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CASE STUDY

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THE EFFECTIVENESS OF INDONESIAN HONEY ON DIABETIC FOOT ULCERS HEALING PROCESS: OBSERVATIONAL CASE STUDY

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ABSTRACT

Diabetic foot ulcers were common diabetes complication that progressively growth globally. The study aimed to investigate the effectiveness of Indonesian honey and its factors associated with the wound healing process. This study design was an observational case study. This study was conducted among type 2 diabetes with diabetic foot ulcers in Griya Afiat Homecare and ETN Center in Makassar City, Indonesia from March to June 2014. The Bates Wound Assessment Tool (BWAT) were used to collect the score of diabetic foot ulcer healing process regarding wound size, depth, edges, undermining, necrotic tissue type, necrotic amount, granulation, epithelization, exudate type and amount, surrounding skin color, edema, and induration. Descriptive, Independent *t*-test, Analysis of Variance (ANOVA) and Wilcoxon signed rank test were conducted appropriately. In total, ten types 2 diabetes patients with diabetic foot ulcers participated. The factors associated with wound healing process were diabetes treatment ($t= 2.44, p= 0.041$) and primary dressing ($t= -2.76, p= 0.025$). The effect of honey primary dressing was in reducing wound size ($p= 0.043$), improving necrotic tissue type ($p= 0.041$), reducing necrotic tissue amount ($p= 0.042$), increasing granulation ($p= 0.038$) and epithelization ($p= 0.042$). In the counterpart, the effect of modern dressing was in improving necrotic tissue type ($p= 0.046$) and increasing granulation ($p= 0.042$). Indonesian honey is beneficial on diabetic foot ulcers healing process. The findings suggest that honey should be considered as the alternative, cost-effective, and beneficial wound dressing on the diabetic foot ulcers.

Keywords: Indonesian Honey, The Bates Wound Assessment Tool, Diabetic Foot Ulcers

1. Introductions

Diabetes mellitus is the chronic metabolic disease which growth in both developed and developing countries (1). The high prevalence of diabetes is predicted to be 9.5 billion in 2045 worldwide (1). The complication of diabetes could be a macro or micro-vascular complication that will be burden diabetes people in their daily activity (2-4).

One of the significant complications is diabetic foot ulcer (5,6). The prevalence of diabetic foot ulcers was high in both western or eastern countries, which about 6.3% of the diabetes population (6). This number could be higher since type 2 diabetes increase globally (1,6). In the previous study found that the number of diabetic foot ulcer was 16.2% of Indonesian diabetes inpatient (5). Moreover, the impact of diabetic foot ulcers on diabetes patients were not solely physically complication or even death but also the economic aspect (5,7).

Diabetic foot ulcers were developed by sensory and autonomic damaged, lower extremity deformity, and also worsen by external or internal trauma repetition (8,9). The repetitive trauma on the lower extremity might be the challenge of Indonesian type 2 diabetes since the habit of this population commonly wears inappropriate footwear or even barely foot in their daily activity that increases the risk of diabetic foot ulcers (10). Furthermore, the initial caused of diabetic foot ulcers were usually unrecognized by the patients (5). In addition, it was frequently difficult to assess when the diabetes patient suffered from the numbness of lower extremity due to sensory damaged (8). Commonly, the complication of lower extremity turns into a complicated and costly problem (8). High prevalence of delayed treated wound that turns into an infected wound was found and led to amputation or even death (5).

Diabetic foot ulcers were curable when comprehensive wound care management was integrated (11). Controlling blood pressure, performing appropriate debridement, choosing beneficial dressing, and preventing offloading is the recommended part of wound care (11). Nowadays, modern dressing occurs to be applied in wound care such as film, foam, hydrogels, hydrocolloids, alginate dressing, and medicated dressing (12). However, these dressing may not be affordable and accessible for diabetes patients, especially for people in a rural area in Indonesia. Since modern dressing may not be covered by health insurance, therefore diabetes patients need cost-effective, affordable, and beneficial dressing.

Hence, honey is established as a contemporary dressing that effective to improve wound healing and reduce the possibility of abnormal bacterial growth (13). A lot of studies had reported the effect of Manuka honey or *Leptospermum* honey on the wound healing process (14-17). However, the published research on the benefit of Indonesian honey on diabetic foot ulcers is still lack. Therefore, we conducted the study to investigate the effect of Indonesian honey on the diabetic foot ulcers healing process.

