

## Negative Pressure Wound Therapy versus Honey Dressings as a Preparation of Complex Wounds before Final Coverage

AHMED EMAD, M.D.\*; MOSTAFA FATHY IBRAHIM, M.D.\*\*;  
MOHAMED H. ABDELMAWLA, M.D.\*\* and EMAD M. SAYED, M.D.\*

*The Departments of Plastic & Reconstructive Surgery\* and General Surgery\*\*, Faculty of Medicine, Beni-Suef University*

### ABSTRACT

**Background:** Management of chronic wounds is considered a complex process as their development is associated by multiple physiological and pathological aspects. The goal of wound bed preparation is to get rid from the barriers that prevent the process of healing. This study focused on and compared between the role of negative pressure wound therapy (NPWT) and honey dressings regarding the promotion of complex wound healing and the pre-operative preparation of chronic wounds for final coverage.

**Patients and Methods:** Between July 2019 and April 2021, 60 cases of complex wounds presented in the upper and lower limbs were managed by 2 different methods for promotion of wound healing or pre-operative preparation before final coverage. Patients were randomly divided into 2 equal groups, group A included 30 cases and they were managed by using honey dressings, while group B included 30 cases and they were managed by using negative pressure wound therapy.

**Results:** Negative pressure wound therapy (NPWT) seems to be more effective with faster healing rates than honey dressings regarding management and promotion of healing of complex wounds ( $p < 0.05$ ).

**Conclusion:** The present results showed that both NPWT and honey dressings have an important role in management of complex wounds, and could lead to a higher proportion of healed wounds, faster healing rates, and potentially fewer rates of complications with superiority of NPWT over honey dressings.

**Key Words:** Wound healing – Honey – VAC.

**Conflicts of Interest:** There are no conflicts of interest.

### INTRODUCTION

Impairment of wound healing especially in complex wounds and in old age patients with associated medical comorbidities is a major problem. It causes morbidity, pain, long timed treatment and ends commonly by repeated and major reconstructive procedures [1].

There are four well known stages for surgical wound healing: Hemostasis, inflammation, cellular proliferation and scar maturation [2]. Any interruption at any stage of them converts the wound from acute to chronic one and results in failure of healing in a timely and orderly manner [3].

The main cause of such interruption is wound infection and so the surgeons accustomed to use many topical products aiming to minimize the risk of such infection [4,5].

Silver is considered one of such topical products that has been used to prevent or minimize wound infection over 2000 years, but Miller AC, et al., concluded that there is insufficient evidence supporting or refuting the routine use of Silver sulfadiazine to treat partial-thickness burns, prevent infection or augment wound healing in human beings [6]. Also Iodine-containing products are still used as a common antiseptics aiming to protect the wound from infection and so plays an important role in wound healing but they carry the risk of allergy or toxicity especially with wounds that have large surface area [7].

Honey is one of the most common dressings used for wound bed preparation. As mentioned in the Pharaonic civilization, honey has been used not only as a food but also as a medical product to protect wounds from ulcerations [8]. Honey is composed of many components like sugar (75-79%), water (20%), proteins, minerals, vitamins, antioxidants and many enzymes [9,10]. The protective and antimicrobial effects of honey are related to some mechanisms like hydrogen peroxide formation, antioxidant effect and its osmotic effect that reduces edema and results in shifting of water from bacteria and so bacterial death [11].

On the other hand, Negative pressure wound therapy (NPWT) became one of the most common healing promoting modalities used to promote complicated wounds healing. It is a noninvasive wound-management system that uses controlled localized sub atmospheric pressure to promote healing in chronic and acute wounds [12]. It consisted of a controlled vacuum source and open-cell foam dressing that absorbs the wound secretions. A properly controlled negative pressure is applied via an adhesive drape that covers the wound [13]. The real mechanism by which NPWT prepares the wound and so promotes its healing is still unclear but many researchers suggest that it is accomplished through different mechanisms like augmentation of blood circulation by angiogenesis, minimizing edema, promotion of granulation tissue formation and reducing bacteria counts [14].

