Combination of Infrared Therapy, Ozone Therapy, and Olive Oil On Diabetic Foot Ulcer in Agam Health Center

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KEYWORDS
Diabetic Foot Ulcer, Infrared, Ozone, Olive Oil Dressing

ABSTRACT
Diabetes mellitus can cause various complications, including weakness to diseases such asfoot infections. One of the common complications that often occurs is diabetic foot disease,According to WHO, globally, in 2021, 10.5 % (536.6 million people) of the age group 20-79 years old will suffer from diabetes mellitus, increasing to 12.2% (783.2 million) in 2045. (WHO 2021). It is recorded that as many as 131 million of the global population experience lower extremity complications due to diabetes mellitus (DM), increasing the risk of death. where 18.8 million of them have diabetic foot ulcers, reaching 12% this percentage is higher than China, the country with the most diabetes mellitus sufferers in the world or the global prevalence, which only goes around 1.4% - 5.9%. This study aims to determine the effectiveness of the combination of infrared therapy, ozone therapy, and olive oil on the healing process of diabetic foot wounds in the Agam Health Center work area in 2024. This type of research uses a Pre -post-test with a control group design on a group. Sampling using a purposive sampling technique of 10 people in the treatment group and 10 in the control group. Data collection was carried out by observation, the research instrument used was the Betes-Jensen Wound Assessment Tool (BWAT) observation sheet. This study was conducted for 28 days. The data analysis used was the Shapiro-Wilk test—data analysis using the Wilcoxon test statistic. The results of the study showed that there was a difference in wound scores before and after in the treatment group with a p-*value*= 0.0005 < α (0.05) and in the control group with p-*value*= 0.0005 < α (0.05). Then, the difference test results between groups with p-*value* = 0.054 ≤ α (0.05). So it can be concluded that the combination of infrared therapy, ozone therapy, and olive oil has been effective in the healing process of diabetic foot wounds.

INTRODUCTION

Clinically there are two categories of diabetes, namely type 1 and type 2, type 1 DM occurs due to the autoimmune destruction of insulin-producing β cells in the islets of Langerhans in the pancreas which is categorized as absolute deficiency, and type 2 DM is the impact of impaired insulin secretion and resistance to insulin action which is often caused by obesity, categorized as relative deficiency. (Atun et al., 2022) And it is explained that of these two types, most cases are type 2 DM. The American Council on Exercise in Smeltzer (2008), said that almost 90-95% of all cases of DM found were type II DM. (Atun et al., 2022)

Based on data from the World Health Organization (WHO) in 2013, the number of adults with Diabetes Mellitus (DM) worldwide reached 381 million individuals and is projected to increase to 591 million by 2035. (Izadi et al., 2019) WHO also estimates that in 2014, there were around 422 million adults over the age of 18 living with diabetes globally (WHO, 2016). According to the International Diabetes Federation (IDF) in 2019, the number of people in the world aged 20-70 years and suffering from diabetes was 351.7 million. (IDF, 2019 in Cho et al., 2018) .

Indonesia ranks seventh globally after Mexico in terms of the number of diabetes mellitus cases, with a percentage reaching 10.7 million individuals (11.5%). Projections show a continuous increase until 2030, estimated to reach 13.7 million (14.9%), and in 2045 it is estimated to reach 16.6 million (18.2%). (IDF, 2019).Common diseases in the city. In 2014, diabetes mellitus was ranked tenth and rose to fourth in 2018. (Izzati et al., 2023)

Agam Regency is one of the regencies in Bukittinggi City, the Agam Regency Health Service Profile Data for diabetes mellitus sufferers according to the 2020 standard was 1,544 people out of 2,600 people (59.3%) and in the last 3 years, namely in 2022, there were 235,134 people with diabetes mellitus (Agam Regency Health Service, 2022)

Diabetes mellitus can cause various complications, including weakness to diseases such as pulmonary tuberculosis and foot infections. One of the common complications that often occurs is diabetic foot disease, which increases the risk of developing foot ulcers (diabetic ulcers), which if not treated properly can lead to removal. (Hastuti, 2008, Hayati et al., 2021) This diabetic foot condition can also develop into gangrene, which is one of the persistent complications of diabetes mellitus. which is most feared by sufferers. (Naziyah et al., 2022)