2. Objectives

The study aimed at examining the effect of Indonesian honey and modern dressing on wound healing score and its factors associated with wound healing score

3. Methods

This observational case study was conducted from March to June 2014. Eligible participants were recruited from Griya Afiat Homecare and ETN Center Makassar, Indonesia, which provided the homecare for a patient with diabetic ulcers. We used consecutive sample to collect the participants. The eligible participants were recruited if they met the inclusion criteria: (1) had diabetic ulcers, (2) obtained primary honey dressing or modern primary dressing, (3) received wound care regularly (4) voluntarily enrolled. We excluded participants if they had allergic to honey and planned for amputation.

Trained wound care nurses in both of Griya Afiat Homecare and ETN Center conducted wound care. We observed the diabetic ulcers healing process of 5 participants who were treated regularly with the honey of pure nectar of Kapok flowers (Nusantara®, Jakarta, Indonesia) as a primary dressing and 5 participants with modern primary dressing (silver-containing dressing, cadexomer, and antimicrobial dressing) for 2-week. We scored a healing process in the first observation as pre-test score and after 2-week

Health Department of Makassar City and Governor of South Sulawesi had approved the study protocol and informed consent form. All of the participants were understood and voluntarily enrolled and had been validated before securing informed consent form. We collected demographic data (e.g., age and gender) and participants' characteristics (e.g., diabetes medication, primary dressing, a secondary dressing, tertiary dressing, and pre-test and post-test wound healing score).

The Bates Wound Assessment Tool (BWAT) was used to assess the progression of wound healing score (18). The BWAT has 13 items with Likert scale 1 to 5 (wound size, depth, edges, undermining, necrotic tissue type, necrotic amount, granulation, epithelization, exudate type and amount, surrounding skin color, edema, and induration). The score of BWAT indicates that the less wound healing score, the healthiest wound healing patients had. We calculated the score for each item and the total score of BWAT. The permission used of BWAT is already given freely for the researcher, expert wound care, or novice nurse, and it has been validated (18).

IBM SPSS 21.0 (SPSS, Chicago, IL, USA) was used to analyze the data. The descriptive analysis was used to describe demographic and participants' characteristics in percentage, frequency, mean, and standard deviation. An independent *t*-test and one-way analysis of variance (ANOVA) were used to assess factors associated with wound

healing score. Furthermore, we used the Wilcoxon signed rank test to investigate the difference between pre-test and post-test score for 13 items of wound healing in Indonesian honey and new primary dressing group. The significance level was set to 0.05.

4. Results

In total, ten patients with diabetic ulcers enrolled in this study. Table 1 presents the demographic and characteristic of the participants. The majority of the participants were female and middle age adults (45 – 59 years old). Most of them did not take diabetic medication (oral medication or insulin). Half of the participant used Indonesian honey as a primary dressing, and others used modern primary dressing with silver-containing dressing, cadexomer, and antimicrobial dressing. The medicated dressing was mostly used in patients as a modern secondary dressing. The majority of participants used elastic dressing or combined it with gauze as a modern tertiary dressing. The average of wound healing pre-test score on the honey group and modern primary dressing was 34 (SD= 7.90) and 43.8 (SD= 5.26), respectively. After 2-week observation, the wound healing post-test score on the honey group and modern primary dressing was 28.2 (SD = 7.59) and 39.2 (SD= 4.65), respectively.

Table 2 presents the factors associated with wound healing score. This study found there was a significantly different mean score of wound healing between patients who did not take diabetes medication and patients with diabetes medication ($t = 2.44, p = 0.041$). The finding also showed that patients who used honey as a primary dressing had significant better wound healing score than modern primary dressing ($t = -2.760, p = 0.025$).

Table 3 presents the association between honey and modern primary dressing on each wound-healing item. This study found that honey primary dressing was significantly associated with decreasing wound size ($p = 0.043$), improving necrotic tissue type ($p = 0.041$), decreasing necrotic tissue amount ($p = 0.042$), increasing granulation tissue ($p = 0.038$) and increasing epithelization ($p = 0.042$). In the counterpart, the modern primary dressing was significantly associated with the improvement of necrotic tissue type ($p = 0.046$) and increasing granulation tissue ($p = 0.042$).