The aim of our study is to assess and to compare between the role of NPWT and honey dressings regarding augmentation of chronic wound healing or even preparation of chronic wounds bed for final coverage.

## PATIENTS AND METHODS

*A- Patients:* Between July 2019 and April 2021 in Plastic and Reconstructive Surgery Department, Beni-Suef University, 60 cases of chronic upper and lower limb wounds were managed. 45 cases were diabetic cases that had post amputation non healed stump, 10 cases were post traumatic wounds that failed to heal by the usual antiseptic dressings like Iodine dressings and 5 cases of bed sores over trochanteric area.

### *Inclusion criteria:*

- Patients who had complicated upper or lower limb wounds.

### *Exclusion criteria:*

- Patients who had early fresh wounds.
- Wound in other areas rather than the upper and lower limbs.

### *Patient counseling and consent:*

The study was approved by the Faculty of Medicine, Beni-Suef University Research Ethics Committee.

*B- Study design:* Choosing the cases for each modality (Honey dressings or NPWT) occurred in a random pattern. We had 2 groups, Group A involved 30 cases and they were managed by honey

dressings. Group B involved the other 30 cases that were managed by NPWT.

*C- Patient and wound assessment:* In the form of:

- Taking a detailed history about:
  - Wound etiology and date of onset.
  - Previous methods that were used for wound management like type of the used dressings.
  - Any associated local or systemic comorbidities like limb ischemia, uncontrolled diabetes mellitus or autoimmune diseases.
- Wound examination for: Location, size, depth, floor of the wound, the condition of the skin around the wound and any wound discharge.
- Wound swab: Before starting of each dressing modality to assess presence and type of bacterial growth.

*D- Procedure:* Nearly all cases had necrotic and devitalized tissues and so the first step in all cases were surgical debridement either being bedside or in the OR. This is a very important step to get rid from any necrotic tissues before starting the dressing. Immediately after surgical debridement we started dressing by one of the above mentioned modalities (honey or NPWT).

*In Group A:* Under complete antiseptic measures the honey was placed on the dressing and left for ten minutes till the dressing became totally soaked then it was applied on the wound. The dressing was changed every 12 hours.

*In Group B:* In this group the patients were managed by NPWT. The procedure started by proper surgical debridement followed by washing of the wound by sterile saline then total wound coverage by polyurethane ether foam. A Ryle tube was embedded in the well-trimmed foam then they were totally covered by an airtight adhesive drape. The Ryle tube was connected to the vacuum source with exertion of an intermittent -125mm Hg negative pressure with a 5 minute on and 2 minutes off cycle. Wound secretions were collected through the Ryle tube in a collection canister. Changing of the dressing was done every 4 days unless high amount of wound secretions were collected before 4 days.

In both groups we stop dressing when granulation tissue covered nearly 100% of the wound surface or the volume of exudate collected by VAC therapy was less than 20ml/day without any signs of infectious process around the wound.

**Evaluation:**

*The goals of our study were:*

Comparing the effect of honey and NPWT dressings in management and preparation of problematic wounds and their role in increasing the rate of wound healing.

Our evaluation depended on analysis of wound digital photographs. These photographs were taken on the day of start then after 1 week, 2 weeks (and even 3 weeks if needed).

*During the duration of the management the following items were evaluated:*

- Time of onset of granulation tissue deposition.
- Percentage of decreasing of wound size per week.

- Total time needed for full wound preparation before final coverage, direct closure or complete wound healing.
- Total time needed for the swabs to be void of bacterial growth, so wound swabbing is done every 5 days.

The digital photographs were processed by Auto CAD program (Autodesk Auto CAD 2013) that estimated the percentage of the total wound size and percentage of the size of the deposited granulation tissue.

The calculated ratios and percentages were used for statistical analysis to examine the significance of the differences between both groups (Fig. 1).

