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Effectiveness of Hydro Pressure Techniques on Biofilm Removal for Diabetic Ulcuses Patients at Wocare Indonesia

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ABSTRACT

Diabetic ulcer wounds that occur in patients with diabetes that involve disorders of the peripheral and autonomic nerves. Diabetic wounds are a significant complication of diabetes and a global public health problem. There has been no wound-washing intervention using the hydro pressure technique as a wound washer tool for diabetic ulcer Biofilm. The aim is to determine the effect of the hydro pressure technique as a wound washer on biofilm for diabetic foot ulcer patients. The methodology research in this study used the pre-experimental method with a pre-test and post-test approach. The sampling technique was carried out using total sampling. The total sampling of this study is 25 respondents in criteria inclusion in this area. The research instrument used was a biofilm observation sheet. The statistical tests used were univariate and bivariate, using paired sample t-tests. The results show that there is a significant difference between the values of the biofilm observation sheet before hydro pressure is performed and after hydro pressure is performed on diabetic ulcer patients. The hydro pressure technique can reduce the average value of biofilm in the wound healing process. This research contributes to recommending that diabetic ulcer sufferers use the hydro pressure technique to remove biofilm in the wound healing process.

Keywords: Hydro Pressure Techniques, Biofilm, Diabetic Ulcuses, Wound Care, Diabetes Care

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1. INTRODUCTION

Diabetes mellitus (DM) type 2 is a group of metabolic diseases characterized by hyperglycemia that occurs due to defects in insulin secretion, insulin action, or both and clinically appears when the body is no longer able to produce enough insulin to compensate for increased insulin resistance (Batista et al., 2021; Decroli et al., 2019; Galicia-Garcia et al., 2020). This situation has a lot to do with unhealthy lifestyles, such as lack of movement and ready-to-eat food, which is consumed more and more every day (Amera et al., 2022; Garg & Duggal, 2022; Herrera et al., 2021). Type 2 diabetes mellitus is also known as non-insulin dependent DM (Non Insulin Dependent Diabetes Mellitus or NIDDM), which is caused by a decrease in target tissue sensitivity to the metabolic effects of insulin, which is often referred to as insulin resistance (Banu & Sur, 2023; Lee et al., 2022; Sbraccia et al., 2021). Currently, diabetes mellitus is one of the most common chronic diseases in Indonesia and worldwide. In Indonesia, diabetes mellitus is the third highest cause of death (6.7%) after stroke and coronary heart disease (Wahidin et al., 2024). In the United States, diabetes mellitus is the seventh leading cause of death (Buscemi et al., 2021). Diabetes mellitus is the ninth-highest cause of death worldwide (Khan et al., 2020).

In 2019, the prevalence of diabetes mellitus in the world was around 9.3% and is expected to increase to 10.2% in 2030. In 2018, the prevalence of diabetes mellitus in Indonesia increased by 0.5% from 2013 to 2%. However, the prevalence of people with blood sugar levels above normal increased to 8.5%

compared to 2013, which was only 6.5%. WHO predicts that the number of people with diabetes mellitus in Indonesia will continue to increase to 21.3 million people in 2030. Around 90% of people with DM are type 2 (Wijaya et al., 2021). According to the study by Alsabek & Abdul Aziz (2022) and Chai et al. (2020), diabetic ulcers are one of the most common complications experienced by people with diabetes. According to Lu et al. (2024), a diabetic ulcer is a full-thickness wound that destroys deep tissue, progressing to the distal ankle associated with neurological disorders.

The wound healing process consists of three phases: inflammatory, proliferative, and maturation (Ayadi et al., 2020; Masson-Meyers et al., 2020). Proper wound care is essential because it determines the accelerated growth of new tissue (granulation), including capillaries, collagen, and fibroblast cells, which are new cells damaged by bacteria during a diabetic ulcer (Dixon & Edmonds, 2021). Wound washing aims to improve visualization of the wound bed and edges, remove organic and non-organic matter, and remove excess exudate (Rezvani Ghomi et al., 2023). Indications for washing a wound are showing signs of infection, being contaminated with dirt, which can increase the risk of infection, and having dirt such as sand or remnants of dressings on the wound (Holloway, 2020; Powers & Rogers, 2022).

