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Original research article

Efficacy of honey dressing in chronic wounds with biofilm

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Abstract

Background: Very few studies are available for the use of honey in the treatment of chronic wounds with biofilm. Honey dressing is one of the surgical advances in recent times avoiding the mechanical debridement and reducing postoperative pain and cost effective.

Methods: It is a prospective comparative study of effectiveness of honey dressing versus mechanical debridement in wounds with biofilm for a period of one and half year in patients who met inclusion criteria

Results: Majority of patients in honey group are in the mean age of 49.8±19 and in debridement group are in the mean age of 53.4±17.5. Granulation tissue appeared in 14 days in honey group compared to debridement group which appeared in 20 days.

Conclusion: Honey dressing in chronic wounds with biofilm is a useful measure as it reduces postoperative pain and hospital stay and cost effective.

Keywords: Honey dressing, biofilm, mechanical debridement

Introduction

Chronic wounds are the significant health problems globally. Chronic wounds fail to progress through the expected healing process in a timely manner. Health care costs related to the management of chronic wounds still form a major burden. Microbial Bioburden in wounds is one of the important factors responsible for the chronicity of wounds. Wound infection results from complex interaction between an individual's immune system, condition of the wound and number and virulence of bacteria present. Bacteria can exist in at least two different phenotypic growth forms: the first being single, fast-growing cells i.e., the planktonic form; the second as aggregated communities of slow-growing cells in a biofilm form [1]. A chronic wound is a wound that is arrested in inflammatory phase of wound healing and cannot progress further [2]. Clinicians agree that infection causes serious delay in healing because of bacterial virulence factors [3]. Development of biofilm in acute wounds leads to chronic inflammation characterised by elevated levels of pro inflammatory cytokines that leads to increased number of neutrophils, macrophages and mast cells that secrete proteases and ROS that become chronically elevated and accidentally become (off target), destroy proteins that are essential for healing, leading to chronic non healing wound [4].

Honey has been used to treat the wounds since many years as it contains antibacterial activity, osmotic effect, de-sloughing activity etc. in this antibiotic era, no studies have shown the development of resistance to honey. There are studies done *in vivo* show the eradication of biofilm by the honey. Earlier studies conducted in our institution showed existence of biofilm in 60% of ulcers. Biofilm in these ulcers could be eradicated with the topical application of honey. Hence this study was taken up mainly to compare the efficacy of honey in eradicate the biofilm as a topical agent in wound healing in ulcers with biofilms with the conventional methods as these biofilms are the major factor in preventing the healing of wounds.

In 2000 several mechanisms were proposed to explain the phenomenon of resistance with biofilms, including delayed penetration of antimicrobials into the biofilm extracellular matrix or other physiological changes brought about by the interaction of the organism with the surface [5]. Biofilms are complex microbial communities containing bacteria and fungi. Microorganisms secrete a protective matrix that attaches the biofilm firmly to a living or non-living surface. They may consist of single bacterial or fungal species or more commonly, may be polymicrobial i.e., contain multiple diverse species [6].

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Almost all chronic wounds have biofilm communities on at least part of the wound bed [7]. 50 chronic wound specimens were evaluated by microscopy, 30 were categorised as containing biofilm (60%) and 8 acute wound specimens had biofilm (6%) [8]. The aim of the present study was to detect biofilm in wounds and to compare the efficacy of honey dressing versus mechanical debridement in healing of ulcers with biofilm.

Materials and Methods

The present Prospective, comparative study was carried out in the Department of General Surgery, Mamata General Hospital, Khammam, Telangana, from April 2022 to September 2023 with and total of 90 with 45 in each group.

Study was approved by the institutional ethics committee and written informed consent was obtained from all patients participating in the study.

Patients came with ulcers during the study period were initially subjected for detection of biofilm in wounds and those who were positive for biofilm are included in the study.

Inclusion criteria

All the patients with ulcers having the biofilm.

Exclusion criteria: Patients with ulcers who are.

- Immune compromised.
- HIV positive individuals on ART medication.
- History of chemotherapy within last 6 months.
- Radiotherapy to local area of ulcer.

Method of collection of data

All eligible patients admitted in the Department of General Surgery in Mamata General Hospital with ulcer during the study period from April 2022 to September 2023 were initially evaluated for the presence of biofilm in ulcers by taking swab cultures from the ulcer. Detection of biofilm was done by Tube adherence test and Congo red agar test.

