



A Comparison of Effectiveness of Hydrophobic Cutimed Sorbact Versus Cadexomer Iodine 0.9% on Healing of Diabetic Foot Ulcer: A Randomized Control Trial



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Abstract

Background: Diabetic foot ulcers have risen with DM. The IDF reports 15-25% of diabetics get foot ulcers, rising to 25% over time. Due to biofilm and bacteria growth, diabetic ulcers need advanced wound therapy using antimicrobial dressings. Modern antibacterial treatments include sorbact hydrophobic and 0.9% cadexomer iodine.

Purpose: Analyse the effectiveness of cutimed sorbact hydrophobic with cadexomer iodine 0.9% on diabetic ulcer infection.

Methods: A single-blind, fold-over, randomised controlled study. Patients with diabetes who developed foot ulcers between September 1 and December 1, 2023. One hundred sixty-two participants were randomly assigned to receive cutimed sorbact hydrophobic or cadexomer iodine 0.9%. After 120 days, both groups.

Results: It was found that the two groups had similar body mass index (0.364), wound size (0.317), and baseline age ($p=0.432$). The mean difference in confidence value of -0.16 (OR -2.54 to 1.29; $p=0.058$) showed that diabetic foot ulcers in both groups had similar wound size on the thirtyth day. On day 60 of treatment, Sorbact Hydrophobic showed a difference of 22.56 ± 9.87 compared to Cadexomer Iodine 0.9%, with an MD-CI value of -6.75 (OR 5.19 to -0.34; $p=0.039$). At 90 days of treatment, cadexomer iodine showed a significant difference from sorbact hydrophobic (9.73 ± 2.14), with an MD-CI value of -12.29 (OR -9.19 to -4.26; $p=0.016$; $R^2=-0.417$).

Conclusion: Sorbact Hydrophobic reduces wound size, infection and bacterial resistance, speeding chronic wound healing. On chronic wounds, hydrophobic sorbact can be used as a primary dressing.

Keywords: iodine, sorbact, cadexomer, wound care, wound chronic

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Introduction

According to the International Diabetes Federation (IDF, 2021), the number of individuals affected by Diabetes Mellitus was 425 million in 2017, and it is projected to rise to 629 million in 2045. Among the world's countries with the highest prevalence of diabetes mellitus, Indonesia placed sixth with 10.3 million cases. The number of individuals diagnosed with Diabetes Mellitus in Indonesia has climbed by 2.0%, surpassing the 1.5% increase recorded in 2013, according to reports from the Basic Health Research (Riskesdas, 2018). There are 131,846 individuals in West Java who have been diagnosed with diabetes, making about 1.7% of the population. According to the doctor's diagnosis, 5,592 people in Bandung alone have Diabetes Mellitus, regardless of age (Riskesdas, 2018). No statistically significant effects were found in relation to the DFU recovery process, and not all subjects thought that the contemporary dressings might be useful (Burhan & Sebayang, 2022). The researchers in this study set out to determine how well contemporary dressing therapy for diabetic foot ulcers (DFUs) compared to traditional wound care methods like povidone iodine (Burhan & Sebayang, 2022). The rise in the prevalence of DM has led to a corresponding increase in diabetic complications, specifically diabetic foot ulcers. According to the (Ogurtsova et al., 2017), the occurrence of diabetic foot ulcers increases to 25% throughout a patient's lifetime, with foot ulcers affecting 15-25% of those with DM. Diabetic foot ulcers accounted for 7-8% of hospital admissions in the United States in 2017, making it the leading cause (Burhan et al., 2022).

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Keywords: wound cleansing, wound care, wound chronic

According to Nurhida (2017), a significant proportion of patients with diabetes mellitus (DM) in Indonesia, specifically 32.5%, undergo amputation. Furthermore, among these patients, 23.5% are individuals with chronic diabetic ulcers who require hospitalization (Lin et al., 2020).