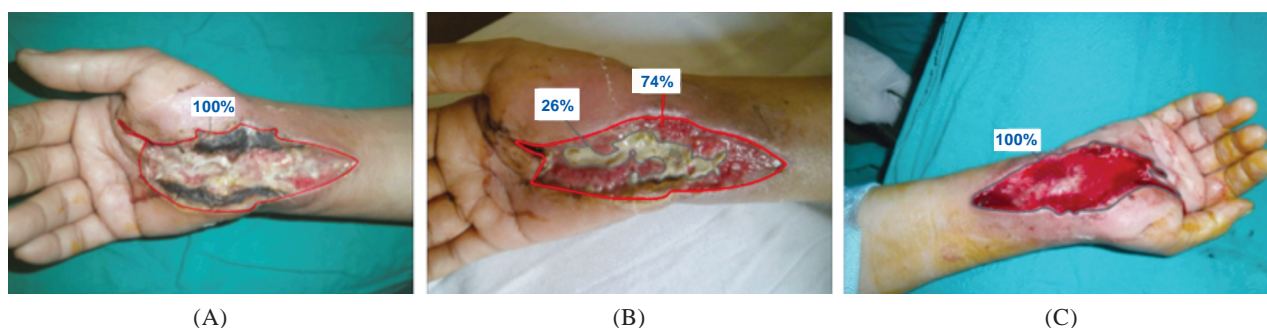


Fig. (1): Shows the calculated ratios and percentages of a complicated upper limb wound at different stages. (A) Before starting of management (100% necrotic tissue). (B) After 1 week from VAC therapy (74% granulation tissue deposition and 26% necrotic tissue). (C) After 2 weeks from VAC therapy (100% granulation tissue deposition).

**RESULTS**

*Statistical analysis:*

SPSS v. 25 (Statistical Package for Social science) for Windows was used for data analysis.

Categorical variables were presented as number and percent. Numerical variables as mean and standard deviation. Age and Percentage of decreasing in wound size in the third week variables were normally distributed but, Percentage of decreasing in wound size in the first week, in the second week, and total number of dressing's variables are not normally distributed.

Comparison between two groups regarding scale variables was done using *t*-test and regarding categorical variables, they were done using chi-squared test. Mixed model AOVA was used to test the interaction between timing factor and grouping

factor regarding in the change of the percent of decline of the wound size. The significance of the results was assessed in the form of *p*-value that was differentiated into: Non-significant when *p*-value >0.05 and significant when *p*-value 0.05.

Table (1): Baseline characteristics of the studied groups.

Baseline characteristics	Honey group n=30 (%)	VAC group n=30 (%)	<i>p</i> -value
Age	51.97±9.18	50.03±10.49	0.450
<i>Sex:</i>			
Males	15 (50)	16 (53.3)	0.796
Females	15 (50)	14 (46.7)	
<i>HTN:</i>			
Negative	11 (36.7)	10 (33.3)	0.787
Positive	19 (63.3)	20 (66.7)	
<i>DM:</i>			
Negative	9 (30)	6 (20)	0.371
Positive	21 (70)	24 (80)	

Table (2): Follow-up of the percent of decline of the wound size in the studied groups.

% of decline of wound size (mean% ± SD %)	Honey group n=30 (%)	VAC group n=30 (%)	p-value
After 1 week	15.5±12	17.4±2.5	<0.001
After 2 weeks	47.2±9.8	66.8±9.6	<0.001
After 3 weeks	81.2±8.5	89.8±3.9	<0.001
p-value (1 week vs 2 weeks)	<0.001	<0.001	
p-value (2 weeks vs 3 weeks)	<0.001	<0.001	
p-value (1 week vs 3 weeks)	<0.001	<0.001	
p-value of interaction between timing factor and grouping factor	0.036	0.036	

Table (3): Comparison between honey group and VAC group regarding the total time needed for full wound preparation and total number of dressings and total time needed for the swap to be void of bacterial growth.

Outcomes (mean ±SD)	Honey group n=30 (%)	VAC group n=30 (%)	p-value
Total time needed for full wound preparation (days)	17.4±3.5	12.8±3.7	<0.001
Total number of dressings	35±7	4±1	<0.001
Total time needed for the swap to be void of bacterial growth	15.4±2.5	11.4±3.5	<0.001

Table (4): Comparison between honey group and VAC group regarding the total time needed for full wound preparation in patients who had different comorbidities.

