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Original Article

Treatment of Gangrene Wounds with Hydrocolloid Dressing Methods for Diabetes Mellitus Type 2 in Educational Hospital, North Sumatera University

Soep[1], **R.R Sri Arini Winarti Rinawati**[1], **Metrys Ndama**[2]
[1]Department of Nursing, Poltekkes Kemenkes Medan, North Sumatera, Indonesia
[2]Department of Nursing, Poltekkes Kemenkes Palu, Central Sulawesi, Indonesia
*Corresponding author: soep15182@gmail.com

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ABSTRACT

Wound care in a moist environment is superior to a dry environment. Appropriate wound care methods can help accelerate the healing of gangrenous wounds. This study aimed to determine diabetic wound healing using the modern hydrocolloid dressing method. This experimental research design utilized pre-test and post-test techniques to assess the difference in the effect of gangrene wound care with modern hydrocolloid dressings on gangrene wound healing in diabetic patients. The study was conducted at USU Teaching Hospital Medan for 14 days, involving 20 respondents with Type II DM patients experiencing gangrene wounds, obtained through non-probability sampling. Data analysis was performed using the independent t-test. The results showed a significant difference in gangrene wound care with the modern hydrocolloid dressing method ($p < 0.05$). The modern hydrocolloid dressing method led to faster healing of gangrene wounds. Conclusion: respondents who used the modern hydrocolloid dressing method experienced better wound status development and faster healing. It is expected that hospitals will plan and establish SOPs for wound care in DM patients with gangrene using modern hydrocolloid dressings and reduce the use of conventional methods. These implications highlight the importance of implementing modern methods in wound care protocols for patients with diabetes mellitus with gangrene, mainly to prevent amputation and improve patients' quality of life. Recommendations include the implementation of modern wound care SOPs, training for health workers, patient and family education, further research, and the procurement of modern dressings.

INTRODUCTION

Diabetes Mellitus is a non-communicable disease caused by the breakdown of insulin production in the body.[1] Symptoms experienced by people with DM are frequent urination, always feeling thirsty, blurred vision, feeling tired quickly, and drastic weight loss. Hyperglycaemia or an increase in blood sugar levels within normal limits will cause various complications.[2]

Patients with diabetes mellitus are prone to chronic complications, one of the most common complications is diabetic foot ulcers. Diabetic foot ulcers are disorders of the lower limbs due to uncontrolled diabetes mellitus which can be caused by vascular disorders, nerve disorders and infections from various microorganisms. The tendency that occurs in patients with diabetes mellitus is slow wound healing and is easily affected by infection so that gangrene can spread, and there is a high risk of lower limb amputation.[3]

The moist wound healing method is a method to maintain wound moisture by using a moisture-retaining dressing, so that wound healing and tissue growth can occur naturally.[4] There are currently more than 3500 types of wound dressings in the world. Some of them are Transparent Film, Hydrogel, Calcium Alginate, Hydrocellulose, Hydrocolloid, Polyurethane Foam, Antimicrobial Dressing, Metcovazin.[5] Wound care performed on patients should be able to improve the wound healing process.

The treatment provided is to provide warmth and a moist environment for the wound. A moist dressing can provide a favourable environment for cells to perform the wound healing process and prevent further damage or trauma.[6] Modern wound dressings on the market today are moisture resistant dressings such as hydrocolloid films because they are waterproof, non-permeable to bacteria, provide thermal insulation, are occlusive, thus providing a moist healing environment and encouraging autolysis, and causing a decrease in local pH which allows the body's defence mechanisms to function more efficiently.[7] Hydrocolloid dressing gels when in contact with exudate, which swells to fill the wound cavity.[8]

Research on modern dressings such as hydrocolloids, hydrogels, and foams found that the frequency of dressing changes in these methods is less frequent (lower) compared to conventional dressings. And for the total effective cost during treatment, it is cheaper compared to conventional dressings that must be changed every day.[9] Occlusive dressings known as modern dressings such as hydrocolloids, hydrogels, and foams leave no pain when changing dressings. In contrast to conventional dressings that sometimes leave pain when the dressing is changed.[10]

USU Teaching Hospital in 2023-2024 received as many as 121 patients with diabetes mellitus with diabetic ulcer complications. Based on the description above and considering the increase in diabetic ulcer cases, this research aims to determine the comparison between modern dressings and conventional dressings.

