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Healing Progression of Diabetic Ulcers Post Debridement with Comprehensive Wound Care: A Case Study

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Abstract

Background: Diabetes mellitus (DM) is characterized by hyperglycemia or elevated blood sugar levels above normal limits. Patients with diabetes mellitus are at high risk of skin integrity disorders, and treatment for this condition involves debridement and comprehensive ongoing wound care. This case study analyzes the outcomes of debridement surgery on a diabetic ulcer in the left antebrachial region at a secondary healthcare facility, as well as ongoing wound care at a primary healthcare facility. Method: Descriptive case study approach. A 59-year-old patient with a history of DM since 2018 and a diabetic ulcer in the left antebrachial region underwent debridement surgery at the secondary healthcare facility and received continuous care using a comprehensive wound care method until complete healing was achieved at the primary healthcare facility over approximately four to five months. Results: Wound healing was achieved in the patient's hands through comprehensive wound care, which is crucial for achieving the desired tissue repair goals. Conclusion: The involvement of a multidisciplinary healthcare team also facilitated the development of an integrated strategy. Emotional support from the family also played a significant role in the patient's wound healing.

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Introduction

Diabetes mellitus (DM) often causes various symptoms and complications in various organs of the body, so it is also known as the silent killer (Julaeha & Farisma, 2022). In 2022, 14% of adults aged 18 years and older had diabetes, up from 7% in 1990. More than half (59%) of adults aged 30 years and older with diabetes did not take medication for their diabetes in 2022. The lowest coverage of diabetes treatment was found in low- and middle-income countries (WHO, 2024). Based on data from the 2018 Basic Health Research (Riskesdas), 2.0% of Indonesians aged 15 years and older were found to have diabetes mellitus based on a doctor's diagnosis. However, when viewed from blood test results, the prevalence rate is much higher, reaching 10.9% in the same age group (Rustiana et al., 2024).

Diabetes mellitus is characterized by hyperglycemia, or elevated blood sugar levels above normal limits (Widasari. et al., 2022), That is, when blood glucose levels are ≥126 mg/dL in a fasting state or after at least 8 hours without calorie intake. A plasma glucose level of ≥200 mg/dL 2 hours after an Oral Glucose Tolerance Test (OGTT) with a 75-gram glucose load, or a random plasma glucose level of ≥200 mg/dL with classic symptoms or a hyperglycemic crisis (Soelistijo, 2021).

Peripheral diabetic neuropathy is one of the complications or complications in patients with diabetes and can trigger the risk of diabetic ulcers (Budiawan et al., 2024). Diabetic ulcers are open wounds caused by nerve damage and vascular disease that commonly occur in patients with diabetes mellitus. Wounds or trauma in areas affected by peripheral neuropathy often go unnoticed due to loss or reduction of sensory function, which ultimately leads to more serious wounds (Ismail et al., 2023).

Patients with diabetes mellitus are at high risk of skin integrity disorders, and treatment for this involves debridement and ongoing wound care (Sari et al., 2023). Wound healing is a complex biological

process to restore damaged tissue. This process is influenced by various factors, both internal and external to the body. In its treatment, healthcare professionals collaborate with other healthcare teams to manage these factors and create optimal healing conditions for patients (Ahmed et al., 2024). Comprehensive nursing intervention is a multidisciplinary approach that includes health education, nutritional guidance, physical activity, medication, and other nursing aspects (Zhou & Zhou, 2024).

Based on the data and analysis above, this case study aims to analyze the results of debridement surgery on patients with diabetic ulcers in the left antebrachium region performed at advanced health facilities and continuous wound care performed at primary health facilities.

Methods

This study used a descriptive design with a case study approach, in which one patient with a post-operative debridement diabetic ulcer was treated continuously using a comprehensive wound care method until complete healing was achieved. This research began in September 2024 and continued until January 2025. The study lasted approximately 4 months after the first debridement of the diabetic ulcer in the left antebrachium region experienced by the patient. The study was conducted at two locations: Lombakasih Community Health Center and Tanduale General Hospital in Bombana District. Lombakasih Community Health Center was the first place the patient visited when the wound was severe, after which the patient was referred to Tanduale General Hospital where the debridement surgery was performed. Post-debridement wound care was then continued at Lombakasih Health Center in Bombana District.