One solution that is widely used in clinical practice is hydro pressure. Several researchers have practiced the hydro pressure technique in self-care. Research by Le et al. (2020) used hydro pressure treatment to repair and care for the skin. According to research by Zhang et al. (2022), the hydro pressure technique can deactivate dangerous tissue cells without chemicals. Research by Mirmoezzi et al. (2021) used a semi-experimental method of applying hydrotherapy treatment to patients with non-specific low back pain, and the results showed that the patient's condition improved after ten sessions. Apart from that, hydro pressure is also used in the food industry. Research by Pallarés et al. (2021) shows that high-pressure technology reduces aflatoxins in fruit juice. Research by Malinowska-Pańczyk (2020) uses hydro pressure to preserve breast milk in the beverage industry. Based on previous research, hydro pressure is widely used by humans for self-care and preserving food. In contrast to these studies, the novelty of this research is the use of high-pressure techniques for diabetic ulcer patients. Washing wounds using hydro pressure is expected to maintain wound moisture, facilitate cell movement, and speed up granulation. This study aimed to determine the effect of the hydro pressure technique as a wound wash on biofilm in patients with diabetic foot ulcers.

2. METHOD

This research design is a type of quantitative research using a pre-experimental design with a pre-test and post-test approach without a control group as a comparison. The total sampling for this study was 25 respondents, in the inclusion criteria, who had diabetic ulcers in July 2023 and who visited for routine control at the Wocare Canter Bogor. The instrument for this study used the biofilm assessment sheet. The biofilm assessment sheet is a measuring instrument containing several questions that refer to the characteristics of biofilm in diabetic wounds and demographic data from respondents. The characteristics of the biofilm sheet are 8 points, namely the color of the wound is bright red, there is a shiny layer on the surface of the wound, the edges of the wound do not blend with the wound bed, the wound is contaminated, there is exudate, and there is a slimy layer.

Data processing in this study has several stages. For example, the researcher will input data from the study results and interviews on the BEAT sheet. Re-checking to anticipate errors or lack of data needed for answers given by respondents. The coding stage for grouping data from the answers given by respondents according to research variables. The purpose of coding is to simplify the tabulation process and the next stage of data analysis. Next, the data processing stage involves entering data into a table with a statistical program on the computer. The statistical hypothesis is that there is a significant difference between the values of the biofilm observation sheet before and after hydro pressure is performed on diabetic ulcer patients. Statistical hypothesis testing was carried out using the paired sample T-test on the average difference between the pre-test (before treatment) and post-test (after treatment).

3. RESULTS AND DISCUSSION

3.1. Results

Table 1 below is the results of characteristics of respondents based on age, gender and history of hypertension.

Table 1
The Results of Characteristics of Respondents Based on Age, Gender and History of Hypertension

Characteristics	Frequencies	Percentage
Based on age		
Adult (36-45)	4	16
Early elderly (46-55)	6	24
Late Elderly (56-65)	10	40
Elderly (>65)	5	20

Based on gender		
Man	12	48
Woman	13	52
Based on history of hypertension		
Hypertension	17	68
Not hypertension	8	32

Table 1 shows the characteristics of respondents based on age, gender, and history of hypertension. Most respondents were aged 56-65 years, with a percentage of 40. The majority of respondents were female, with a percentage of 52. The majority of respondents had a history of hypertension, with a percentage of 68.

Table 2
Distribution of Frequency Based on Measurement of Diabetic Wounds with Biofilm Before and After

Observation	Mean	Std. Deviation
Pre-test	7.48	586
Post-test	3.32	748

Based on Table 2, the average value of the observation was 7.48 from 8.00 during the pre-test to 3.32 from 8.00 during the post-test. Based on the study of 25 respondents with diabetic ulcers, it was found that all respondents had biofilm during the pre-test and there was no biofilm during the post-test. The hydro pressure technique is able to reduce the average value of biofilm in the wound healing process.

Table 3
Differences in Value of Biofilm Assessment Sheet Before and After

Results	N	Mean	Std. Deviation	P-value
Pre-test	25	7.48	586	0.000
Post-test	25	3.32	748	

Based on Table 3, Statistical hypothesis testing was carried out using a paired sample t-test obtained a p-value of 0.000 ($p < 0.05$) which means H0 is rejected and H1 (alternative hypothesis) is accepted which means there is a difference between the values of the biofilm observation sheet before hydro pressure is performed and after hydro pressure is performed on diabetic ulcer patients. The hydro pressure technique is significantly able to remove biofilm in the wound healing process.