METHODS

The study used a two-group experimental research design, with each group using pre-test and post-test to determine the difference in the effect of gangrene wound care with modern hydrocolloid dressing on gangrene wound healing in diabetic patients. This study was conducted at USU Teaching Hospital Medan. The population in this study were all Type II DM patients who experienced gangrene wounds at the USU Medan Teaching Hospital as many as 121 patients. this study was conducted for 14 days. Non-probability sampling technique using consecutive sampling approach, by including every patient who meets the criteria until the time period in this study, a sample of 20 respondents was obtained. The sample criteria in this study were respondents with Type II DM who experienced wounds at the USU Medan Teaching Hospital, willing to become respondents, had a granulation stage wound status, had blood glucose levels that could be controlled with medication, had compos mentis consciousness, and were able to communicate well.

The sample of 20 respondents obtained was divided into 2 groups, namely group A using gangrene wound treatment with the modern hydrocolloid dressing method and group B using the conventional method, Data analysis using the independent t-test statistical test (independent t-test) Patients were given sequential numbers from 1 to 20, then every odd number was put into group A. Every even number was put into group B. This research has passed the ethics test at the Nursing Department of the Poltekkes Kemenkes Medan and was declared ethically feasible with 7 WHO standards with an ethical feasibility letter number 01.26 613 /KEPK/POLTEKKES KEMENKES MEDAN 2024.

RESULT

Based on Table 1, the use of modern wound dressings was more frequent among respondents aged 41–50 years (20%) and >50 years (20%), while conventional dressings were more commonly used among those aged 41–50 years (25%). In terms of sex, both dressing types were more frequently used by female respondents, with 30% of females using modern dressings and

35% using conventional dressings.

Table 1. Frequency distribution of respondents with diabetes mellitus

Characteristics of Respondent	Modern Dressing		Conventional		Total	
	n	%	n	%	n	%
Age						
<40 years	2	10.0	3	15.0	5	25.0
41-50 years	4	20.0	5	25.0	9	45.0
>50 years	4	20.0	2	10.0	6	30.0
Sex						
Male	4	20.0	3	15.0	7	35.0
Female	6	30.0	7	35.0	13	65.0
Education						
senior secondary school	5	25.0	7	35.0	12	60.0
Diploma/Bachelor	5	25.0	3	15.0	8	40.0
Long Suffering						
<5 years	3	15.0	6	30.0	9	45.0
5-10 years	7	35.0	3	15.0	10	50.0
>10 years	0	0.0	1	5.0	1	5.0
Blood sugar level						
< 150 gr/dl	0	0.0	0	0.0	0	0.0
150-200 gr/dl	10	50.0	10	50.0	20	100.0

Regarding education level, modern dressings were equally used by respondents with senior secondary education (25%) and those with a diploma or bachelor's education (25%). In comparison, conventional dressings were more common among those with senior secondary education (35%). Based on the duration of diabetes, modern dressings were mainly used by those who had been diagnosed for 5–10 years (35%), whereas conventional dressings were more often used by those with a duration of <5 years (30%). All respondents had blood sugar levels ranging from 150–200 gr/dl (100%).

Table 2. Analyse diabetic wound progression using modern dressings.

Responden	Overview of wound progression using designer tools		
	Score (Pre Test) 1st day	Score (Post Test) 14st day	Total Score
1	19	8	27
2	24	9	33
3	22	11	33
4	24	10	34
5	24	10	34
6	24	9	33
7	21	10	31
8	22	9	31
9	24	10	34
10	20	10	30

Based on Table 2, it is evident that gangrene wound healing using the modern dressing method from day 1 to day 14 improves, as indicated by the decreasing total value of the DESIGN Tools score. This suggests that the wound healing from gangrene is progressing favorably. Before wound care using modern wound dressings, the scores found were very high; however, there was a drastic decrease after 14 days of treatment.

Based on Table 3, there is a slow progression of wound healing using designer tools. Conventional wound care yields high scores before treatment; however, after 14 days of treatment, there is a decrease in scores, indicating wound improvement. Nevertheless, the change in scores achieved through conventional care is not as significant as those in modern care.