Data collection methods and techniques include interviews, physical examinations, and medical record checks. The interview method uses a direct anamnesis process with the patient, as well as anamnesis with family members. Physical examinations include inspection, palpation, auscultation, and percussion. Medical record reviews are conducted to review the patient's treatment history, and supportive examinations are performed by reviewing laboratory test results.

Results

A 59-year-old female patient presented with an open wound on her left hand, initially a small boil that later enlarged, ruptured, and spread to almost the entire left hand. The patient has had diabetes mellitus since 2018 and experienced her first wound at the end of December 2018. The wound described in this article is the fifth wound that has occurred during the patient's lifetime. The patient also reported feeling very weak and appeared pale. The patient takes diabetes medication irregularly and sometimes does not undergo routine blood sugar level checks, citing lack of time to visit healthcare facilities. The medications the patient is taking include metformin 3x500 mg, glimiperide 1x4 mg, and arkafit 2x1.

Previously, the patient consumed three main meals a day, with snacks consisting of traditional Bugis sweets such as bolu rampah cake, onde-onde, dadar gulung, and so on. Snacks were consumed only 1 to 2 times a day, not every day. The main meal consisted of white rice in normal portions, according to the patient, approximately 1-2 scoops of rice, accompanied by side dishes such as vegetables and fish. Patient undergone sedentary lifestyle.

Physical Examination:

General condition: moderately ill, alert with a GCS of 15 (E4V5M6). Blood pressure 110/70 mmHg, pulse 92 beats per minute, strong and regular, respiration 20 breaths per minute, temperature 37.1°C, SpO2 98% on room air, Visual Analog Scale showing a score of 3. Conjunctiva appears anemic, chest and abdominal examinations within normal limits. Local examination of the left forearm region revealed an open wound in the form of an ulcer with an erythematous base, edema, minimal pus, no active bleeding, and tissue necrosis at some edges of the wound. Palpation revealed warmth, tenderness, normal sensation, CRT <2 seconds, and limited range of motion due to pain and swelling. GDS examination showed 293 mg/dL. Wagner classification indicated grade 4. The patient's diagnosis at the initial examination was generalized weakness + suspected anemia caused by chronic inflammation + diabetic ulcer in the left antebrachium region + Type 2 Diabetes Mellitus.

Figure 1. Healing progression of diabetic ulcer on antebrachium region on the patient left hand: (**a**) Image of the ulcer in the left forearm region of the patient upon first presentation (September 8, 2024); (**b**) Postoperative debridement at the referral hospital (September 9, 2024); (c) Overview of continuous wound care in patients 4 weeks after debridement surgery; (d) Image of diabetic ulcer in a patient with complete healing (January 2025).

The patient was then referred to Tanduale District General Hospital in Bombana Regency for further management of the patient's diabetic ulcer. Debridement surgery was performed, and blood sugar control was managed through insulin administration and a diet prescribed by the hospital. After one week of inpatient care at the hospital, the patient was discharged to continue outpatient care. Wound care was also recommended at the community health center, with daily dressing changes for the first two weeks of treatment and every two days thereafter. Nursing care included monitoring wound characteristics (drainage, color, size, odor), monitoring signs of infection, wound care by removing dressings, cleaning the wound, applying ointment, and re-dressing the wound. Education is also provided to the patient and their family regarding signs of infection in the wound, recommended dressing change intervals, balanced diet recommendations, and self-care instructions for the wound.

During the wound care process, patients also frequently undergo blood sugar tests at the health center. These include random blood sugar tests and fasting blood sugar tests. During treatment, the patient's blood sugar levels are controlled and remain within normal limits, specifically no more than 200 mg/dL for random blood sugar tests and no more than 126 mg/dL for fasting blood sugar levels. Patients are also educated about foods that should be avoided to prevent rapid spikes in blood sugar levels. Recommendations for protein and fiber intake, as well as complex carbohydrates with a lower glycemic index, are also taught to patients and their families.

In social life, family support, especially from children, plays a crucial role in the healing process of patients. Their involvement helps patients better understand their condition and encourages compliance with the treatment plan provided by healthcare professionals. For patients using BPJS Health Insurance Class II, this ensures access to the necessary healthcare facilities.