Total time needed for full wound preparation (days)	Honey group n=30 (%)	VAC group n=30 (%)	p-value
Smokers patients	14.4±2.5	13.4±3.5	0.371
Hypertensive patients	13.4±3.7	12.4±2.5	0.221
Diabetic patients	15.4±2.2	14.7±3.5	0.261

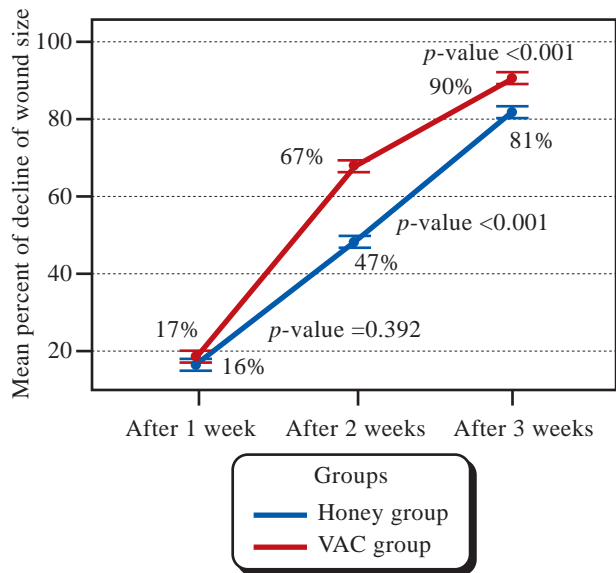


Fig. (2): Follow-up of percent of decline of wound size in both groups.

Clinical cases:

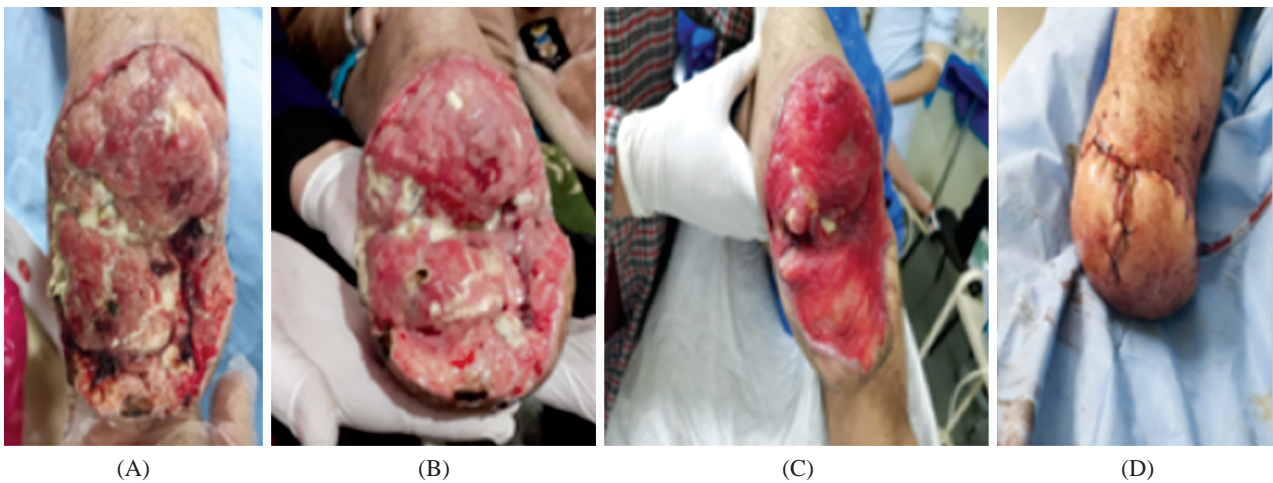


Fig. (3): (A) Post LL amputated infected stump with necrotic tissues. (B) After 1 week from wound debridement and honey dressing. (C) After 3 weeks of honey dressing. (D) The wound immediately after closure by secondary sutures.

