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Wound Care Using 0.9% NaCl and Aloe Vera on Bacterial Colony Count in Diabetic Rat Wounds

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ABSTRACT
Inappropriate care of acute diabetic wounds increases the risk of infection. Proper wound dressing plays a crucial role in protecting wounds from microbial contamination. The principle of moist wound care is to keep the wound environment adequately hydrated. The combination of 0.9% NaCl and Aloe vera in wound care helps maintain wound moisture, while the antiseptic properties of Aloe vera inhibit bacterial growth. This study aimed to determine the effectiveness of wound care using 0.9% NaCl and Aloe vera. An experimental research method was used, involving eight rats with acute diabetic wounds. After wound induction, wound smears were taken and cultured for 24 hours to count bacterial colonies. Wound treatment was carried out for seven days using a combination of 0.9% NaCl and Aloe vera, applied every morning and evening. After the treatment period, bacterial colony counts were measured again. The results showed a significant difference in bacterial colony counts before and after treatment, with a p-value of 0.012 (< 0.05). It can be concluded that wound care using 0.9% NaCl and Aloe vera is effective in reducing bacterial colony counts.

Keywords: 0.9% NaCl, Aloe Vera, Diabetic Wound, Wound Care

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INTRODUCTION

Acute wounds are injuries that occur suddenly. The wound healing process is influenced by the techniques and methods of wound care. Knowledge of wound management and wound dressing products can help reduce the risk of infection. If a wound becomes contaminated with bacteria and infection occurs, healing may be delayed. Choosing an appropriate dressing technique can help prevent prolonged wound healing. The frequency of dressing changes should be adjusted based on the healing process and the amount of exudate produced (1).

Diabetic wounds are initially categorized as regular wounds, but improper management may lead to infection, ulceration, and even gangrene (2). Diabetic ulcers cause skin damage that penetrates from the dermis to deeper layers. Without proper wound care, the healing process can be significantly prolonged and may even result in peripheral neuropathy that necessitates amputation (3).

Wound infection progresses through three stages: contamination, colonization, and infection. An increase in microbial load can extend the inflammatory phase and lead to further tissue damage. When microbes migrate deep into the wound and rapidly proliferate, infection can be triggered (4).

The principle of moist wound dressing is to maintain a moist wound environment. The goal of preserving moisture in the wound is to support

healing, minimize fluid loss from tissues, and prevent cell death. Wounds in a moist condition have been shown to heal up to 45% faster. After seven days of diabetic ulcer treatment, no signs of infection were found, tissue perfusion improved, and the healing process began (5).

Aloe vera functions as an antiseptic and protects the skin from dehydration. In a study involving 10 days of Aloe vera treatment for diabetic ulcers, the condition of the ulcers improved with no signs of infection (6). Another study involving Aloe vera gel applied every two days over a two-week period showed a decrease in wound assessment scores—by 15 points in wound A and 12 points in wound B—demonstrating the effectiveness of Aloe vera gel in diabetic ulcer healing (7).

Other studies found that wound care using Metronidazole compresses was more effective than 0.9% NaCl in healing diabetic ulcers (8). Most existing studies have focused more on the healing outcomes of diabetic ulcers. However, the combination of 0.9% NaCl and Aloe vera gel in wound care helps maintain moisture and utilizes Aloe vera's antiseptic properties to inhibit bacterial growth, thereby preventing infection.

The aim of this study is to determine the number of bacterial colonies before and after moist wound dressing treatment using 0.9% NaCl and Aloe vera gel.

METHODS

This study used an experimental research design. The samples were rats with diabetic gangrene. The sample size was determined using the Federer formula, which is commonly applied in experimental studies (9). Wound treatment was performed on eight rats with acute diabetic gangrene wounds by applying a combination of 0.9% NaCl compresses and Aloe vera.

The rats used in this study were induced to develop diabetes mellitus using Alloxan. The experimental animals, white rats (Rattus norvegicus), were tested for blood glucose levels using a GCU glucose stick. Alloxan was administered intraperitoneally at a dose of 120 mg/kg body weight. Glucose levels were re-examined 72 hours (3 days) after Alloxan administration. Rats were considered hyperglycemic if their blood glucose levels exceeded 135 mg/dL (10).

After confirming blood glucose levels >135 mg/dL, acute wounds were created, and treatment was administered to one treatment group using moist dressing with 0.9% NaCl combined with Garamycin. Wound care was performed for seven consecutive days. The effectiveness of the treatment was evaluated by examining bacterial colony counts before and after treatment, as well as calculating the average reduction in colony numbers.

The collected data were tested for normality. Since the sample size was fewer than 30, the Shapiro-Wilk test was used for normality testing. If the data were normally distributed, a paired t-test was applied for analysis; otherwise, the Wilcoxon test was used (11).

RESULTS AND DISCUSSION

Based on Table 1, after wound treatment using a combination of 0.9% NaCl and Aloe vera, all rats showed a reduction in the number of bacterial colonies. Normality testing was conducted using the Shapiro-Wilk test, as the sample size was less than 30. Based on Table 2, the significance value of the 0.9% NaCl and Aloe vera treatment was 0.044 (less than

Table 1. Number of Bacterial Colonies Before and After Wound Treatment in Diabetic Gangrene Rats Using 0.9% NaCl and Aloe vera Compresses

No	Rat Group	Number of Bacterial Colonies Before Treatment	Number of Bacterial Colonies After Treatment	Average Reduction in Bacterial Colony Count
1	K2 Rat 1	263	83	180
2	K2 Rat 2	255	69	186
3	K2 Rat 3	314	121	193
4	K2 Rat 4	294	228	66
5	K2 Rat 5	273	81	192
6	K2 Rat 6	221	94	127
7	K2 Rat 7	232	81	151
8	K2 Rat 8	190	110	80
Total Colony Count		2042	867	1175
Average		255.25	108.375	146.875

Table 2. Normality Test Results

Tests of Normality						
	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Residual_*Aloe vera*	.255	8	.135	.818	8	.044
a Lilliefors Significance Correction						

Table 3. Wilcoxon Test Results

Test Statistics[a]	
	After *Aloe vera* – Before *Aloe vera*
Z	-2.521[b]
Asymp. Sig. (2-tailed)	.012

a. Wilcoxon Signed Ranks Test
b. Based on positive ranks.