Table 3. Analyse diabetic wound progression using conventional dressings.

Responden	Overview of wound progression using designer tools		
	Score (Pre Test) 1st day	Score (Post Test) 14st day	Total Score
1	24	20	44
2	24	21	45
3	22	20	42
4	24	21	45
5	24	22	46
6	24	21	45
7	21	20	41
8	24	21	45
9	24	20	44
10	23	20	43

Based on the Table 4, the difference in wound healing in the group using the modern dressing method and the conventional method is 0.000. Wound care using the modern hydrocolloid dressing method has a mean value of 40.60 with a standard deviation of 2.120. In wound care using conventional methods has a mean value of 69.87 with a standard deviation of 6.457. The results of the independent t-test showed that there was a significant difference in gangrene wound healing using modern methods with conventional methods with a t-value of -11.318 and a p-value of 0.000 ($p<0.05$).

Table 4. Comparison of wound healing speed in diabetes mellitus using modern and conventional dressings.

Group	Mean	Standard Deviation	Sig
Modern Dressing	40.60	2.120	0.000
Conventional dressing	69.87	6.457	

DISCUSSION

Diabetes Mellitus (DM) Type II is a group of metabolic diseases characterized by hyperglycemia. Chronic hyperglycemia in DM is associated with long-term damage, dysfunction, or failure of several organs. One of the complications in patients with DM is diabetic foot disease, caused by peripheral vascular disorders, neuropathy, or both.[10]

The results of this study indicate that the average respondent has suffered from DM for 5-10 years. This is in line with Hastuti's research (2008), which states that the risk factor for gangrene is the length of suffering from DM, 5-10 years. The duration of DM is associated with prolonged hyperglycaemia, which causes the formation of advanced glycosylation end products (AGEs), free radical formation, and activation of protein kinase C (PKC). Activation of these various pathways results in a lack of vasodilation, leading to decreased blood flow to the nerves and low myoinositol levels in the cells, which contribute to diabetic neuropathy.[11]

This study also showed that the average age of respondents ranged from 40 years to > 55 years. Based on the theory of the aging process, the physiological function of the body reaches its peak between the ages of 20 and 30 years. After reaching its peak, the organs of the body will remain intact for a while, then by increasing age, will decrease little by little. The WHO states that after a person reaches the age of 30 years, blood glucose concentration increases by 1-2 mg/dL per year during fasting and by about 5.6-13 mg/dL 2 hours after.[12]

There is a significant relationship between hyperglycaemia, patient age and duration of DM with the incidence of diabetic neuropathy. Diabetic neuropathy is one of the predisposing factors for gangrene.[13] The results of this study showed that male gender dominated the study sample. The prevalence of peripheral arterial disease is higher in men than in women. This may be related to the habit of consuming nicotine in cigarettes.[14]

Education level is one of the characteristics of respondents in this study. The data results show that the average high school education level is dominant in the sample. To optimise efforts to heal gangrene wounds in DM patients, counselling or, more precisely, health education about

DM and its complications is needed. The purpose of health education is to change the behaviour of people with DM and improve compliance, which will further enhance quality of life.[15] Patient education can have a positive effect, reducing foot ulceration and amputation, especially in high-risk patients. However, it has a short-term impact on patients' knowledge and behavior regarding foot care.[16]

The guidelines for treating gangrene contain 8 categorical formulations such as: diagnosis, demolition, infection control, basic wound preparation, dressing selection, surgery, topical agent selection, and recurrence prevention. One way to control infection is to keep blood glucose levels within normal limits (<200 g/dl). High blood glucose levels in wounds can reduce the function of white blood cells (leucocytes). The results of the respondents' blood glucose values in this study averaged 150-200 g/dl, meaning that each respondent in this study had the same chances and possibilities in achieving optimal wound healing for the gangrene they suffered.[17]

Overview of diabetes mellitus patient wounds using modern dressings

Assessment of diabetic gangrene wound healing progress using DESIGN Tools includes: depth score 0-1-2-3-4-5-µ, exudate score 0-1-3-6, size score 0-3-6-8-9-12-15, inflammation/infection score 0-1-3-9, granulation score 0-1-3-4-5-6, tissue necrosis score 0-3-6, and undermining score 0-6-9-12-24. The highest score is 71 and the lowest score is zero. Wound status was said to improve/heal if the wound status assessment score decreased/reduced from the score on the first day of assessment, and was said not to improve/heal or the development of wound status in a static condition (fixed) if the assessment score on the first day did not change/decreased until the 14th day of assessment of diabetic gangrene wound status development. Using a consecutive design, patients who arrived and were admitted by their respective order were given the same wound care but differed in terms of the dressing used to close the wound, patients who arrived in odd-numbered order received a hydrocolloid dressing, and so on until the end of data collection.