Diabetic ulcer is a long-term consequence of diabetes mellitus resulting from inadequate blood supply and nerve damage (Ndosi et al., 2018). The disorder has a bleak prognosis because to the prevalence of infection, which is the primary factor leading to foot amputation. The International Diabetes Federation (IDF) has explicitly outlined the measures for preventing diabetic ulcers and amputations since 2005. The primary objective of managing diabetic ulcers is to enhance wound healing (Kim, 2023). According (Baltzis et al., 2014), conducted research which found that moisture balancing, also known as modern dressing, is a prevalent kind of wound care in contemporary practice. Diabetic ulcers are skin wounds caused by macroangiopathic complications (Burhan & Arofiati, 2021). Common symptoms include frequent tingling, burning pain in the feet, loss of sensation, tissue damage (necrosis), reduced pulse, atrophy, coldness, thickening of the feet, and dry skin (Clarys et al., 2012). Patients frequently fail to see the wound and are prone to infection because of contamination by both aerobic and anaerobic bacteria. Typical microorganisms seen in long-lasting wounds include of *Staphylococcus aureus*, *Pseudomonas aeruginosa*, *E. coli*, Enterococci, and *Candida albicans*. Untreated gangrene will develop and need amputation (Akash et al., 2020). According to the (Ogurtsova et al., 2017), there is an estimated occurrence of lower limb amputations owing to diabetic ulcers every 20 seconds (Armstrong et al., 2017).

Cutimed Sorbact is a cotton dressing that has been coated with DACC (dialkylcarbonyl chloride), which is a derivative of fatty acids. Dressings containing this material have pronounced hydrophobic characteristics (Totty et al., 2017). Once the dressing comes into contact with its hydrophobic fibres, the bacteria in the wound will establish a lasting association with it (Morilla-Herrera et al., 2020). Once the bacteria in the wound are attached to the dressing, they will remain attached and will not separate from the dressing. When attached to Cutimed Sorbact, the bacteria are rendered dormant, and their metabolic activity is reduced (Kusu-Orkar et al., 2019; Rosana et al., 2009). Consequently, the process of bacterial reproduction is reduced, along with the production of bacterial toxins that hinder the healing of wounds. One advantage of Cutimed Sorbact compared to other chemically active agents like iodine is that it successfully binds infections without destroying them, which means there is no release of bacterial endotoxins. This facilitates the establishment of ideal wound conditions to promote spontaneous healing (Cutting, 2015; Homaeigohar & Boccaccini, 2020).

The field of wound care is experiencing rapid and significant growth in the healthcare industry. An emerging wound care technique involves the application of the moisture balance principle (Tottoli et al., 2020). Some literature suggests that employing this approach is more efficacious for the wound healing process than conventional treatments. The advancement of knowledge about contemporary wound healing techniques has emerged as a prevalent phenomenon in the healthcare domain, necessitating the enhancement of knowledge and proficiency among healthcare professionals, particularly nurses operating in this domain (Kolimi et al., 2022).

Cadexomer iodine can serve as a useful resource in the management of diabetic foot wounds (Woo et al., 2021). This dressing is intended for the topical treatment of diabetic foot wounds in venous ulcers, diabetic ulcers, and decubitus ulcers (pressure sores) (Westby et al., 2017). This dressing functions as a carrier system that facilitates the dispersion of iodine. Iodine can permeate the cell membranes of bacteria and interfere with the formation and production of proteins and nucleic acids (Homaeigohar & Boccaccini, 2020; Sood et al., 2014). The dressings contain cadexomers, which are small particles made of polysaccharides and contain 0.9% iodine. When applied to a lesion that produces fluid, the cadexomer particles can expand and gradually release iodine into the wound over time (Roche et al., 2019).

Method

This research

The Health Research Ethics Commission of University of Monash approved this randomized controlled trial (RCT) on August 2023, with registration number LPPM-UMI/065/08/2023.