Diabetic foot ulcer (DFU) is a complication due to various causes such as neuropathy, ischemia, and infection, that contribute to morbidity and amputation. It has been found that lower extremity amputation. Diabetic foot ulcers are serious complications, ulcers are lesions in the skin layer channels, necrosis, or gangrene on the feet caused by various factors. Diabetic foot ulcers hurtsufferers' quality of life and physical, psychological, social, cultural, and economic well-being. (Zlotnik & Chetverushkin, 2023) It is recorded that as many as 131 million of the global population experience lower extremity complications due to diabetes mellitus (DM), increasing the risk of death. where 18.8 million of them have diabetic foot ulcers reaching 12%, this percentage is higher than China, the country with the most diabetes mellitus sufferers in the world or the global prevalence which only reaches around 1.4% - 5.9%. (Izzati et al., 2023)

Healing of diabetic foot ulcers is often difficult due to various factors, including decreased blood flow to the feet, diabetic neuropathy that interferes with pain and pressure perception, and bacterial infection. (Chen et al., 2021) Although various therapies have been used to treat diabetic foot ulcers, conventional therapies such as wound care, antibiotics, and debridement (wound cleaning) do not always provide satisfactory results. (History et al., 2021)

The use of Infrared Therapy has been recognized to have a positive impact in increasing local blood flow and accelerating wound healing.and reduce pain in patients with a variety of conditions, including chronic wounds. This therapy has been the focus of research, especially in the context of healing diabetic foot ulcers (DFUs), because of its potential benefits in increasing local blood flow, accelerating wound healing, and reducing pain. Several studies have shown that infrared therapy can stimulate cell growth, including cells involved in the wound-healing process. Infrared radiation can stimulate cell activity, including those involved in the formation of new tissue (granulation), which facilitates tissue regeneration and the wound healing process. In addition, infrared radiation also encourages the production of collagen, an important structural protein in the formation of connective tissue. Increased collagen can improve the structural strength of skin tissue and support a more effective healing process. (Malawat, 2017)

Based on research conducted by Chen Rong Fu in 2020, the results showed that infrared therapy significantly increased the wound healing rate and accelerated the healing process in patients with chronic diabetic foot ulcers. Through meta-analysis, infrared therapy has been shown to reduce wound size in patients with the condition. These findings provide additional evidence of the effectiveness of infrared therapy in accelerating wound healing. From this systematic analysis and meta-analysis, it can be concluded that infrared therapy is an effective and potential method in the treatment of chronic diabetic foot ulcers. (Chen et al., 2021)

Ozone therapy is a therapy composed of ozone. This gas is present in the atmosphere with direct disinfectant and trophic effects as well as systemic antibacterial and antiviral effects. This gas also increases blood circulation, makes glucose metabolism more effective, increases erythrocyte metabolism, and increases fatty acid metabolism. Ozone is produced by three main energy sources, namely electrical discharge, chemical electrolysis, and ultraviolet radiation. Ozone has the property of being able to react with inorganic and organic substances until carbon oxides, higher oxides, and water are formed, namely until the oxidation is complete. (Ugazio et al., 2020)

Based on the journal (Wen & Chen, 2020) Believe that the acceleration of the trend of wound closure in the young population may be due to O2 tension by ozone in the area around the wound which acts as an antibacterial agent to reduce bacterial infection. At the end of the 20th century, a team of German scientists used ozone on skin ulcers caused by diabetes. They used plastic bags for an average of 25 minutes with concentrations ranging from 10 to 80 µg / mL. (Wen & Chen, 2020)

Based on the results of research conducted by Zhang et al reported that the level of efficacy, reduction in wound size, and ulcer healing were much higher at the end of treatment in the ozone

therapy group compared to the control group. This study investigated the impact of ozone therapy on the healing of Diabetic Foot Ulcers (DFU) in two groups of subjects. The control group received routine care for DFU, while the intervention group also received routine care but with the addition of ozone therapy twice a week. The results showed that ozone therapy was very effective in treating DFU and accelerated recovery time in the intervention group compared to the control group. (Izadi et al., 2019)

Olive oil has long been used in traditional and modern medicine for its powerful anti-inflammatory, antimicrobial, and antioxidant properties. In the context of healing Diabetic Foot Ulcers (DFU), olive oil can provide several benefits, namely the active components contained in olive oil, such as oleuropein and oleocanthal, have anti-inflammatory properties that can help reduce inflammation around diabetic foot wounds. It can also help reduce pain and discomfort associated with foot wounds in people with DM. Olive oil also has strong antimicrobial activity against various types of bacteria and fungi. Thus, topical use of olive oil on diabetic foot wounds can help prevent infection and speed up the healing process. (Hayati et al., 2021)

According to the journal entitled "The Effect of Topical Olive Oil in Healing Foot Ulcers in Patients with Type 2 Diabetes", it was concluded that routine care by cleaning the wound using 0.01% HOCL solution, drying it, then applying enough olive oil according to the size of the wound, then wrapping it with sterile gauze and attaching it with hepafix helps accelerate the growth of granulation tissue. The use of olive oil for wound care did not cause any side effects reported during the study. (Hayati et al., 2021) Olive oil is generally safe to use topically and can be used in conjunction with other therapies, such as infrared therapy or ozone therapy, to increase the effectiveness of diabetic foot wound healing.