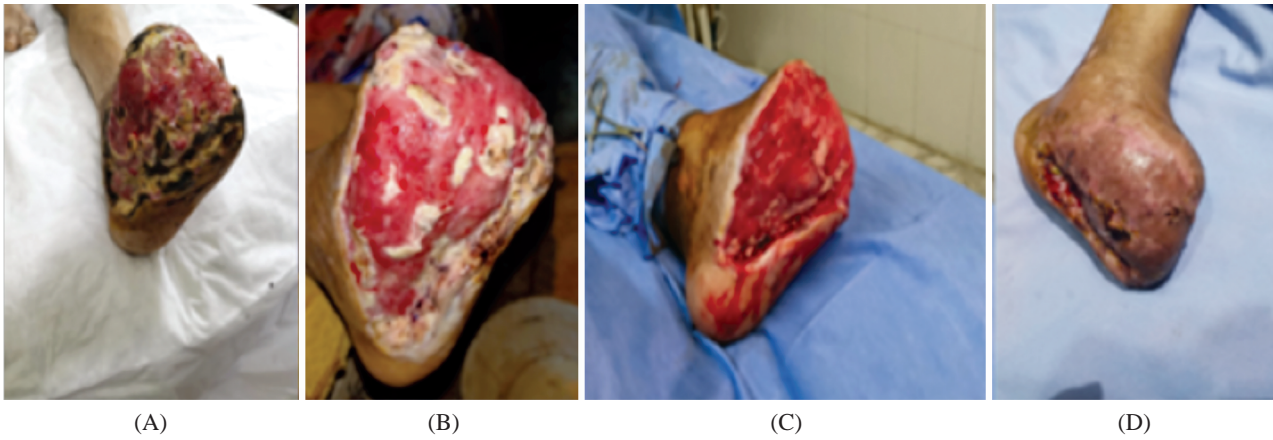


Fig. (4): (A) Post forefoot amputated infected stump with necrotic tissues. (B) After 1 week from wound debridement and honey dressing. (C) After 3 weeks of honey dressing. (D) The wound after complete coverage by STG.

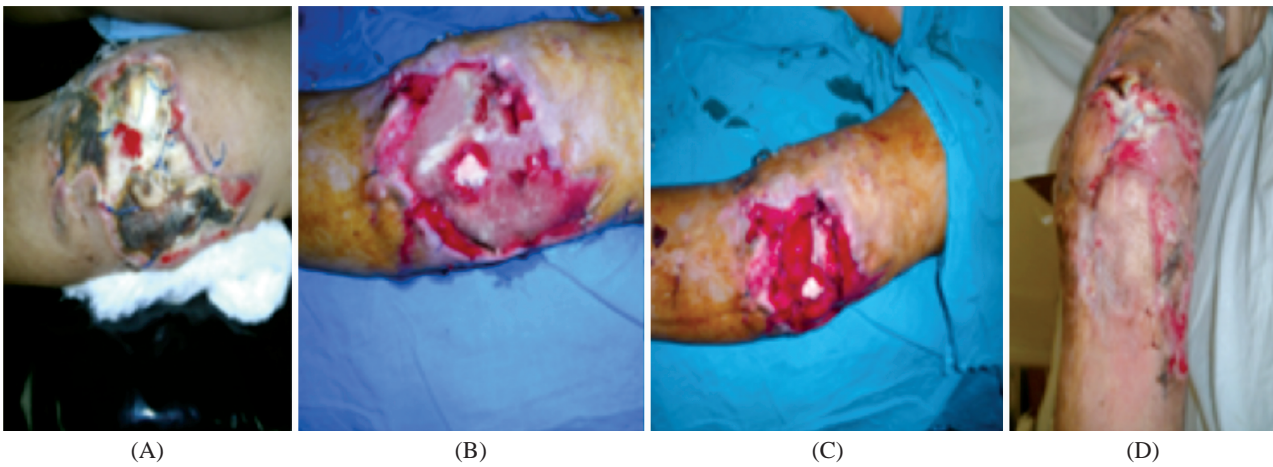


Fig. (5): (A) Post traumatic wound over the knee with infected and gangrenous tissues. (B) The wound after 1 week from debridement and VAC dressing. (C) The wound after 2 weeks of VAC dressing. (D) The wound after final coverage by STG.