Study Design & Participants

The study included persons aged 17-65 who had a diagnosis of diabetes and acquired a foot ulcer between September 1, 2023, and December 1, 2023. A random assignment was conducted for the group of 81 individuals, with some receiving the hydrophobic sorbate group and others receiving the cadexomer iodine group. An Indonesian study conducted a single-blind randomized controlled experiment with a sample size of 162 individuals who had diabetic foot ulcer lesions. The study enrolled participants from Queen Hospital Yogyakarta. The study comprised patients of both sexes who were receiving therapy for diabetic foot ulcers. The study's inclusion criteria





were determined based on the Bates Jensen wound assessment instrument, which included the following: a blood sugar level ranging from 120 to 180 mg/dl, a HbA1c level ranging from 4.5 to 7%, a lesion length exceeding 5 cm, and the presence of infection. This assessment incorporates comorbidities and complications as instances of exclusion criteria.

Sample Size

The researchers utilised the G-Power software to determine the appropriate sample size for the study, with a specific emphasis on the variable pertaining to the healing process of diabetic foot ulcer ulcers [2]. The final sample size for each group was calculated to be 42, based on several critical values (alpha level = 0.05), statistical power = 95%, and M1 (mean of group 1) = 19.4 M2 (mean of group 2) = 23.12 SD1 (standard deviation of group 1) = 8.75, SD2 (standard deviation of group 2) = 11.45. This resulted in a total sample size of 162 (Figure 1).

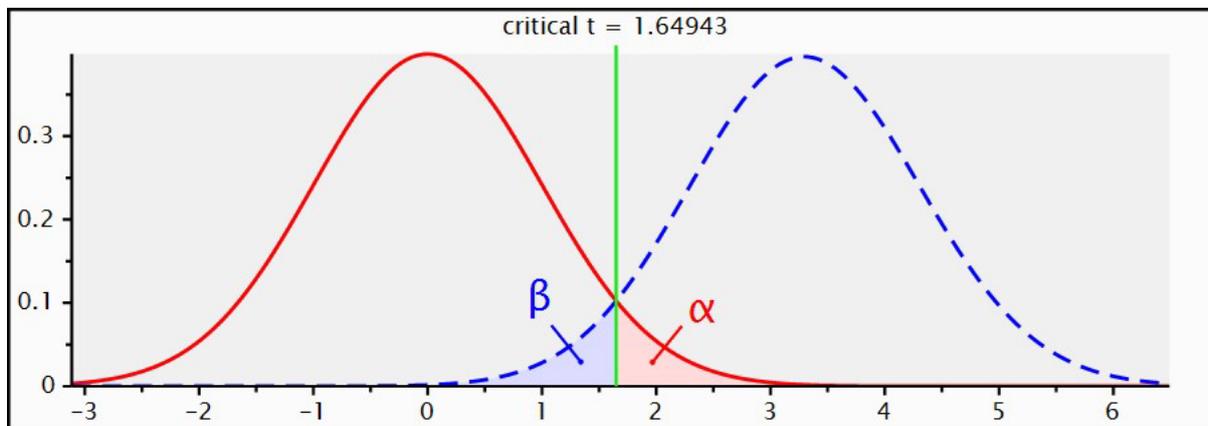


Figure 1. The mean difference between two independent means refers to the average discrepancy between the means of two distinct groups

Sampling

The research registration process has been finalized, resulting in the acquisition of a unique registration number and the issuance of a referral. Afterwards, the researchers proceeded to enter the designated room and formally introduced themselves to patients afflicted with diabetic foot ulcers (DFU). Afterwards, the researcher assessed the wound using the Bates Jensen Assessment Wound scale. The researcher also investigated the inclusion criteria and provided a detailed explanation of the study's objectives and procedures during the wound care session. Both male and female people who met the necessary qualifications and indicated their desire to take part in the study submitted a written consent form. By analyzing medical records, researchers were able to collect demographic data. The subjects were divided into two equal groups using a random assignment method: one group received sorbact hydrophobic and the other received cadexomer iodine 0.9%. Random Allocation Software (RAS) enabled this randomization by means of block randomization with block sizes ranging from 3 to 7. Capsules were placed into pre-made envelopes according to the quantity of samples. From one to sixty-two, we allocated numbers to each packet. By opening the envelopes in the order that the participants were enrolled in the experiment, the allocation of interventions was determined. The distribution envelopes were made by someone who had no part in the sample process. Maintaining a state of blindness was crucial for all researchers, participants, and outcome evaluators involved in this study.