The combination of ozone therapy, and infrared therapy using olive oil may have a synergistic effect that can increase the effectiveness of wound healing compared to using each therapy separately. For example, ozone therapy can provide antimicrobial effects, infrared therapy can increase local blood flow, and olive oil can strengthen tissue structures and provide essential nutrients for skin regeneration. The use of this combination can harness the strengths of each therapy to improve treatment outcomes. Using a combination of therapies that include different aspects such as ozone therapy, infrared therapy, and olive oil, Although scientific evidence for a specific combination of ozone therapy, infrared therapy, and olive oil for the treatment of diabetic foot ulcers may be limited, the authors may refer to previous studies that show the benefits of each therapy separately. The study of the combination of ozone therapy, infrared therapy, and olive oil in diabetic foot ulcers may also be an innovative effort to explore new solutions in the treatment of this difficult-to-heal condition. By trying a new approach that combines several therapies that are beneficial in the context of wound healing, the authors may hope to find a more effective solution to this complex problem. Thus the authors took this approach based on the potential evidence of each therapy and hoped to see similar or better effects when these therapies were combined.(Wang et al., 20 20) .

Based on the phenomena and benefits of combination therapy above, the author is interested in researching "The Effectiveness of Combination of Infrared Therapy, Ozone Therapy and Olive Oil on Diabetic Foot Ulcers in the Agam Health Center Work Area in 2024".

RESEARCH METHODOLOGY

The research design is used to guide researchers to obtain answers to research by referring to the type of research used. In this study, researchers used a Quasy Experiment design with a Pre-Posttest With a Control Group Design approach. Population is a collection of individuals objects or phenomena that can potentially be measured as part of the study. Population can also be interpreted as a target where researchers produce research results. The size of the population in the study was patients who had diabetic foot ulcers in the proliferation phase, 10 people in the intervention group and 10 people in the control group. The number of samples is 20 people. The research method uses a purposive sampling technique. The research instrument is a tool that will be used for data collection. In this study, the SOP was used by researchers to observe the implementation of the combination of infrared therapy, ozone therapy, and olive oil. The diabetic foot wound healing process variable is measured using the Bates-Jensen Wound Assessment Tool (BWAT) observation sheet.

Univariate analysis is an analysis to explain or describe the characteristics of each research variable. In this study, researchers analyzed the healing process of diabetic foot wounds before and after a combination of infrared therapy, ozone therapy, and olive oil.

Bivariate analysis was conducted to determine the effect of the combination of infrared therapy, ozone therapy, and olive oil on the healing process of diabetic foot wounds. Bivariate analysis used the Wilcoxon Test. Bivariate analysis is to conduct a difference test between pre and post-test. It is said that there is an effect if the difference test results obtain a *p-value* <α (0.05).

RESULT

1. Respondent Characteristics

The data obtained by researchers during the research period from August to September to 2024 in the Agam Health Center area with respondent characteristics consisting of age, gender, and location of the wound. These characteristics can be seen in the following table.

Table 5.1 Overview of Respondent Characteristics

Group	Respondent Characteristics	Mean	F	%
Group Intervention	Age	32 57-62	2 8	25.0 75.0
	Gender	Man Woman	10 0	100 .00
	Location of the wound	Left Foot Right Foot	4 6	40.0 60.0
Group Control	Age	53-59 61-69 75	4 5 1	25.0 65.0 10.0
	Gender	Man Woman	5 5	50.0 50.0
	Location of the Wound	Left Foot Right Foot	5 5	50.0 50.0

Based on table 5.1 above it shows that there are 10 respondents in the intervention group and 10 in the control group. It can be seen that the general average of respondents in the intervention group is 75% of respondents aged 57-62 years and 25% of respondents aged 32 years. The average age of respondents in the control group is 65% of respondents aged 61-69 years, then 25% of respondents aged 53-59 years, and 10% of respondents aged 75 years. The average gender characteristics in the intervention group are 100% male. The average gender in the control group is 50% male and 50% female. The average characteristics of respondents in the intervention group regarding the location of the wound are 60% right foot wounds and 40% left foot wounds. Then, the average location of foot wounds in the control group was 50% on the left foot and 50% on the right foot.

