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Original Research Article

Reduction of *Staphylococcus aureus* bacteria collaboration in diabetic ulcers by giving virgin coconut oil

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ABSTRACT

Background: Diabetic ulcers often result in amputations. The bacteria found in diabetic ulcers are *Enterobacter sp*, *Staphylococcus aureus*, *Salmonella sp* and *Pseudomonas sp.* Nursing management of ulcer patients has been attempted but nothing has been effective yet. Using virgin coconut oil (VCO) contains anti-inflammatory, antipyretic and has an analgesic effect to increase the formation of new blood vessels with faster wound healing. Aim was to study the effect of wound care by giving VCO on the colonization of *Staphylococcus aureus* bacteria in diabetic ulcers.
Methods: Quasi-experimental research with the two-group pre-test and post-test design approach involved 36 diabetic ulcer patients with consecutive sampling by doing wound care for 4 days. The duration of treatment was 30-40 minutes. Data was taken by swab on wound fluid before and after the intervention. Bivariate analysis carried out t-independent test of DM ulcers.
Results: The results showed the average number of colony staphylococcus in the intervention group before being given wound care with VCO 72.88, while after being treated with 38.88 wound VCO and the average results of the number of colony staphylococcus in the control group before being treated with NaCl 77.88, whereas after being treated with VCO 38.88 wound with NaCl 72.88 in the statistical test the p value is 0,000.
Conclusions: There was a significant influence between the number of colony *Staphylococcus* in the control group and the intervention group.

Keywords: Diabetic ulcer, Virgin coconut oil, Wound care

INTRODUCTION

Diabetes mellitus (DM) is a chronic disease whose incidence continues to increase throughout the year.[1] One complication that occurs is diabetes ulcers. Diabetic ulcers are a problem in DM patients because they often lead to amputation.[2] Diabetic ulcers are superficial infections that occur on the surface of the skin of DM patients. The risk of ulcers in DM patients is 29 times greater than for patients without DM. The risk of death will increase 2.5 times in DM patients with ulcers, compared with DM patients without ulcers.

The entry of bacteria becomes the beginning of ulcers and high sugar levels become a strategic place for bacterial development. The bacteria contained in diabetic ulcers were *Enterobacter sp* (10.71%), *Staphylococcus aureus* (17.85%), *Salmonella sp* (82.15%), and *Pseudomonas sp* (17.86%).[3] DM ulcers are not enough to be treated only by using antibiotics, and treatment of DM ulcers must be accompanied by wound care or rehabilitation by a surgical specialist. Antibiotics are only suitable for acute wounds. DM ulcer is a chronic wound so antibiotic resistance often occurs. Dirty wounds will become difficult to heal because the inflammatory process

continues to occur. This can be corrected by treating wounds.

One of the bacteria that often causes infection in DM ulcers is *Staphylococcus aureus*. These bacteria form biofilms at the base of the wound making it difficult for phagocytosis of neutrophils. This causes the bacteria to live longer and slow the wound healing process.[3]

Wound healing consists of several phases, including the inflammatory, proliferation and remodeling phases. Normal wounds will heal for 7-10 days. The duration of the wound healing phase is influenced by many factors, one of which is the condition of hyperglycemia. In DM patients wound healing lasts longer.

Wound care is one of the nursing actions that aims to provide a conducive environment so that the wound can be handled properly. Modern wound care has found that wound care using a moist method is much more effective for wound healing. In addition to stimulating wound granulation, wound care using a moist method also prevents infection.[4] So far conventional wound care has not shown faster wound tissue repair. Wound treatment methods using natural ingredients are expected to accelerate the repair of DM ulcers.

Wound care can be done using ingredients that come from nature. Many of these natural ingredients contain anti-inflammatory, antibacterial, antioxidant and can stimulate collagen growth. The use of natural materials has been widely used by the community, both for the management of acute or chronic wounds.[5]

Virgin Coconut Oil (VCO) is one of the natural ingredients that can be used for wound care. VCO is made from fresh coconut milk which is fermented into oil. Indonesia is one of the main coconut producers in the world.[6] Coconut has also been used by many people in daily life. This makes VCO easy to obtain for the public. VCO is used as a companion to conventional wound care. Giving is done by applying VCO to the wound surface after the wound is cleaned using physiological NaCl.