Once the biofilm is detected thorough clinical examination of the ulcer will be done. The study subjects will be randomly divided into two groups, Honey (H) group and Debridement (D) group.

The honey group was treated with topical application of dressing which were soaked with honey. Dabur honey of 10-30 ml was taken on a sterile gauze piece and diluted with normal saline in ratio of 1:2 and was spread over ulcer bed thoroughly and the ulcer was covered using sterile pads and roller gauze. Consecutive day's regular dressing with honey was done.

Control group was treated with mechanical debridement and dressed in 10% Povidone Iodine.

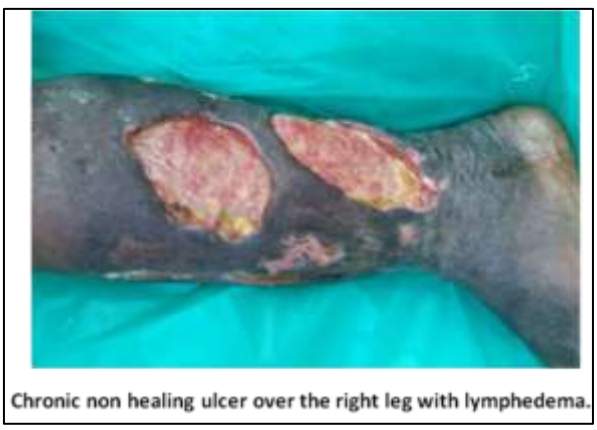
Once in 5 days wound assessment was done regarding

a) Discharge.
b) Foul smell.
c) Granulation tissue.
d) Size of the ulcer in both the groups.

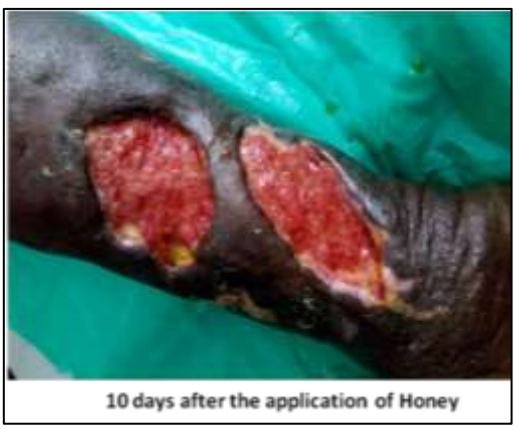
The same protocol was followed for consecutive days, ulcer assessment was done using same parameters and culture swab was taken and sent for biofilm detection.

Ulcers which were free from biofilm or pus culture sensitivity was sterile were taken up for definitive management in both groups.

Statistical analysis: By Fisher exact test and Chi square test and p value <0.05 was considered significant.



Chronic non healing ulcer over the right leg with lymphedema.



10 days after the application of Honey

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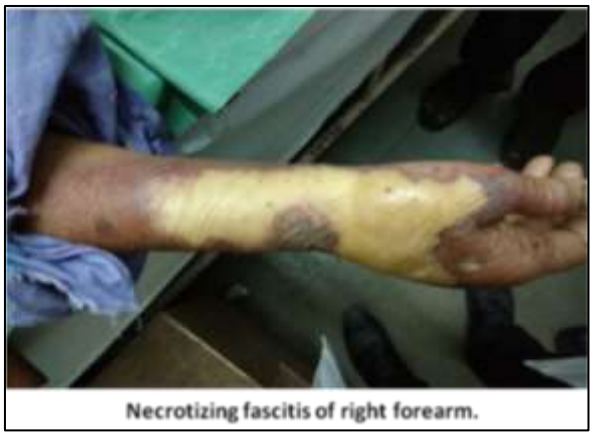

Necrotizing fascitis of right forearm.

On day 15 after application of honey

Results

Table 1: Distribution of Age between Honey Group (H) and Debridement Group (D)

Age (YRS)	Honey Group		Debridement Group		p value
	N	%	N	%	
≤15	3	6.7	2	4.4	0.405
16-30	7	15.6	2	4.4	
31-45	8	17.8	12	26.7	
46-60	10	22.2	14	31.1	
61-75	16	35.6	13	28.9	
>75	1	2.2	2	4.4	
Total	45	100.0	45	100.0	

Table 1 shows the distribution of age between the Group H and Group MD with percentage distribution of age is maximum in between 61-75 years (35.6%) in Honey group and 46-60 years (31.1%) in Group M.