3.2. Discussion

Bivariate results by testing the difference in the value of the biofilm observation sheet before and after hydro pressure was carried out using a paired sample t-test obtained a p-value of 0.000 ($p < 0.05$) which means H0 is rejected and H1 (alternative hypothesis) is accepted which means there is a difference between the values of the biofilm observation sheet before hydro pressure is performed and after hydro pressure is performed on diabetic ulcer patients. Based on the results, the average value of the observation was 7.48 from 8.00 during the pre-test to 3.32 during the post-test. Based on the study of 25 respondents with diabetic ulcers, it was found that all respondents had biofilm during the pre-test and there was no biofilm during the post-test. So it can be concluded that the use of hydro pressure is effective as a wound washer fluid for diabetic ulcer wound biofilms.

This is in line with research conducted by Nurlany et al. (2021) which examined the effectiveness of using hydro pressure wound cleaning liquid in reducing biofilm in diabetic foot ulcers where in each case there was a decrease in the good score with hydro pressure wound cleaning fluid. scores occur both as a whole and which focus on the condition of the biofilm, one of which is characterized by a decrease in exudate in the wound. In the study it appears that when there is a biofilm on the wound, granulation tissue will not be visible in the wound because it is covered by the biofilm and will inhibit the wound from healing. This is as stated in Percival et al. (2014), Deng et al. (2022) and Gardezi et al. (2021) where wound recovery is also influenced by factors, such as: bacterial infections that produce biofilms, potassium levels, and wound fluids. The presence of biofilm on the wound bed can inhibit phagocytic activity of polymorphonuclear neutrophils. The presence of a bacterial biofilm is thought to be a barrier to the wound's natural progression toward healing. Biofilms play an important role in the inability of chronic wounds to heal. It is estimated that more than 90% of chronic wounds contain bacteria and fungi that live in biofilms (Alves et al., 2021; Liu et al., 2024).

In all diabetic patients, wounds are handled using the 3M method, namely washing, removing dead tissue, and changing dressings (Farahani & Shafiee, 2021; Laurano et al., 2022). To remove the biofilm in

the wound, use methods such as washing the wound using the hydro pressure technique, washing it clean, drying it using gauze, cleaning the biofilm using gauze or using a mechanical debridement technique, namely using scissors, tweezers, and gauze. Biofilm greatly inhibits the wound process towards healing, one of which is inhibiting the wound epithelial process, due to the moist concept that exists in the hydro pressure technique and assisted by mechanical debridement techniques to remove dead tissue, good wound tissue will be visible so that the dressing used can work more effectively on the wound healing process.

Based on the results of this study it appears that all patients using hydro pressure wound washes did not show any side effects when using it, which means that this liquid is safe for the body. In addition, moist techniques in wound care must also be considered. for wet and dry dressings, if the wound has a large amount of exudate, the dressing must be changed immediately. Especially if the exudate seeps out of the dressing which causes the dressing to become dirty. Wound care with dry wet dressings will be very difficult if you want to open the dressing, because the dressing becomes dry, will cause pain and also bleeding when the dressing is removed and can damage cells. The moist wound healing technique is a wound handling technique by keeping the wound moist so that it can facilitate cell movement in the wound, and can speed up the granulation process in the wound

4. CONCLUSION

The results of statistical hypothesis testing show that there is a difference between the values of the biofilm observation sheet before hydro pressure is performed and after hydro pressure is performed on diabetic ulcer patients. By looking at descriptive statistics before and after using the Hydro Pressure technique as a wound wash, there is a decrease in the average value. The hydro pressure technique is able to reduce the average value of biofilm in the wound healing process. Biofilm, which consists of microorganisms clinging to the wound's inner surface, can lead to prolonged infections and hinder healing. Hydro pressure techniques offer a non-pharmacological approach to addressing this issue. However, the application of hydro pressure techniques should be personalized and administered by skilled medical professionals. It is essential to note that this therapy may not be universally suitable for all wound types or stages of diabetic ulcers. Therefore, consulting with a knowledgeable doctor or nurse specializing in wound care is strongly advised before opting for any specific treatment approach.

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