2. Univariate Analysis

Table 5.2
Average Wound Regeneration Value Before Infrared Therapy Ozone Therapy with Olive Oil

Variable	N	Mean	SD	Min	Max
Pre-test Intervention group	10	30.80	7.25	21	40

on Diabetic Foot Ulcers in the Agam Health Center Work Area 2024

Based on Table 5.2, it is known that the average value of diabetic wound healing before being given**a** combination of infrared therapy and ozone therapy with olive oil is 30.80 with a standard deviation of 7.25. regeneration valuethe lowest is 21 and the highest is 40.

Table 5.3
Average Wound Regeneration Value After Infrared Therapy Ozone Therapy with Olive Oil on Diabetic Foot Ulcers in the Agam Health Center Work Area 2024

Variable	N	Mean	SD	Min	Max
Post test Intervention group	10	21.00	3.43	17	27

Based on Table 5.3, it is known that the average value of wound regeneration after being given**a** combination of infrared therapy and ozone therapy with olive oil is 21.00, with a standard deviation of 3.43. regeneration valueThe lowest is 17, and the highest is 21.

Table 5.4
Average Wound Regeneration Value Before Control Group Intervention for Diabetic Foot Ulcers in the Agam Health Center Work Area 2024

Variable	N	Mean	SD	Min	Max
Pre test Control group	10	35.30	7,088	27	46

From Table 5.4, it can be seen that the average value of diabetic foot wound regeneration before intervention in the control group was given with a mean of 35.30 and a standard deviation of 7.088, a minimum value of 27, and a maximum of 46.

Table 5.5
Average Wound Regeneration Value After Intervention for Diabetic Foot Ulcers in the Agam Health Center Work Area 2024

Variable	N	Mean	SD	Min	Max
Post test Control group	10	25.70	6,584	17	38

Based on table 5.5, the average value of diabetic foot wound regeneration after intervention in the control group can be seen with a mean of 25.70 and a standard deviation of 6.584, a minimum value of 17 and a maximum of 38.

3. Bivariate analysis

Table 5. 7

The Effect of Combination Infrared TherapyOzone Therapy And Olive Oil Intervention GroupAgainst Ulcers Diabetic Feet in the Agam Health Center Work Area 2024

Variable	N	Mean	SD	P value
Pre	10	30.80	7.25	0.0005
Post		21.00	3.43	

Based on Table 5.7, it is known that the average wound regeneration value before administering the Infrared Combination TherapyOzone therapy and olive oil Intervention groupis 30.80, and after administration is 21.00. There is a p-value = 0.0005 < α (0.05), which means there is an Effect of Giving a Combination of Infrared Therapy,Ozone Therapy,and Olive OilIntervention Group Against Ulcersof Diabetic Foot in the Agam Health Center Working Area 2024.

Table 5.8

The Effect of InterventionControl Group Against Diabetic Foot Ulcers In The Working Area Of Agam Health Center 2024

ıriable	N	Mean	SD	MD	P value
Control	10	25.70	6. 584	4.7	0.0 54
Intervention	10	21.00	3. 43		

Based on Table 5.8, it is known that the average wound regeneration value before the Control Group intervention was givenis 35.30,and after administration is 25.70. There is a *p-value* = 0.0005 < α (0.05), which means there is an Effect of Giving the Control Group Intervention on UlcersDiabetic Feet in the Agam Health Center Work Area 2024

Table 5.9

Effectiveness of Combination Intervention of Infrared Therapy and Ozone Therapy Using Olive Oil on UlcersDiabetic Foot in Agam Health Center Work Area 2024

Variable	N	Mean	SD	P value
Pre	10	35.30	7.088	0.0005
Post		25.70	6,584	

Based on Table 5.9, it is known that the average wound regeneration valueControl groupis 25.70 and the intervention group is 21.00 there is a difference in the mean of administration of 4.7 There is a p-value = 0.054 ≤ α (0.05) (Ha is accepted) meaning there is a difference in effectiveness in the intervention group and the control group (the researcher did not provide treatment) against ulcersDiabetic Foot in the Agam Health Center Working Area 2024.

DISCUSSION

Average Wound Healing Before Combination of Infrared Therapy, Ozone Therapy and Olive Oil on Diabetic Foot Ulcers

From Table 5.2, it can be seen that the average healing of diabetic foot ulcers before being given infrared therapy, ozone therapy, and olive oil is 30.80, with a standard deviation of 7.25 a minimum

value of 21, and a maximum value of 40. In the intervention group, using the same observation sheet this is in line with previous research, according to which the BWAT observation sheet can be used to measure the score of wounds given conventional wound care and also modern wound care. The number of amputations in patients has resulted in patients being afraid to undergo wound care and check their wounds at the hospital or other health workers, even though wound care is good for the wound healing process so that it can improve the quality of life of sufferers. The a need to build a relationship of mutual trust at the beginning of wound care. Some patients are afraid to undergo wound care because they are afraid of pain, accepting reality, and also subsequent amputation. The amputation process has an impact on the patient's physical and psychological health. Special nursing care is needed to meet the physical, spiritual, cultural, and emotional needs of post-amputation that are unexpected or unplanned.