Table 1. Participants' demography and characteristic (N = 10)

Variables	N (%)	Mean (SD)
Age		
< 45 years old	1 (10)	
45 – 59 years old	6 (60)	
>59 years old	3 (30)	
Gender		
Male	3 (30)	
Female	7 (70)	
Diabetes medication		
Yes (oral medication or insulin)	4 (40)	
No	6 (60)	
Primary dressing		
Honey	5 (50)	
Modern dressing	5 (50)	
Secondary dressing		
Gauze	1 (10)	
Modern dressing	9 (90)	
Tertiary dressing		
Gauze	1 (10)	
Elastic dressing/ Combination of Gauze and dressing elastic	9 (90)	
Wound Healing Pre Test Score		
Honey		34 (7.90)
Modern Primary Dressing		43.8 (5.26)
Wound Healing Post Test Score		
Honey		28.2 (7.59)
Modern Primary Dressing		39.2 (4.65)

Note: *descriptive analysis*

Table 2 Factors associated with wound healing score (N=10)

Variables	Wound Healing Level	
	F/t	P
Age ^a	1.323	0.326
Gender ^b	1.870	0.098
Diabetes Treatment ^b	2.440	0.041*
Primary dressing ^b	-2.760	0.025*
Secondary dressing ^b	0.703	0.502
Tertiary dressing ^b	1.120	0.295

Note: ^a Analysis of Variance (ANOVA), ^b Independent T-test analysis, * $p < 0.05$, ** $p < 0.01$

Table 3. The relationship of honey or modern primary dressing and wound healing items (N=10)

Wound Healing Items	Honey (n= 5)	Modern Primary Dressing (n= 5)
	p	p
Size	0.043*	0.109
Depth	0.083	1.000
Edges	0.276	1.000
Undermining	0.157	1.000
Necrotic Tissue Type	0.041*	0.046*
Necrotic Tissue Amount	0.042*	0.066
Exudate Type	0.705	0.317
Exudate Amount	0.655	0.180
Skin color surrounding wound	0.317	0.317
Peripheral Tissue Edema	0.317	0.180
Peripheral Tissue Induration	0.317	1.000
Granulation	0.038*	0.042*
Epithelization	0.042*	0.180

Note: Wilcoxon Signed Rank Test Analysis, * $p < 0.05$, ** $p < 0.01$

5. Discussion

We found that patients who took diabetes medication had poor diabetic foot ulcers healing. The finding is contrary to the previous study (19). The diabetes medication helps the patient to control the blood glucose level associated with diabetes complication (3,4). Zoungas et al. (2017) showed that monitoring HbA1c could lower the

20% of kidney disease and 13% of eye disease events (3). However, the participants of this study who did not take any medicine had better wound healing process because they might control their blood glucose level by managing their diabetes care behavior. Most of them think that they don't want to rely on medicine and prefer to manage their diabetes care by following the suggested diet, fasting, and engaging in exercise by their capability.

Our finding showed that participants with honey primary dressing associated with better wound healing score. The previous studies support this result (13,16,17,20). Further analysis also revealed primary honey dressing could improve wound size, necrotic tissue type, reduce necrotic tissue amount, increase granulation, and enhance epithelization. Honey had been reported to be useful to shorten wound healing time (21). Debridement is the wound care part that decreases necrotic tissue amount (7), and honey was showed to facilitate the autolytic debridement by softening necrotic tissue type (13,17).

The process of wound healing consists of the inflammatory phase, proliferative phase, and remodeling phase (22). In the inflammatory phase, honey could suppress this phase by activating neutrophils and macrophages (23). Moreover, the role of antibacterial in honey was already published (24,25). Antibacterial content of honey such as the acidity and non-peroxide activity is beneficial to reduce microorganism in wound surface (21,24,26,27). Therefore, honey may prevent the delayed wound healing process due to the unnecessary infection.

In the proliferative phase, honey has an effect on stimulating blood vessels growth and accelerating angiogenesis, which lead to improving granulation (23,28). Honey increases the activity of myofibroblast in the granulation tissue. Fibroblast stimulation could release the element of connective tissue such as collagen which turns in to wound edges restoration and lead to wound size reduction (23). Furthermore, in the remodeling phase, honey had been reported to increase epithelization (28).

6. Conclusion

The effect of Indonesian honey on the diabetic foot ulcers healing process was revealed in this study. It may suggest the health care professionals consider in establishing honey content dressing, which is more achievable, affordable, beneficial, and cost-effective dressing. Hopefully, in the future study, we may develop the study with a better method, more study sample, and produce Indonesian honey-content dressing for wound care.

7. Acknowledgment

Before interpreting the results, we may consider the strength and weakness of this study. This study investigated the wound healing process in detail for each specific wound-healing item. However, due to the limited study period, the total sample of this

study was few. The homogenous of the sample in both groups was also challenging to achieve. Therefore, gain more study sample is suggested for developing a future study.

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