Intervention

The diabetic foot ulcer (DFU) group got cutimed sorbact and cadexomer iodine 0.9% for ninety days during the wound care treatment. Every other day, dressing changes were made. Participants received a booklet with a table displaying the days of the week along with instructions on how to take care of their DFU wounds, maintain good personal cleanliness, and follow a diet. A phone number was provided to patients in case they had any questions or concerns.

Data Collection Tool

The researchers assessed individual appropriateness by considering demographic parameters and used the BWAT scale, which quantifies wounds [23]. This study incorporated demographic factors, including age, educational attainment, job situation, duration of diabetes, and duration of treatment for diabetic foot ulcers (DFU). Additionally, it considered blood sugar level and Hb1AC value. The Bates-Jasen score scoring sheet was used to collect data on wound size, to estimate and evaluate the average wound healing score.



Data analysis

The collected data was analyzed using the Jamovi program (Jamovi, 2023) and R-studio. The normality of the data was evaluated using the Kolmogorov-Smirnov test. The researchers analyzed the results using an intention-to-treat (ITT) methodology. The present study sought to investigate the impact of infection and ischemia on the process of wound healing. The researchers employed an independent t-test and Mann-Whitney U test to assess the wound size, toe-brachial index, transcutaneous oxygen tension, and infection rates in the two experimental groups

Results

The recruiting of participants took place in September and December of 2023. A study was conducted with 162 individuals who had diabetic foot ulcers. These individuals were randomly assigned to two groups, each comprising of 81 participants. Three individuals in the hydrophobic sorbact group declined to continue their participation and were thus eliminated from the trial. Additionally, one individual passed away because of disease complications, and another individual refused to participate due to the presence of other medical conditions, as indicated in Figure 1.