Wound care uses non-pharmacology, namely wound care, that uses therapy to treat wounds. Ozone therapy and infrared therapy are two types of alternative treatments used to speed up the healing of foot wounds in diabetes sufferers. Diabetic foot wounds can be a serious problem due to poor blood circulation, infection, and the body's slower ability to heal wounds. Ozone therapy uses ozone gas, which is used to treat various health problems, including infections, anti-virus, anti-bacterial, anti-fungal, anti-inflammatory, anti-pain, and binding body metabolic waste and body toxins. Ozone therapy uses ozone in gas form, which can be introduced into the body through infusion, intramuscular injection, or intravenous injection. Ozone gas can also be mixed with oxygen and injected directly into the body through the skin. Ozone therapy can improve immune performance, reduce viral load, and speed up the healing process of diabetic wounds. (Rusdianti, 2023)

Olive oil has been used in traditional and modern medicine to aid wound healing, including diabetic foot ulcers. The nutritional content and natural properties of olive oil make it an attractive alternative for the treatment of chronic wounds such as diabetic ulcers. (R.Faradillah et al. , 2023) Olive oil contains natural antioxidants and anti-inflammatories, such as polyphenols, vitamin E, and monounsaturated fatty acids, which can aid in the wound healing process. Topical application of olive oil to diabetic foot wounds can help maintain moisture, prevent dryness, and potentially speed healing.

In line with the results of research conducted by R Faradillah in 2023 which showed that the combination of ozone therapy and infrared therapy is an effective therapy to improve blood circulation in helping wound healing and is systemic effective in reducing the size of wounds, reducing hospitalization and producing more antioxidants in patients with diabetic foot ulcers. (R. Faradillah et al. , 2023)

The researcher's assumption is that age is a major factor in wound healing. If the patient is elderly, healing takes longer than at a young age. In patients with diabetes mellitus, healing will take longer and it is not certain that they can be completely cured, unlike other wounds such as accidents, healing will be faster. The dominant wound healing of respondents has reached the stage of epidermis and/or dermis liseration and there are respondents who have reached the stage of all layers of skin being lost with extensive destruction, damage to muscle and bone tissue. And there are also respondents who have reached the epithelialization stage. Healing of diabetes mellitus wounds can be influenced by daily nutrition and blood sugar levels. In patients with diabetes mellitus, to accelerate the wound healing process, patients need to pay attention to nutrition during wound care, namely protein, because it can help repair skin tissue and other body tissues that are damaged. Likewise with blood sugar levels, if blood sugar levels are not controlled, this will complicate the wound healing process, namely by exercising regularly, regulating food intake, checking blood sugar regularly, and being disciplined in consuming diabetes medication according to doctor's recommendations.

Average Wound Healing After Combination Intervention of Infrared Therapy, Ozone Therapy and Olive Oil on Diabetic Foot Ulcers.

After the intervention was carried out for 28 days, the results of the research data showed that the average healing of diabetic foot ulcers after being given a combination of infrared therapy, ozone therapy and olive oil was 21.00 with a standard deviation of 3.43 and a minimum value of 17 and a maximum value of 27. There was a decrease in the diabetic foot ulcer treatment group after the researcher administered a combination of infrared therapy, ozone therapy and olive oil.

The combination of infrared therapy, ozone therapy, and olive oil for the treatment of diabetic foot wounds offers a holistic approach that utilizes the benefits of each therapy to speed healing and prevent complications. Diabetic foot wounds are often difficult to heal due to poor blood circulation,

nerve damage (neuropathy), and a high risk of infection. The combination of these three therapies is designed to address the problem from multiple angles, namely by increasing circulation, reducing infection, accelerating tissue regeneration, and maintaining wound moisture. Infrared therapy uses light with wavelengths that can penetrate skin tissue and increase blood circulation. Infrared light widens blood vessels, increasing blood flow and oxygen to the wound area, which is important for healing chronic wounds in people with diabetes. Ozone can be given in gas form which is applied directly to the wound through a techniqueozone baggingor applied in the form of ozonated olive oil. Ozone helps speed healing by increasing oxygen supply to tissues, killing pathogens, and repairing damaged tissues.