Table 2: Distribution of Sex between Honey and Debridement Groups

Sex	Honey Group		Debridement Group		p value
	N	%	N	%	
Male	37	82.2	37	82.2	-
Female	8	17.8	8	17.8	
Total	45	100.0	45	100.0	

Table 2shows the sex distribution among the two groups. In this study in both the groups were male predominant i.e. 82.2%.

Table 3: Distribution of ULCER between Honey and Debridement Groups

ULCER	Honey Group		Debridement Group		p value
	N	%	N	%	
Acute	18	40.0	14	31.1	0.509
Chronic	27	60.0	31	68.9	
Total	45	100.0	45	100.0	

Table 3 shows the distribution of ulcers among the groups. In this study most of the ulcers were chronic 60% and 68.9% in honey and debridement groups respectively.

Table 4: Distribution of Organisms Isolated Between Honey and Debridement Groups

Organisms Isolated	Honey Group		Debridement Group		p value
	N	%	N	%	
Pseudomonas aeruginosa	16	35.6	22	48.9	0.200
Klebsiella pneumoniae	22	48.9	17	37.8	0.288
Acinobacter	3	6.7	0	0.0	0.242
E. coli	4	8.9	5	11.1	0.725
Citrobacter koseti	7	15.6	4	8.9	0.522
Klebseilla oxytoca	4	8.9	1	2.2	0.361
MRSA	6	13.3	3	6.7	0.485
Enterococs	2	4.4	1	2.2	0.557

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Staphylococcus aureus	24	53.3	21	46.7	0.674
Aspergillus fumigatus	0	0.0	1	2.2	0.494
Streptococus sps.	0	0.0	1	2.2	0.494

Table 4 shows the organisms isolated between the groups. In this study most common organism isolated was staph aureus 53.3%, K.P 48.9% in honey group, P.A 48.9% and staph aureus 46.7% were isolated in debridement group.

Table 5: Distribution of Organisms Isolated Between Types of ULCERS among Group D

Organisms Isolated	ULCER				p value
	Acute		Chronic		
	N	%	N	%	
Pseudomonas aeruginosa	9	64.3	13	41.9	0.165
Klebsiella pneumoniae	4	28.6	13	41.9	0.392
Acinobacter	14	100.0	31	100.0	-
E. coli	1	7.1	4	12.9	0.569
Citrobacter koseti	0	0.0	4	12.9	0.159
Klebseilla oxytoca	0	0.0	1	3.2	0.497
MRSA	0	0.0	3	9.7	0.228
Enterococs	1	7.1	0	0.0	0.132
Staphylococcus aureus	5	35.7	16	51.6	0.322
Others	1	7.1	1	3.2	0.262
Total	14	100.0	31	100.0	

Table 5 shows the distribution of organisms between the types of ulcers among the debridement group. In this study the most of the ulcers were chronic ulcers and the commonest organism isolated was *Acinobacter* sps.

Table 6: Distribution of Granulation Tissue Time between Honey and Debridement Groups

Granulation Tissue Time (Days)	Honey Group		Debridement Group		p value
	N	%	N	%	
≤10	12	26.7	12	26.7	0.081
11-15	19	42.2	8	17.8	
16-20	9	20.0	12	26.7	
21-25	4	8.9	7	15.6	
26-30	1	2.2	5	11.1	
>30	0	0.0	1	2.2	

Table 6 shows the appearance of granulation tissue among both groups. In this study, in 42.2% patients' granulation tissue was appeared in less than 2weeks in honey group, whereas in debridement group 26.7% patients appeared in 16-20 days.

Table 7: Distribution of Surgery between Honey and Debridement Groups

Surgery	Honey Group		Debridement Group		p value
	N	%	N	%	
SEC Healing	3	6.7	8	17.8	0.3
SS	3	6.7	6	13.3	
STGS	33	73.3	28	62.2	
STGS & SS	3	6.7	2	4.4	
Others	3	6.7	1	2.2	
Total	45	100.0	45	100.0	

Table 7 shows the percentage of definitive treatment in both the groups. In this study 73.3% and 62.2% underwent split thickness skin grafting in honey and debridement group respectively.