VCO contains anti-inflammatory, antipyretic and has analgesic effect. VCO can increase the formation of new blood vessels in wounds.[7] Good flow of nutrients and oxygen can accelerate wound healing. In addition, VCO also has a high antioxidant content that can help the wound healing process. An in-vitro study proves that lauric acid found in VCO can reduce the colonization of *Staphylococcus aureus* bacteria. In addition, lauric acid can also stimulate collagen growth so that it can repair wounds more quickly.[8] The purpose of this study was to study the effect of VCO administration on colonization of *Staphylococcus aureus* bacteria in DM ulcers in DM patients in Padang Indonesia.

METHODS

Quantitative research with quasi-experimental design, pre and post-test control group design is research that gives treatment to DM ulcer patients. It was held on 12 March - 13 May 2020 at RSUD Dr. Rasidin Padang. The population in this study was DM ulcer patients in the city of Padang. The sample was 32 patients who met the inclusion and exclusion criteria. Patients were divided into 2 groups: 16 people as a control group and 16 people as an intervention group. Inclusion criteria: patients with DM ulcers who did not use herbs during wound care. The exclusion criterion was severe illness during the study. The study was conducted at the patient's home. Wound care is done once a day for 4 times. The length of time needed for 1x treatment is 30-40 minutes. Duration of administration for 1 week. Data taken by swab on wound fluid. Pre-test data were taken on the first day before the wound was cleaned. Post-test data were taken on the last day after the wound was cleaned. Data was collected with a colony counter then processed with SPSS using independent t test. Sterile wound care sets consisting of: anatomical tweezers, syringes, sterile coma, sterile gauze, and physiological NaCl, colony counters and observation sheets, VCO obtained from HPA products International. Material for taking wound swabs: sterile cotton swabs, physiological NaCl, sterile gauze, sterile test tubes, labels and markers. Working procedures: Clean the wound with sterile gauze and physiological NaCl carefully, wipe sterile cotton swab into the DM ulcer without affecting the wound edges, enter the swab into the test tube, close the bottle, label and bring to the laboratory. Wound care is done once a day for 4 days, with 40-60 minutes long wound care. Before the colony was counted, a bacterial culture was carried out first. Each test bacterium was inoculated on Muller-Hinton agar (MHA) by zigzagging closely from the ground up using an ose and spider needle and incubated in an incubator for 24 hours at 37^0C. Bacteria that have been incubated and grown on MHA agar with a round loop needle and bacterial staining are done using gram staining to ensure staphylococcus bacteria. The following day, the test bacterial suspension was diluted using a manually diluted formula (equivalent to 0.5 McFarland), (0.1 µL ulcer sample and 100 µL (Nacl). After absorbance was produced in this range, the bacterial suspension was diluted again so that the final bacterial count was obtained, contained in each one well plate is equivalent to approximately 1/dilution factor (1/10-8) CFU/mL calculation of the number of colonies using the cup calculation method. The principle of the cup calculation method is if the living microbial cells are grown on a medium so microbial cells will multiply and form colonies that can be seen directly with the eye without using a microscope. The pour plate method is a microbial calculation method where the dilution and the media are provided first. The dilution is piped as much as 1 ml or 0.1 ml. This cup is first sampled piped into a petri dish and then inserted in the media agar. It was tested by independent test.

RESULTS

Based on table 1, it was found that more than half of the 78.13 respondents were female. Table 2 showed the average number of colony *Staphylococcus* in the intervention group before being given wound care with VCO was 72.88, while the number of colony *Staphylococcus* after being given wound care with VCO was 38.88. Based on Table 3, the average number of colony staphylococcus in the control group before being treated with NaCl was 77.88, while the number of colony staphylococcus after being treated with NaCl was 72.88.