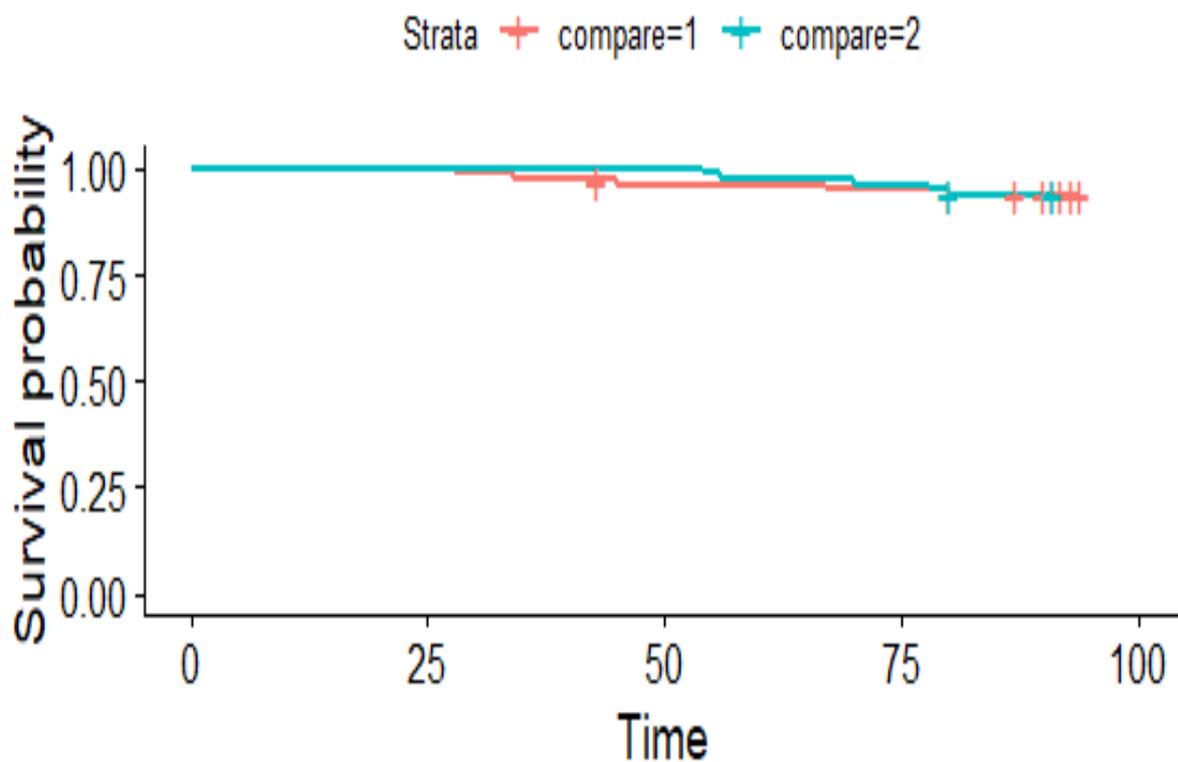


Figure 1. Survival analysis compare group sorbact hidropobic dan cadexomer iodine 0.9%.

Within the cadexomer iodine 0.9% group, two individuals declined participation due to irrelevance, while three individuals with comorbid problems and systemic disorders were excluded, as depicted in figure 1 and figure 2.

The study found that the participants' ages were similar, with a mean age of 46.76 years (standard deviation of 14.92). The p-value for this finding was 0.432. The Body Mass Index indicates that the value in both groups is approximately equal, specifically 28.28 (8.9), with a p-value of 0.364. Regarding gender, the percentage of female participants was greater in the hydrophobic sorbact group at 61.2%, while in the cadexomer iodine group it was 0.9%. In contrast, the percentage of male participants was 67.56% in the cadexomer iodine group. The statistical significance, as indicated by the p-value, was 0.231. At the educational level, the results were consistent, with the average percentage of high school students in the hydrophobic sorbact group being 46.12% and in the cadexomer iodine 0.9% group being 51.35%, with a p-value of 0.219. When analyzing the length of diabetes, the hydrophobic sorbact group had the greatest diabetes rate of 47.88% over a four-year period, while the cadexomer iodine 0.9% group had a rate of 48.18%.



The statistical significance, as indicated by the p-value of 0.301, suggests that there is no significant difference between the two groups. In the context of diabetic foot wound care, the hydrophobic sorbact group achieved a tau value of 51.83%, while the cadexomer iodine group achieved a value of 46.14%.