Table 8: Distribution of Hospital Stay Between Honey and Debridement Groups

Hospital Stay (Days)	Honey Group		Debridement Group		p value
	N	%	N	%	
≤10	0	0.0	1	2.2	0.004*
11-15	1	2.2	6	13.3	
16-20	4	8.9	3	6.7	
21-25	14	31.1	1	2.2	
26-30	8	17.8	8	17.8	
>30	18	40.0	26	57.8	

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Total	45	100.0	45	100.0	

Note: *means significant at 5% level of significance (p<0.05)

TABLE 8 shows the length of hospital stay in days among the two groups. In this study, 40.0% in honey group and 57.8% in debridement group were discharged after one month which was statistically significant with p value 0.004. 31.1% in honey group were discharged by 3 weeks, 17.8% in debridement group were discharged by 4 weeks.

Table 9: Distribution of Complications between Honey and Debridement Groups

Complications	Honey Group		Debridement Group		p value
	N	%	N	%	
BKA	1	2.2	0	0.0	0.408
Graft Rejection	2	4.4	2	4.4	
Post Op Oozing	2	4.4	0	0.0	
Post Op Oozing & Graft Rejection	1	2.2	0	0.0	
No	39	86.7	43	95.6	
Total	45	100.0	45	100.0	

The table compares complications between the "Honey Group" and the "Debridement Group" following a treatment. Both groups had a similar rate of graft rejection (4.4%). The Honey Group exhibited more incidents of Below Knee Amputation (BKA), post-operative oozing, and combined post-op oozing & graft rejection than the Debridement Group. However, a greater percentage of the Debridement Group (95.6%) had no complications compared to the Honey Group (86.7%). The p-values provided help determine if these differences are statistically significant, with values below 0.05 typically indicating significance. The only given p-value, 0.408 for BKA, suggests no significant difference between the groups for that complication.

Discussion

In this study 42.2% in honey and 26.7% in debridement group had healthy granulation tissue within 11-15 days and 16-20 days respectively. The mean time for appearance of healthy granulation tissue was 14.7±5 days in honey group and 17.9±5.4 days in debridement group which was statistically significant (p=0.025) which is like study done by Anand SR et al 2014. The mean duration of granulation tissue by topical application of honey was 18.1±5.5 days and another study done by Subramanyam M, showed honey dressing significantly stimulated the rate of burn wound healing demonstrated by formation of granulation tissue and reduction in wound size especially after 21 and 28 days after burn.

In another study done by H. Maghsoudi *et al*., showed clinical evidence of granulation tissue formation and epithelisation of raw areas was observed in comparative study between 42 patients in honey group and 42 patients in mafenide acetate group. In honey treated patients all wound healed by 21 days (100%) compared to 42 patients (84%) (p<0.001) in the mafenide acetate group. In a study done by Sonia G *et al*. 2015 showed 31% of subjects in honey dressing group achieved complete healing of chronic wounds at 6^{th} week.

Another study done by Mehdi *et al*. Conducted metanalysis to evaluate the efficacy of honey in observational studies and clinical trials. The mean duration of hospital stay in the study was 34.1±15.7 days in honey group and 36.0±15.8 days in debridement group. In a study done by Anand SR *et al*. mean duration of hospital stay was 26.4±3.1 days whereas in study H. Maghsoudi *et al*. 2011 comparison between honey and mafenide acetate in the treatment of burn wounds the mean hospital stay in honey treated group was 22±1.2 days versus 32.3±2 days in a mafenide acetate group (p<0.005) which is significant.

To conclude, all patients with chronic wounds with biofilm were effectively managed with the topical application of honey when compared to the mechanical debridement with povidone iodine dressings with significant appearance of healthy granulation tissue, mean duration of healing of wounds and the hospital stay is less in the patients treated with topical honey. Honey dressing is more effective when compared to the mechanical debridement with povidone iodine dressing in achieving complete healing, reducing the hospital stay and increasing the comfort (i.e., repeated debridement under local or spinal anesthesia and cost and pain will be more in subjects with debridement) to the subjects with chronic wounds. There were no side effects or reactions found in subjects treated with honey except the pain which was due to low P^H of honey.

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