Table 1: Gender frequency distribution of VCO administration against colonization of *Staphylococcus aureus* bacteria in diabetic ulcers (n=32).

Gender	Frequency (F)	Percentage (%)
Male	7	21,87
Female	25	78,13

Table 2: The average effect of wound care with VCO on colonization of *Staphylococcus aureus* bacteria in diabetic ulcers.

Variable	Mean	N
Average number of colony staphylococcus before VCO administration	72.88	16
Average number of colony staphylococcus after VCO administration	38.88	

Table 3: The average effect of wound care with NaCl administration on colonization of *Staphylococcus aureus* bacteria in diabetic ulcers.

Variable	Mean	N
The Mean number of colony staphylococcus before administration of NaCl in the control group	77.88	16
The mean number of colony *staphylococcus* after administration of NaCl in the control group	72.25	

Table 4: Effect of wound care by administering VCO on colonization of *Staphylococcus aureus* bacteria in bacterial ulcers in the control and intervention groups.

Variable	Mean	SD	P	N
Average influence of wound care with VCO on colonization of *Staphylococcus aureus* bacteria in control and intervention diabetic ulcers	33.375	5.020	0.000	32

Based on table 4, the value of p=0.000 (p.0.05) which means there is a significant difference between the number of colony *Staphylococcus* in the control group and the intervention group.

DISCUSSION

The most influential thing in chronic wound healing such as DM ulcers is the amount of colony staphylococcus present in the wound. The biofilm layer produced by staphylococcus is a mechanical barrier to wound healing. Biofilm coating occurs 60% in chronic wounds and 6% in acute wounds. The biofilm layer prevents contact between the antibacterial and the wound surface. The biofilm layer which is in the wound is resistant to irrigation performed with 0.9% NaCl. Based on the results of the study the number of colony staphylococcus treated wound using NaCl 0.9% on average amounted to 72.25 by using a 10-8 dilution. The amount of colony is lower than the amount of colony *Staphylococcus* before wound care, which is 77.88 with the same dilution. Lower results were shown by the number of colony staphylococcus in the intervention group with an average colony number of 38.88. The antibacterial content of VCO can damage bacterial cells thereby inhibiting the growth of Staphylococcus bacteria.[9]

NaCl 0.9% is a bactericidal liquid, works by diluting and destroying the outer membrane of bacteria, and after the membrane is destroyed, electrolysis of NaCl produces free chlorine, such as HCLO, Cl_2 and Cl-. This chlorine will interact with bacterial enzymes and destroy the peri plasma and inner membrane so that the cytoplasm can get out of bacterial cells resulting in bacterial cell death.

NaCl 0.9% also gives a moist environment to the wound. Humid environment can help break down necrotic tissue in the wound. Performing wound care with NaCl can reduce the number of staphylococcus bacteria and clean the wound from necrotic tissue. Conventionally, if the biofilm layer is too thick, debridement of the wound is done to remove the biofilm layer in the wound. Regular debridement can accelerate wound healing.[10]

VCO contains the main active ingredient, lauric acid. Lauric acid contains antibacterial which can kill gram-positive bacteria.[11] Lauric acid in VCO inhibits enzymes for bacterial growth so that it is effective in reducing colony *Staphylococcus.*[12] Based on the results of the study there were significant differences between the control group and the intervention group. Lauric acid can also damage bacterial cell membranes so that they interfere with protein signaling for bacterial cell growth.[13,14] As a result, bacteria will die. The reduced number of colony staphylococcus will be accompanied by a reduction in the thickness of the biofilm layer in the wound.[15]

In addition, VCO contains anti-inflammatory which can reduce the inflammatory process so that swelling, redness

and pain can be reduced. The VCO content also provides a moist environment for wounds. This helps the wound healing process.[16,17]

CONCLUSION

VCO can reduce the number of colony staphylococcus in DM ulcers so that VCO can be used to treat wounds especially DM ulcers at home.

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