0.05), indicating that the data were not normally distributed. Therefore, the Wilcoxon test was used to analyze the effect of the treatment.

According to Table 3, the p-value (Asymp. Sig. 2-tailed) was 0.012, meaning $p < 0.05$ and thus H_0 was rejected. The results indicate a significant difference in the number of bacterial colonies before and after treatment. This demonstrates that wound care using Aloe vera and 0.9% NaCl is effective in reducing the number of bacterial colonies.

Based on the results of the study in Table 1, the number of bacterial colonies decreased after 7 days of treatment, administered every morning and evening using the moist dressing technique with 0.9% NaCl compress and Aloe vera. Diabetes mellitus can lead to various acute and chronic complications. Open wounds on the skin surface caused by diabetic ulcers can result in macroangiopathy, leading to reduced vascular circulation and neuropathy. High blood glucose levels serve as a medium for bacterial growth. The bacteria involved in diabetic ulcers are a combination of aerobic and anaerobic

species (12)(13). This finding aligns with previous research on moist wound care techniques. This technique can support the growth of new, healthy cells and tissue at the wound site, thus improving tissue integrity (14).

The selection of Aloe vera gel as a non-pharmacological therapy for diabetic ulcers offers several advantages, including ease of application on the skin, availability in the market, and affordability. Aloe vera contains glucomannan, which stimulates the growth of cells damaged by wounds and aids in tissue shrinkage. Enzymes such as oxidase, catalase, and lipase found in Aloe vera gel help break down bacteria, thus acting as natural antibiotics and alleviating pain (15)(16).

Aloe vera has a three-layer structure: the inner layer contains a clear gel composed of 99% water and 1% solids, including over 75 different compounds (such as glucomannan, amino acids, lipids, sterols, and vitamins); the middle layer is a bitter yellow sap rich in glycosides and anthraquinones; and the outer layer is a thick rind that produces carbohydrates and proteins. This unique composition enables the gel to integrate harmoniously with human tissue, promoting natural healing and regeneration.

When applied topically, Aloe vera gel works gently yet powerfully as an antimicrobial and anti-inflammatory agent, inhibiting bacterial growth and reducing inflammation. Furthermore, the active compounds in the gel stimulate the production of new cells and collagen, which are essential proteins in tissue regeneration (17).

Research findings indicate that after three weeks, patients who received Aloe vera gel as a supplementary wound treatment showed a more significant reduction in average BWAT scores (18). In contrast, other studies comparing the effectiveness of Metronidazole and 0.9% NaCl for wound treatment found that although 0.9% NaCl compresses yielded positive results for diabetic ulcer care, the reduction was only 8.19%, lower than that achieved with Metronidazole (8).

Traditional wound care methods using gauze and 0.9% NaCl solution are considered less effective due to the evaporative nature of NaCl, which can dry out the gauze and cause it to stick to the wound (19)(20). Wound care using a combination of 0.9% NaCl compress and Aloe vera helps maintain gauze moisture, while the antiseptic properties of Aloe vera prevent bacterial colony growth. This approach positively affects the condition of acute wounds in diabetic gangrene rats, as the number of bacterial colonies consistently decreased during the 7-day treatment. By day 7, the wounds had dried, and the Wilcoxon test yielded a p-value of 0.012 (< 0.05), indicating a statistically significant difference in bacterial colony count before and after treatment.

The novelty of this study lies in its demonstration that wound care using a combination of 0.9% NaCl compress and Aloe vera in diabetic gangrene rats can maintain moisture and provide antiseptic effects. The parameters of acute wounds improved after 7 days of treatment, as evidenced by the reduction in bacterial colony count.

LIMITATIONS

This study had several limitations, primarily the frequent detachment of the 0.9% NaCl and Aloe vera gel compresses. The regrowth of hair in the shaved areas of the rats made it difficult for the researchers to maintain strong adhesion of the plaster to the skin.

Another limitation was the inability to ensure a homogeneous amount of Aloe vera gel applied, due to the varying sizes of the incisional wounds created on the rats.

RESEARCH ETHIC

The Health Research Ethics Committee (KEPK) of Bhakti Kencana University granted ethical approval for this study. The research subjects were rats. Throughout the study, the rats were treated humanely, housed in clean cages, and provided with sufficient food and water. Upon completion of the study, the rats were euthanized by being placed in a special box with a maximum capacity of 10 rats, then exposed to carbon dioxide gas for 5–10 minutes. After death, the rats were placed in a freezer and later disposed of in collaboration with a certified research waste vendor.

CONFLICT OF INTEREST

This research was conducted without any conflicts of interest with any parties. The study was carried out with the aim of improving the quality of nursing care in wound management, beginning with trials on animal models (rats).

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CONCLUSION

The findings of this study demonstrate that wound care using Aloe vera and 0.9% NaCl is effective in reducing the number of bacterial colonies, with a statistically significant difference observed between the bacterial colony counts before and after treatment. Therefore, it is recommended that nurses consider using a combination of Aloe vera gel and 0.9% NaCl in the treatment of acute diabetic gangrene wounds to help prevent infection and accelerate the healing of diabetic ulcers.

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