800 μ A. When HVES is used in soft tissue procedures, voltage typically ranges from 100 to 200 V (342–500 μ C/s). The electric current amplitude used during HVES procedures (approximately 2.5 A) is approximately 25 times greater than that applied during low-voltage ES, but the average amperage is low, usually within 1.5–2.0 mA. Patients subjected to amperage used during low- and high-voltage stimulation felt a painless tingling sensation but no muscle contractions.

Honey Therapy: The Honey is obtained from The National Research Center. The investigation of the ether extract of the honey sample revealed the presence of 90 compounds, 9 of which are new to honey. The main compounds are aliphatic acids (37 compounds), which represent 8.72% for the honey. The presence of ten aliphatic dioic acids represents 0.16% for the honey. Honey contained a little number with very small amounts of these dioic acids. Methyl butandioic acid was the only dioic acid in all honey sample. Octandioic and nonandioic acids were present in high amounts in the honey.

Procedures: The experimental protocol was explained in details for every patient before starting the initial assessment, and a written consent form was signed by each patient before starting. The treated patients were instructed to report any side effects during the treatment sessions.

Evaluation procedures:

Procedures of Local Ultrasonography and Doppler examination for measuring the ulcer depth: A special gel is placed on the area being examined while a wand like device called a transducer is passed lightly over the skin of the ulcer. Internal images of the ulcers are shown on a screen, recorded as a video or printed as a photo. Assessment was done before the treatment and after 8 weeks of treatment.

- A hand-held Doppler with accompanying probe. Ensure that the correct probe size was available. Use an 8 megahertz for lower limb assessment and a 5-megahertz probe if there is a lot of edema. Contact tissue viability service to access 5-megahertz prob.
- Ultrasound Gel and tissues.
- Cling film for covering any ulceration.

Treatment procedures: Both two groups received wound care including cleaning the wound by alcohol and dressing care.

- Patient in the First Group received the treatment program including: Positioning + High voltage electrical stimulation + Dressing.
- Patient in the Second Group received the treatment program including: positioning + Topical application of Honey therapy + Dressing.

Procedures of High Voltage Electrical Stimulation for the first study group (A):

- Positioning of the patient: according to the site of the ulcer.
- Wound preparation: Even though many describe honey as having cleansing and deriding action on wound, the wound was cleaned at first. Somereport abscesses opened and pockets of pus drained, and necrotic tissue removed.
- Scrubbing the wound with a soft tooth brush followed by hydrogen peroxide, saline rinse and betadine.

High Voltage Electrical Stimulation application:

- Patients in group A additionally received HVES procedures. The device used for this purpose was the phy action. The voltage exceeded 100 V. Twin monophasic pulses lasting 100 μ s in total and having a frequency of 100 Hz was applied as per previously published protocols.
- The amperage utilized during HVES procedures evoked a tingling sensation in the patients, but no motor effects were induced. The positive electrode and the negative electrode were made of conductive carbon rubber. Each patient had his/her own set of electrodes. The active electrode was placed on an aseptic gauze pad saturated with physiological saline overlying the wound site. The passive electrode (closing the electric circuit) was positioned at least 20 cm from the pressure ulcer (proximally or distally, depending on its location). After each procedure, the electrodes were sterilized in a disinfectant solution.
- Patients received 20-minute procedures per session. Treatment continued until healing or for a maximum of 8 weeks.

- During the first 1 to 2 weeks, the HVES procedures utilized cathodic stimulation to facilitate granulation tissue formation, followed by anode stimulation for the rest of the treatment period.
- Dressing of wound: The wound covered by dressing in the form of clean sterilized gauze and well fitted to the skin through silk adhesive plaster.

Procedures of Honey therapy for the second study group (B):

Positioning of the patient: according to the site of ulcer wound preparation: Even though many describe honey as having cleansing and deriding action on wound, the wound was cleaned at first. Somereport abscesses opened and pockets of pus drained, and necrotic tissue removed. Scrubbing the wound with a soft tooth brush followed by hydrogen peroxide, saline rinse and betadine. Honey preparation and application: Honey prepared and measured by using syringe to fit three quarters volume of ulcer wound. Honey poured into the wound to three-quarters fill.

Dressing of wound: The wound covered by dressing in the form of clean sterilized gauze and well fitted to the skin through silk adhesive plaster

Frequency of application: Honey therapy was applied every other day for eight weeks (5).

Statistical analysis: Unpaired t-test were conducted for comparison of age between groups. Chi- squared was carried out for comparison of sex distribution between groups. Normal distribution of data was checked using the Shapiro-Wilk test for all variables. Levene’s test for homogeneity of variances was conducted to test the homogeneity between groups. Unpaired t-test was conducted to compare the mean values of UDD between the group A and B. Paired t-test was conducted for comparison between pre and post treatment in each group. The level of significance for all statistical tests was set at $p < 0.05$. All statistical analysis was conducted through the statistical package for social studies (SPSS) version 25 for windows (IBM SPSS, Chicago, IL, USA).