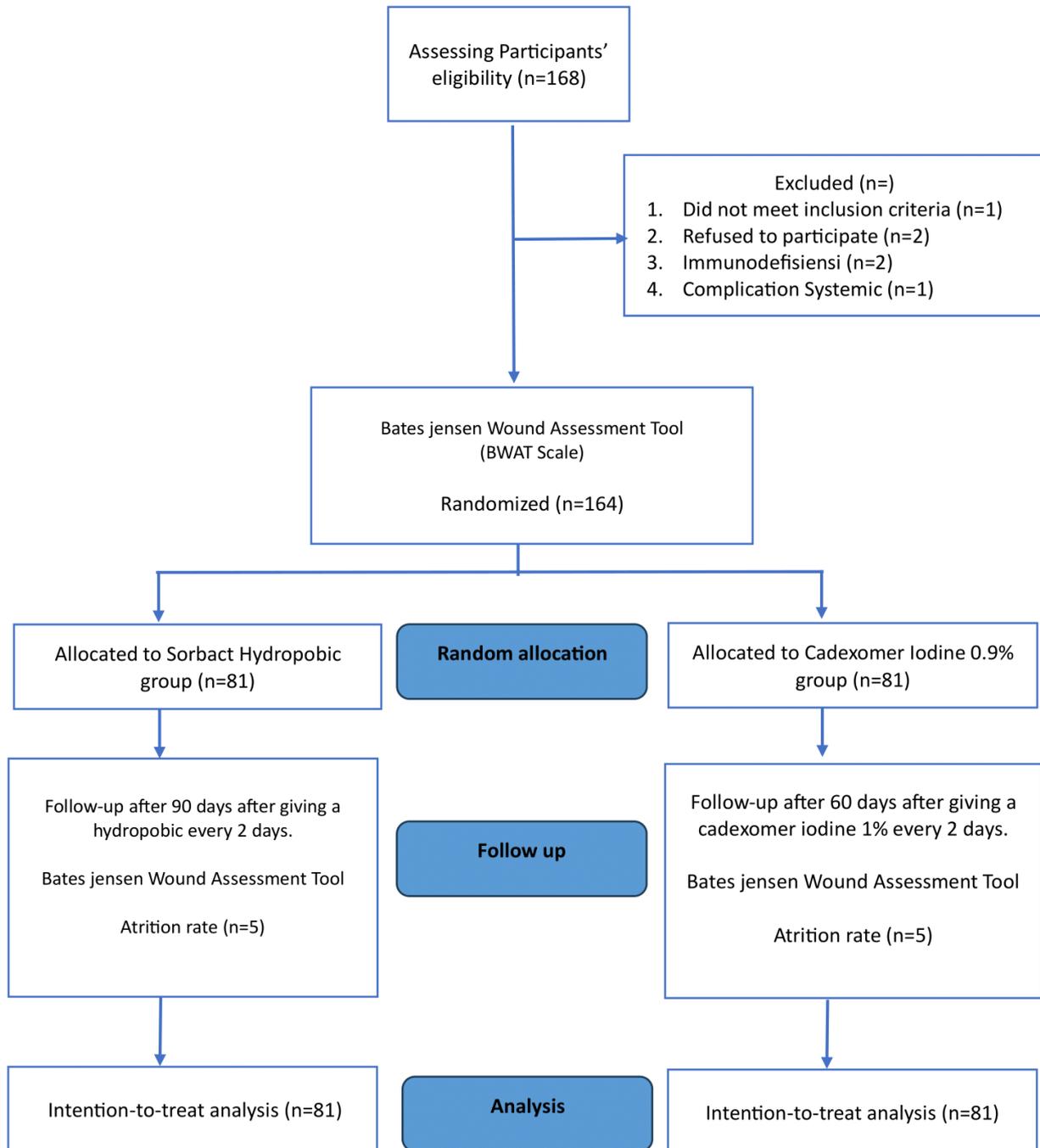


Figure 2. Flowchart of the study (CONSORT)

The p-value for the comparison between the two groups was 0.732. The blood sugar levels at the time of examination indicated that both groups were close to the normal range, with an average value of 116.52±57.23 (57.23). The statistical analysis showed that there was no significant difference between the groups, as indicated by a p-value of 0.194.



Table 1. Comparison of diabetic foot ulcer characteristics baseline between ozone and placebo groups