Table 2 presents the results of the assessment of measuring instruments, providing an overview of the progress of diabetic gangrene wound healing in respondents who received a hydrocolloid dressing as a diabetic gangrene wound cover. Throughout the data collection period, 10 patients met the inclusion criteria and were willing to participate as respondents in this study. The same standard operating procedure for wound care was applied to respondents with modern dressings, and wound status assessment was carried out for two assessments, namely the day 1 assessment, followed by the day 14 assessment.

Wound features of patients with diabetes mellitus using conventional dressings.

Wound status assessment was carried out twice, namely on the first day and continued until day 14. The observation sheet used in this study was the DESIGN Tools. In patients with Diabetes Mellitus (DM), metabolic disorders characterized by chronic hyperglycemia lead to peripheral vascular damage and neuropathy. This condition triggers the appearance of chronic wounds, especially in the lower extremities, known as diabetic ulcers. One method of wound care that is still commonly used is the conventional method, such as antiseptic-soaked gauze dressings.

Comparison of diabetes mellitus wound care using modern dressings and conventional dressings

Wound care is a series of activities carried out to treat wounds with the aim of preventing trauma (injury) to the skin, mucous membranes or other tissues, fractures, surgical wounds that can damage the skin surface. The series of activities includes cleaning the wound, applying bandages, changing dressings, packing the wound, repairing the wound, and providing comfort measures, which include cleaning the skin and drainage area, irrigation, removal of drainage, and applying bandages.[18]

The healing process of gangrene wounds using the modern hydrocolloid dressing method is faster than the conventional method.[19] This is because in the healing process of the modern hydrocolloid dressing method, the basis of dressing selection must consider the following points: Does not adhere to the wound bed so as not to cause wounds during replacement, impermeable

to microorganisms, able to maintain high humidity in the wound area and can remove excessive exudate, thermal insulation, non-toxic and non-allergic, comfortable and easy to manage, able to protect the wound from further trauma, does not need to change the dressing too often, has a low price, is durable and the dressing material is readily available.[20]

The conventional method is that traditional gauze dressings have a high MVTR (Moisture Vapor Transmission Rate) value, which causes high oxygen evaporation in the wound tissue, resulting in the wound surface drying out and slower wound healing. Oxygen plays a crucial role in the synthesis of new wound tissue collagen. The main component of nutrition is oxygen, which is essential for the healing process by producing granulation tissue and ensuring immunity against infectious agents. Additionally, factors that can impact wound healing include the patient's gender, wound severity, blood sugar levels, and nutritional status.

However, the research is limited to a sample size that is too small, so it cannot provide a firmer picture of the comparison of the two methods.

CONCLUSIONS

In modern dressings used for diabetes mellitus patients, a significantly faster recovery is observed compared to conventional dressings. The assessment process is carried out over 14 days, divided into two assessments: on the first day and on day 14. The significance value was found to be 0.000. Wound healing progress assessment is conducted using the Assessment of Diabetic Gangrene Wound Healing Progress with the DESIGN Tool.

The implications of this study include increased wound healing speed, Reduced Risk of Infection, Improved Patient Comfort, and Cost Efficiency. These implications show the importance of implementing modern methods in wound care protocols for patients with diabetes mellitus with gangrene, mainly to prevent amputation and improve patients' quality of life.

The recommendations from this study are: Implementation of Modern Wound Care SOPs, Training for Health Workers, Patient and Family Education, Further Research, and Procurement of Modern Dressings: Hospitals are expected to allocate budget for the procurement of modern dressings so that they can be widely used in diabetic patients with gangrenous wound complications.

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