Results

Subject characteristics: Table (1) showed the subject characteristics of the group A and B. There was no significant difference between groups in age and sex distribution ($p > 0.05$).

Table 1. Basic characteristics of participants

	Group A	Group B	p-value
	Mean ± SD	Mean ± SD	
Age (years)	40.13 ± 4.39	40.53 ± 3.94	0.79
Sex, n (%)			0.71
Females	7 (47%)	6 (40%)	
Males	8 (53%)	9 (60%)	

SD, standard deviation; p-value, level of significance

Effect of treatment on UDD:

Within group comparison: There was a significant decrease in UUD post treatment in the group A and B compared with that pre treatment ($p < 0.001$). The percent of decrease in UDD in the group A was 74.83% and that for group B was 77.15%. (table 2, figure1).

Table 2. Mean UUD pre and post treatment of the group A and B:

	Group A	Group B	MD	t- value	p value
	Mean ± SD	Mean ± SD			
UUD (mm)					
Pre treatment	5.88 ± 1.67	5.82 ± 1.81	0.06	0.09	0.92
Post treatment	1.48 ± 0.95	1.33 ± 0.91	0.15	0.42	0.67
MD	4.4	4.49			
% of change	74.83	77.15			
t- value	15.13	16.64			
	$p = 0.001$	$p = 0.001$			

SD, standard deviation; MD, mean difference; p-value, probability value

Between groups comparison: There was no significant difference between groups pre-treatment ($p > 0.05$). Comparison between the groups A and B post treatment revealed a non significant difference in the UUD ($p > 0.05$). (Table 2, Figure1).

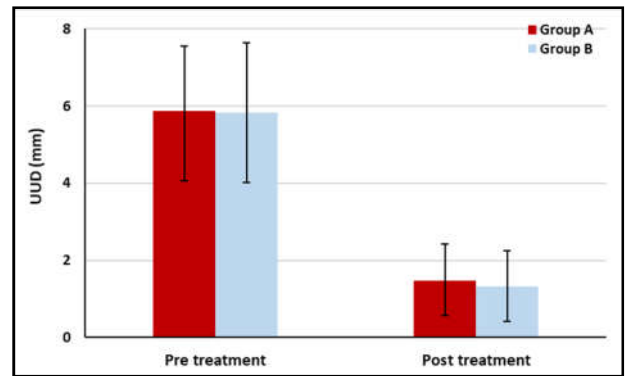


Figure 1. Mean UUD pre and post treatment of the group A and B.

DISCUSSION

Results of this study revealed that there was significant decrease in UUD before and after treatment in both groups. There was no significant difference in the UUD between the group A and group B post treatment. Use of High Voltage Electrical Stimulation and Honey therapy in the treatment of lower limb pressure ulcers had a valuable healing effect. Weitz *et al.*,1996, Houghton 2003 and Davini *et al.*,2005 have demonstrated the effect of HVES in healing chronic ulcers of the lower limbs of different etiologies, reporting a reduction of almost 50% in the surface area of the lesion. (6,7,8). Silva *et al.*,2010 documented a reduction in the total area of the ulcers after fifteen weeks of treatment. In view of these results, it is reasonable to conclude that HVES was effective in treating chronic ulcers of the lower limbs in the sample evaluated (9). Zhang *et al.*, 2021 mentioned that honey has been used in clinical practice for many types of disease for centuries. It is still being used as a dressing material for burn wounds, decubitus ulcers, gunshot wounds and wound dehiscence. It enhances auto debridement by absorbing edematous fluid around the ulcer margins and promotes granulation tissue formation and epithelization (10) Al-Waili *et al.*,2011 reported that There are tremendous data supporting the effectiveness of honey in the management of wounds. The data clearly demonstrate that with the use of honey, no allergic reaction is elicited and no significant side effects were reported, and there is rapid elimination of wound odor, improvement of granulation and epithelialization, reduction of amount of exudates, and sterilization of wounds from microbes.

In addition to its valuable nutritional constituents, honey has anti-inflammatory and antioxidant activities that make it a suitable natural subject for wound healing. (11)

CONCLUSION

Application of High Voltage Electrical Stimulation (HVES) and Honey therapy in the treatment of lower limb pressure ulcers had a valuable healing effect. The results of this study support the expectation that both high voltage electrical stimulation and honey therapy were effective in enhancing healing process of lower limb pressure ulcers as evaluated by measure ultrasonographic ulcer depth (UUD) and there was significant decrease in the UUD before and after treatment in both groups. But there was no significant difference in the ultrasonographic ulcer depth (UUD) between group A (High Voltage Electrical Stimulation) and group B (Honey therapy) post treatment.

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