Olive oil contains powerful antioxidants, such as polyphenols and vitamin E, which can fight oxidative stress and accelerate skin cell regeneration. Additionally, olive oil is moisturizing, keeping the wound moist, which supports faster healing.

According to the researcher's assumption, the combination carried out for the treatment of diabetic foot wounds shows effective results because each of these therapies has a good role in the treatment of diabetic foot wounds, as well as stimulating cell growth through increased blood circulation, then olive oil and ozone support tissue regeneration, providing an optimal environment for the formation of new tissue. This can be measured with the BWAT (Bates-Jensen Wound Assessment) format. The BWAT sheet can be used to assess or measure wound healing.

Average Wound Regeneration Value Before Control Group Intervention for Diabetic Foot Ulcers in the Agam Health Center Work Area 2024

In the control group, the wound care used was only 0.01% HOCL fluid without using additional therapy, then after being observed, the research results showed that the average pre-test wound regeneration of the control group before being given intervention had a mean of 35.30 with a standard deviation of 7.088, the minimum value was 27 and the maximum value was 46.

Diabetic foot ulcers are caused by three factors often called triads, namely: ischemia, neuropathy and infection. Uncontrolled blood sugar levels can cause chronic peripheral neuropathy where the neuropathy is sensory, motor and also autonomic. In people with diabetes have vascular disorders such as ischemia, this is caused by the process of macroangiopathy and decreased circulation such as tissue characterized by the loss and reduction of arterial pulses that cause the feet to become atrophied, cold and nails thicken. Then there is tissue necrosis which can cause ulcers which usually start from the tips of the feet or legs. Neurovascular disorders in people with diabetes will be treated with atherosclerosis where atherosclerosis is a condition of arteries that thicken and narrow due to the accumulation of fat in the blood vessels. (Primadina et al., 2019) Thickening of the arteries in the legs can affect the muscles in the legs due to lack of blood supply, tingling, discomfort and also in the long term can cause tissue death that will develop into diabetic foot ulcers (Kartika, 2017). Common complications of Diabetic foot ulcers are skin infections, bones, abscesses, gangrene, deformities to amputation.

According to the Researcher's Assumption, the control group was treated with wounds without using adjuvant therapy. In this control group, the researcher only saw a comparison with the intervention that had been carried out in the intervention group. This control group only cleaned the wound using sigpro fluid, different from the intervention group. The above conditions indicate that there is still a lack of knowledge of diabetic foot wound patients and their families regarding wound care using adjuvant therapy.

Average Wound Regeneration Value After Control Group Intervention for Diabetic Foot Ulcers in the Agam Health Center Work Area 2024

After being observed for 28 days in the control group that only used 0.01% HOCL fluid when treating diabetic foot wounds, the results of the study showed that the average regeneration of diabetic foot wounds Post-Test control group was 25.70 with a standard deviation of 6,584, the minimum value was 17 and the maximum value was 38. Where the post-treatment group score was lower than the control group, this is because 0.01% HOCl focuses on wound disinfection, while the combination of infrared, ozone, and olive oil therapy emphasizes tissue regeneration, reducing inflammation, and skin nutrition.

This is in line with research by Khairul Bahri (2021) which states that wound healing with hypochlorous acid in patients with diabetes mellitus is very effective in killing germs around the wound and shows that wound healing with hypochlorous acid is proven to be faster. Sigprocare contains hyochlorous acid which does not cause trauma, is environmentally friendly and does not cause delays in

wound healing. In addition, sigprocare HOCl 0.01% is also used to compress wounds or infections because HOCl is a microbial used to remove biofilms.

According to the researcher's assumption in the control group that did not undergo additional intervention from the researcher, there was no increase in wound regeneration scores in diabetic foot ulcer patients. Where at the time of observation in the control group there was no increase because only 0.01% HOCL fluid was given without additional therapy such as combination therapy or adjuvant therapy. When observing patients in the control group, patients were less aware of other alternative treatments such as combination therapy, researchers did not see a significant difference in the results of this test.

The Effect of Combination Infrared TherapyOzone Therapy And Olive Oil Intervention Group Against UlcersDiabetic Foot

Based on table 5.7, it shows that the average score of diabetic foot wound healing in the treatment group before being given infrared therapy intervention, ozone therapy and olive oil was 30.80 with a standard deviation of 7.25 and the average score of wound healing of respondents after being given 6 times of infrared therapy intervention, ozone therapy and olive oil was 21.00 with a standard deviation of 3.43. There is a difference in the average score of diabetic foot wound healing in the treatment group between before and after being given infrared therapy, ozone therapy and olive oil, obtained *P-value* (0.0005) < α (0.05) (Ha Accepted) means that there is a difference in the average wound healing using a combination of infrared therapy, ozone therapy and olive oil before and after the intervention was given.