Variable	Sorbact Hydropobic (n=81) Mean±SD and n (%)	Cadexomer Iodine 0.9% (n=81) Mean±SD and n (%)	P-value
Age (Years) <i>53.12±12.26</i>	46.32±16.34	47.21±13.51	*0.432
Body mass index (kg/m ²) <i>27.28±5.34</i>	28.17±8.16	28.11 ±9.64	*0.364
Gender			
Male	78 (38.8)	91 (67.56)	**0.231
Female	84 (61.2)	71 (32.44)	
Level Education			
Junior high school	61 (33.76)	56 (27.81)	**0.219
High school	73 (46.12)	82 (51.35)	
University	28 (31.2)	24 (20.84)	
Duration of diabetes			
Three years	47 (21.13)	43 (32.10)	**0.301
Four years	78 (47.88)	65 (48.18)	
>Five years	69 (30.99)	54 (19.72)	
Long-term diabetic foot ulcer			
1 years	92 (21.8)	79 (46.14)	**0.732
2 years	45 (37.8)	52 (34.12)	
>3 years	25 (40.4)	31 (19.74)	
Glycemic (mg/dl) <i>153.52±43.78</i>	110.54±61.14	121.65±53.32	*0.194
HbA1c (mmol/L) <i>10.84±4.3</i>	10.64±4.20	11.15±5.21	*0.642
Wound Size (Cm) <i>Baseline 25.61±12.14</i>	32.19±7.34	35.11±9.15	*0.317

The hemoglobin A1C test revealed an average value of 10.89±4.70 in both groups, with a p-value of 0.642. The size of the lukan in both groups is homogeneous, with an average value of 33.65 and a p-value of 0.317, as shown in table 1. The average wound size score in the dressing group did not change on treatment day 30.

Table 2. Comparison of mean scores of wound healing size, and placebo groups

Variable	Sorbact Hydropobic group (n=81) Mean±SD	Cadexomer Iodine 0.9% group (n=42) Mean±SD	Mean difference (95% Confidence Interval)	P-value	r ² /r _{rb}
Day 30 treatment	35.11±18.13	34.64±15.82	-0.16 (-2.54 to -1.29)	0.058*	-0.319*
Day 60 treatment	22.56±9.87	32.73±14.38	-6.75 (-5.19 to -0.34)	0.039*	-0.264*
Day 90 treatment	9.73±2.14	17.38±8.92	-12.29 (-9.19 to -4.26)	0.016*	-0.417*

The Mean Difference Confidence Interval (MD-CI) value was -0.16 (OR -2.54 to -1.29), with a p-value of 0.319 and an R2 value of -0.319. By the 60th day, the treatment started to demonstrate a reduction in the size of the diabetic foot wound. The MD-CI value was -6.75 (OR -5.19 to -0.34) with a p-value of 0.039 and an R2 value of -0.264. On the 60th day of treatment, a notable reduction in wound size was observed, indicated by an MD-CI value of -12.29 (OR -9.19 to -4.26), with a p-value of 0.016 and an R2 value of 0.417. This information is presented in table 2 and figure 3.



Figure 3. Diabetic foot wound healing process day 1 to day 90.



Discussion

According to the data in table 2, the average wound score after using hydrophobic sorbact treatment for modern wound care is 9.73. The highest wound score recorded is 9, which suggests that the wound is undergoing regeneration. A lower score implies a better wound condition. In contrast, the wound score for cadexomer iodine 0.9% is 29.38. The wound scores ranged from -9.19 (highest) to -4.26 (lowest). As a result of the properties of Cutimed Sorbact, bacteria are rendered inactive, and their metabolic activity is reduced. Consequently, the process of bacterial reproduction is reduced, along with the production of bacterial toxins that impede the healing of wounds. One advantage of Cutimed Sorbact compared to other chemically active chemicals like iodine is that it successfully binds infections without destroying them (Burhan et al., 2023). This prevents the generation of bacterial endotoxins that can lead to the development of bacterial resistance (Kusu-Orkar et al., 2019). Meanwhile, Cadexomer Iodine will undergo gelation for a period of 72 hours, thereby promoting the acceleration of tissue growth through the wet qualities of the wound healing process. According to the research, modern wound care methods can maintain a moist environment, prevent infections, speed up the healing process, absorb excess wound fluid, remove dead tissue, provide comfort, be sterile, and be cost-effective (Gupta et al., 2022).