Fig. (6): (A) Upper leg chronic infected raw area. (B) 10 days from debridement and VAC dressing. (C) The wound after final coverage by STG.

## DISCUSSION

In the past, just coverage of the wound by a clean dressing with keeping it protected from entry of harmful bacteria leads to its dryness which allows it to get red from any fluid, discharge or exudates. These ideas were the main concept of dressings but such ideas get changed nowadays, being the wound warm and moist gives it better chance for rapid and successful wound healing [15].

Using of Honey as a wound healing component has started with ancient civilizations. Honey promotes wound healing through the following effects:

- Promotes wound contraction, granulation tissue formation wounds epithelialization and new vascularization in the wound bed.
- Minimizes post-operative inflammatory sequelae like tissue edema and adhesions [16].

Several previous studies have confirmed that using honey dressings plays a very important and significant role in healing of complicated wounds. At 2009 Asadullah Makhdoom et al., achieved very good results by using natural honey dressings in managing diabetic wounds [17]. Abdul Rashid Surahio et al., at 2014, had excellent results in management of chronic diabetic foot ulcers with marked decrease of the risk of foot amputation by using Honey dressings [18].

On the other hand Negative pressure wound therapy (NPWT) was used in the past as an alternative therapy for comorbid patients with complex wounds [19]. Several studies assert that application of NPWT on complicated wounds minimizes the time needed for completion of healing and wound bed preparation. Julien Shine et al., used VAC therapy in management of complicated upper extremity wounds and achieved positive outcomes and mentioned that it could be a definitive treatment for such complicated wounds [20]. Also Valerio Iacovelli et al., concluded that VAC therapy had nice results during management of Fournier's gangrene [21].

Practical wise through our study we found some advantages and disadvantages for each type of dressing. Regarding honey dressings it carried the advantages of being easier in using, less expensive than VAC and no need for a specialist for dressings. But it still carries the problem of being a frequent dressing (twice per day) which may be more painful than VAC. Regarding VAC dressing it had the advantage of being more rapid than honey in wound bed preparation and also did not need frequent

dressings, but on the other side it still needs a specialist for its application and also may have some complications that may appear during its use like bleeding, hematoma, dissemination of infection and skin.

### Conclusion:

Using of VAC Therapy System and honey dressings appeared to give us a very good results in management of complex wounds and excellent effect during wound bed preparation before final coverage with superiority of VAC therapy over honey dressings.