According to the researcher's assumption, the effect of the combination of infrared therapy, ozone therapy and olive oil in healing diabetes mellitus wounds is due to a decrease in the mean score before and after being given a combination of infrared therapy, ozone therapy and olive oil, which is 30.80 to 21.00. The decrease in the degree of diabetes mellitus wounds is caused by the administration of a combination of infrared therapy, ozone therapy and olive oil because it provides significant benefits in healing diabetic foot wounds. The main benefits include increased circulation and tissue oxygenation, protection from infection, reduced inflammation and pain, and accelerated tissue regeneration. This combination therapy offers a holistic and effective approach to addressing the challenges of diabetic wound healing, which may help reduce the risk of serious complications, such as amputation, and improve patients' overall quality of life.In addition, the speed of wound healing is also influenced by age and width of the wound. Respondents with younger ages will experience faster wound healing than elderly respondents. This is because the cells owned by young respondents are more active in dividing and regenerating so that the wound healing process takes place faster than respondents with older ages, especially the elderly. In addition, the width of the wound also affects the speed of wound healing. The wider the wound, the more cells are needed to regenerate the wound and it takes longer to heal.This combination of therapies makes the patientfeel the positive impact, namely that the wound is getting better and the patient satisfaction level is good.Some patients said they were happy and had just learned how to treat wounds in a modern way.Where modern maintenance techniques are very precise and careful when carrying out the work and using tools.which is used completely to support the wound healing process. Some patients regretted previously doing conventional treatment which caused pain during the process and also the wound did not get better. From the explanation above, the wound care technique with modern dressing is very good fromThe results that have been studied show that there is a faster healing process compared to other treatments.conventional which has a slow healing process. Then this combination therapy wound care is safe forwounds and does not cause new wounds.

The Effect of Intervention on Control Group on Diabetic Foot Ulcers

Based on table 5.8, it shows that the average score of diabetic foot wound healing of respondents in the control group before being given intervention was 35.30 with a standard deviation of 7.088 and the average score of wound healing of respondents after being given 6 interventions in the control group was 25.70 with a standard deviation of 6.584. There is a difference in the average score of diabetic foot wound healing of respondents between before and after being given infrared therapy and ozone therapy, obtained *P-value* (0.0005) < α (0.05) (Ha Accepted) meaning there is a difference in the average wound healing in the control group.

In this control group using sigprocare HOCl 0.01 % administration in healing diabetes mellitus wounds that affect the healing of diabetes mellitus wounds, it can be seen that there is a

decrease in the score on the BWAT sheet such as wound depth, wound edge color, amount of exudate, amount of necrotic. Wound healing with sigprocare HOCl 0.01% not only affects diabetes mellitus wounds but can also be used on other wounds such as burns, accident wounds. HOCL 0.01% focuses on preventing infection, so the quality of the tissue formed may not be as optimal as methods that support active tissue regeneration. Then the healing tissue can take longer to become strong and healthy because it only utilizes the body's natural processes without additional stimulation.

The researchers assumed that the healing results in the control group would be in line with what usually happens in daily clinical practice. Wound healing is slower , and the risk of complications such as infection or even amputation remains, especially in patients with advanced diabetes or wounds that are difficult to heal. Because the control group received only standard care without additional therapies (eg infrared therapy, ozone therapy, or olive oil), the researchers assumed that their healing would be slower and perhaps not as effective as the group that received the new intervention.

Effectiveness of Giving Combination Intervention of Infrared Therapy and Ozone Therapy with Olive OilBefore and After UlcersDiabetic Foot

Based on table 5.9, the results of this study indicate that the average healing of diabetic foot wounds in the intervention group was 21.00 and in the control group was 25.70. There was a difference in healing of diabetic foot wounds between the intervention group with the provision of infrared combination therapy, ozone therapy and olive oil intervention and the control group (no intervention from the researcher) with a mean difference of 4.7. Based on the results of the study, there was a significant difference in the treatment of diabetic foot wounds between the intervention group and the control group where the p value = 0.054 ≤ α (0.05) Ha was accepted.

Based on the research results of Amir et al., (2022) it was stated that there was a difference in wound healing in diabetic ulcer patients in the control group (without ozone therapy) and the treatment group (treated with ozone therapy) at the Kedungdung Health Center, Bangkalan Regency. This is also supported by the research results of Fahada et al., (2023) which found that the tendency for decreased levels of VEGF, TGF-β, and PDGF in wound exudate occurred because the inflammation and proliferation processes in the treatment group took place faster than the control group. From this study, it can be recommended that ozone therapy be used as a therapy in wound healing.