Elevated levels of microorganisms prevent wound healing and favor its chronification. The main target when colonization occurs is to reduce the bacterial load to a level that promotes mobilization of the immune system. The hydrophobic dressing prevents the formation of biofilms on the wound through physical effects, so the possibility of antimicrobial resistance is significantly reduced, triggering keratinocyte migration which leads to periodic epithelialization and decreased wound size (Morilla-Herrera et al., 2020). Hydrophobic sorbact has been found to be highly efficient in the treatment of chronic wound infections, According (Kusu-Orkar et al., 2019), Ten patients were included in this case series, with ages ranging from eleven months to eight years. There were five girls and five boys. Hot water burns accounted for 80% of the burns, and all individuals had Fitzpatrick skin type VI. Half of the patients who took sorbact hydrophobic saw improvement in seven days, 70% in fourteen, and 100% in twenty-one. No burn wounds had unfavourable healing, and the investigation only found one wound complication. The duration of hospitalisation ranged from zero to eleven days (mean = 5.1 days), and the average number of dressing changes was one and a half (range = 1-2). Furthermore, (Malone et al., 2017), conducted a study titled "Effect of cadexomer iodine on the microbial load and diversity of chronic non-healing diabetic foot ulcers complicated by biofilm in vivo". They used scanning electron microscopy and fluorescence hybridization to confirm the existence of biofilm in all 17 individuals with diabetic foot ulcers included in the study. The dressings used in contemporary wound care methods must fulfill specific criteria, including the maintenance of wound hydration, absorption of exudate, infection control, odor management, and efficacy in treating diabetic ulcers (Afonso et al., 2021; Pouget et al., 2020). In accordance with previous research that one of the wound dressings capable of minimising exudate and biofilm in wounds is hydrophobic sorbact which has superior efficacy compared to various wound dressings such as cadexomer iodine against *Pseudomonas aeruginosa* biofilm exudates in ex vivo models (Fitzgerald et al., 2017; Homaeigohar & Boccaccini, 2020).

Strengths And Limitations of The Study

This study employed a randomized controlled trial with single-blind methods, which is considered a rigorous and reliable research approach with a strong statistical power. The potential for researcher bias in the sample and data collection was mitigated. Nevertheless, the utilization of sorbact and cadexomer iodine 0.9% is restricted in terms of non-blinded statistical values. We further emphasize the importance of proficiency and adherence to standard operating procedures while using this hydrophobic sorbact in the treatment of diabetic foot lesions

implications on patient care and the profession.

The findings of this study have significant implications for the field of diabetic foot wound care, particularly for the use of hydrophobic sorbact. The results will offer choices for managing infections and reducing the size of wounds in the healing process of diabetic foot ulcers.

Conclusion

The research conducted on groups, specifically diabetic ulcer patients treated with Cutimed Sorbact (Hydrophobic) antimicrobial wound care and those treated with Cadexomer Iodine (Hydrogel) wound care, indicates that on day 90 of the wound healing process, the average value of hydrophobic sorbact was -12.29 (OR-9.19 to -4.26; $p=0.016$; $R^2=0.417$). The study findings demonstrated a notable disparity in the wound healing process between the utilization of Cutimed Sorbact (Hydrophobic) and Cadexomer Iodine 0.9% wound treatment. This discrepancy arises from the fact that the dressing's effectiveness increases as the value decreases.

Author contribution

Septian Mixrova Sebayang, M.N: Conception and design of study, Search Data Base, Methodology, Extration Data Qualitative, Extration Data Quantitative, Analysis Risk of Bias, Data Analysis and Intepretation, Writing – Review and Editing. 1.Asmat Burhan, M.N: Conception and design of study, Search Data Base, Methodology, Extration





Data Qualitative, Extration Data Quantitaive, Analysis Risk of Bias, Data Analysis and Interpretation, Writing – Review and Editing

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Funding Information

None

Conflict of Interest Statement

The authors declare that they have no competing interests.

Data Availability

Upon reasonable request, the datasets used or created for this study can be acquired from the relevant author..

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