## REFERENCES

- 1- Pawan Agarwal, Rajeev Kukrele and Dhananjaya Sharma: Vacuum assisted closure (VAC) negative pressure wound therapy (NPWT) for difficult wounds: A review. *Journal of Clinical Orthopedics and Trauma*, 10: 845-848, 2019.
- 2- Gregory S. Schultz, R. Gary Sibbald, Vincent Falanga, Elizabeth A. Ayello, Caroline Dovesett, Keith Harding, et al.: Wound bed preparation: A systematic approach to wound management. *Wound Rep. Reg.*, 11: 1-28, 2003.
- 3- Stuart Enoch, Keith Harding: Wound Bed Preparation: The Science Behind the Removal of Barriers to Healing. *Wounds*, 15 (17), 2003.
- 4- Wild S., Roglic G., Green A., Sicree R. and King H.: Global prevalence of diabetes: Estimates for the year 2000 and projections for 2030. *Diabetes Care*, 27 (5): 1047-1053, 2004.
- 5- Trengove N.J., Stacey M.C., McGeachie DF. and Mata S.: Qualitative bacteriology and leg ulcer healing. *J. Wound Care*, 5 (6): 277-80, 1996.
- 6- Miller A.C., Rashid R.M., Falzon L., Elamin E.M. and Zehtabchi S.: Silver sulfadiazine for the treatment of partial-thickness burns and venous stasis ulcers. *J. Am. Acad Dermatol.*, 66 (5): 159-165, 2012.
- 7- Moberg S., Hoffman L., Grennert M.L. and Holst A.: A randomized trial of cadexomer iodine in decubitus ulcers. *J. Am. Geriatr Soc.*, 31 (8): 462-465, 1983.
- 8- Sare J.L.: Leg ulcer management with topical medical honey. *Br. J. Community Nurs.*, 13 (9): S22, S24, S26, 2008.
- 9- Robson V., Dodd S. and Thomas S.: Standardized anti-bacterial honey (Medihoney) with standard therapy in wound care: Randomized clinical trial. *J. Adv. Nurs.*, 65 (3): 565-575, 2009.
- 10- Parinaz Nezhad-Mokhtari, Siamak Javanbakht, Nahideh Asadi, Marjan Ghorbani, Morteza Milani, Younes Hanifehpour, et al.: Recent advances in honey-based hydrogels for wound healing applications: Towards natural therapeutics. *Journal of Drug Delivery Science and Technology*, 66, 2021.
- 11- Peter Molan and Tanya Rhodes: Honey: A Biologic Wound Dressing. *Wounds*, 27 (6): 141-151, 2015.
- 12- Leland Jaffe and Stephanie C. Wu: Dressings, Topical Therapy, and Negative Pressure Wound Therapy. *Clin. Podiatr. Med. Surg.*, 36 (3): 397-411, 2019.

- 13- Peinemann F. and Sauerland S.: Negative pressure wound therapy-systematic review of randomized controlled trials. *Dtsch Arztebl Int.*, 108 (22): 381-309, 2011.
- 14- Malmjsjo M., Gustafsson L., Lindstedt S., Gesslein B. and Ingemansson R.: The effects of variable, intermittent, and continuous negative pressure wound therapy, using foam or gauze, on wound contraction, granulation tissue formation, and ingrowth into the wound filler. *Eplasty*, 12 (5), 2012.
- 15- Joshua S. Boateng, Kerr H., Matthews, Howard N.E Stevens and Gillian M. Eccleston: Wound Healing Dressings and Drug Delivery Systems: A Review. *Pharmaceutical Sciences*, 97 (8), 2008.
- 16- Hana Scepankova, Patricia Combarros-Fuertes, José María Fresno, María Eugenia Tornadijo, Miguel Sousa Dias, Carlos A., et al.: Role of Honey in Advanced Wound Care. *Molecules*, 26 (16), 2021.
- 17- Asadullah Makhdoom, Muhammad Shoaib Khan, Muhammad Ayub Lagahari, Muhammad Qasim Rahopoto, Syed Muhammad Tahir and Khaleeqe Ahmad Siddiqui: Management of diabetic foot by natural honey. *J. Ayub. Med. Coll. Abbottabad*, 21 (1), 2009.
- 18- Abdul Rashid Surahio, Ashar Ahmad Khan, Main Usman Farooq and Iffat Fatima: Role of Honey in Wound Dressing in Diabetic Foot Ulcer. *J. Ayub. Med. Coll. Abbottabad*, 26 (3): 304-306, 2014.
- 19- Avery C., Pereira J., Moody A. and Whitworth I.: Clinical experience with the negative pressure wound dressing. *Br. J. Oral Maxillofac. Surg.*, 38: 343-345, 2000.
- 20- Julien Shine, Johnny I. Efanov, Laurence Paek, Édouard Coeugniet, Michel A. Danino and Ali Izadpanah: Negative pressure wound therapy as a definitive treatment for upper extremity wound defects: A systematic review. *Int. Wound J.*, 16: 960-967, 2019.
- 21- Valerio Iacovelli, Chiara Cipriani, Marco Sandri, Roberta Filippone, Antonella Ferracci, Salvatore Micali, et al.: The role of vacuum-assisted closure (VAC) therapy in the management of FOURNIER'S gangrene: A retrospective multi-institutional cohort study. *World Journal of Urology*, 39: 121-128, 2021.