This study is in line with the study conducted by Rahmi, et al (2017) with the title "diabetic wound healing process with infrared therapy and ozone therapy at the Maitis Efrans Wound Care Clinic" in his study there were 2 respondents, it was found that the assessment of diabetic wounds before wound treatment with infrared therapy and ozone therapy in one respondent the total score was 54 and in respondent two the total score was 50 stated that the wound was regenerating. The diabetic healing process of the two respondents progressed, the final total score of respondent one was 30 and respondent two was 28 respondents (Nontji et al., 2019) .

Non-pharmacological or herbal therapy for wound care, one of which is using olive oil, olive oil has a large content, namely vitamin E to moisturize the skin and ward off infection, vitamin K for faster drying, healing wounds and bleeding, vitamin C is useful in forming red blood cells. In line with research from Nasiri et al, Pranata Dian, based on the title of Diabetes Mellitus Wound Care using Olive Oil with a P value = 0.000 (≤ 0.05) it was found that there was an effect of olive oil for treating damage to the integrity of the skin of Diabetes Mellitus wounds. In a more complete combination of therapeutic approaches by increasing blood flow, oxygenation, and tissue regeneration tends to provide better and faster recovery results. And the skin that is formed is also stronger and more elastic with maintained moisture, thanks to olive oil.

The existence of a very significant difference in the two groups of diabetes mellitus wound degrees is caused by the administration of a combination of infrared therapy, ozone therapy and olive oil providing significant benefits in healing diabetic foot wounds. One of the main benefits includes increased circulation and tissue oxygenation, protection from infection, reduction of inflammation and pain, and acceleration of tissue regeneration. This combination therapy offers a holistic and effective approach to addressing the challenges of diabetic wound healing, which may help reduce the risk of serious complications, such as amputation, and improve patients' overall quality of life.

The use of HOCL 0.01% can sting a little or cause discomfort to some patients, especially on open wounds. Compared to infrared therapy, ozone and olive oil therapy often have a more soothing effect and can help reduce pain, so patients may feel more comfortable during treatment. HOCL 0.01%

is good for preventing infectionAndkeep the wound sterile **,** but may not accelerate tissue regeneration as quickly as combination therapy. Then the combination of infrared therapy, ozone, and olive oil **provides** a more comprehensive approach , accelerating tissue regeneration, reducing inflammation, and producing better tissue quality.

CONCLUSION

Of the 20 respondents who were divided into the intervention group, 10 respondents in the control group were 10 respondents, all respondents were in the wound regeneration category before being given a combination of infrared therapy, ozone therapy and olive oil.

1. The average diabetic foot ulcer before being given a combination of ozone therapy and infrared therapy and olive oil was 30.80 with a standard deviation of 7.25.
2. The average diabetic foot ulcer after being given a combination intervention of ozone therapy and infrared therapy with olive oil was 21.00 with a standard deviation of 3.43 .
3. The average diabetic foot ulcer before intervention in the control group was 35.30 with a standard deviation of 7.088 and after intervention in the control group was 25.70 with a standard deviation of 6.584.
4. There is an effectiveness of providing a combination of infrared therapy, ozone therapy and olive oil interventions on diabetic foot ulcers in the Agam Health Center Work Area in 2024 with a value in the control group of 25.70 and a value in the intervention group of 21.00 with a mean difference of 4.7, there is a p value = 0.054 ≤ α (0. 05) (Ha accepted).

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1. For Respondents
   It is expected that respondents will be more motivated to apply the combination of infrared therapy, ozone therapy and olive oil in healing diabetic foot ulcers and pay attention to personal hygiene. This is because the wound regeneration process cannot run smoothly and effectively if personal hygiene is not maintained properly even though a combination of infrared therapy, ozone therapy and olive oil is given in healing diabetic foot ulcers.
2. For Educational Institutions
   It is expected to be an additional reference and scientific contribution for Fort De Kock University Bukittinggi regarding efforts to accelerate the healing of diabetic foot ulcers by providing a combination of infrared therapy, ozone therapy and olive oil for researchers and future researchers.
3. For Further Researchers
   It is expected that further researchers can conduct more in-depth research, so that the presentation of this research can be clearer. In addition, it is expected that further researchers can increase the number of samples in testing it to a wider scope and compare it with other interventions to test its effectiveness so that the research results can be more significant and detailed by considering its bias and it is expected for other studies to be able to check the patient's blood sugar before the intervention is carried out.

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