Discussion

The wound healing process occurs naturally as the body's response to tissue damage. However, the mechanism is complex because it requires coordination between various cells, cytokines, mediators, and the role of the vascular system (Wallace et al., 2023). Wound healing is the process of tissue repair after an injury through the phases of inflammation, proliferation, and remodeling or maturation (Naziyah et al., 2022).

Diabetic ulcers are complications in patients with uncontrolled DM, which are caused by poor glycemic control, peripheral vascular disease, and neuropathy (Alzamani et al., 2022). Neuropathy plays a role in ulcer formation by altering pain and pressure sensations in parts of the body of patients with DM,

such as the feet. This also affects skin integrity and reduces circulation, making wound healing more challenging, especially for deeper wounds involving tissue and bone (Ahmed et al., 2024).

In this patient, complete wound healing occurred after continuous wound care for approximately 4 to 5 months. There are several factors that cause wound healing to take longer, such as bacterial contamination, weakened immune system, coagulation disorders, blood supply, and the patient's advanced age (Marques et al., 2024). Healing problems can also caused by vascular insufficiency/ peripheral artery disease (PAD), peripheral neuropathy that involved sensory/motor/autoimmune) (Dayya et al., 2022).

Debridement surgery was undergone for this patient. Debridement aims to speed the wound process by promote the production of healthy granulation tissue. There are several type of debridement treatment, surgical debridement is the gold standard of wound debridement. It was done under a strict sterile environment and have rapid outcome, it also needs adequate pain management and also post-operation nursing care to provide wound healing (Clare et al., 2021). Surgical debridement reducing the risk of infection by removing the necrotic tissue and reduce the risk of abscess formation due to ulcers that can lead to amputation (Moghaddam Ahmadi et al., 2024).

Post-debridement patient care is mostly carried out at the primary health care facility level, namely the Lombakasih Community Health Center. At the community health center level, a comprehensive approach is still implemented to improve peripheral tissue perfusion and achieve improvement in skin tissue integrity in patients. In practice, this is achieved through collaboration among a multidisciplinary healthcare team comprising doctors, nurses, and nutritionists. This interprofessional synergy enables the development of integrated strategies, such as optimal blood sugar control, weight management, and continuous wound care. Through this collaboration, it is hoped that patients will experience improvements in wound condition, effective diabetes management, and prevention of further complications that could compromise peripheral tissue health. Emotional support is also provided by the patient's family, helping the patient feel able to navigate the healing process with the full support of both family and healthcare professionals (Ismail et al., 2023).

Research limitations

This study was conducted at a primary health care center in a rural area, resulting in many limitations in observing these patients. Limitations in facilities and infrastructure, such as complete blood tests and cultures, prevented researchers from identifying the types of bacteria contributing to the formation of diabetic ulcers in these patients resulting the use of broad-spectrum of antibiotics for this patient.

Conclusion

The management of diabetic ulcers in this patient demonstrates that successful healing depends not only on medical interventions such as debridement, glycemic control, and continuous wound care, but also on a holistic approach involving patient education, family support, and multidisciplinary collaboration among healthcare professionals. Postoperative care at the community health center was able to maintain tissue integrity through routine wound monitoring, maintaining blood sugar levels within normal limits, and following a diet plan recommended by a nutritionist. Factors such as age, vascular condition, and infection risk also influence healing time, which in this case took approximately 4–5 months. Emotional support from family, utilization of BPJS health insurance, and active patient involvement in the care process are key elements supporting treatment success and preventing further complications. In conclusion, a holistic approach that includes diabetes management, proper wound care, and family support are key factors in achieving the best possible outcomes for patients.

Appendix A

Table 1. Wound care timeline of the patient with diabetic ulcers on the hand

Time / Week	Treatment	Clinical Finding	Clinical Notes
Week 0 (Day 0)	Patient comes to the primary health care, traditional wound toilet + referral to the district hospital	Open wound with necrotic tissue, moderate exudate	Blood sugar 293 mg/dL, IV line treatment as long as pain killer was given as preparation before referral
Week 0 (Day 2)	Surgical Debridement	Open wound, the necrotic tissue has been removed	Patients who have undergone initial debridement surgery are given prophylactic antibiotics
Week 2	Wound care with modern dressings (hydrogel + sterile gauze)	Necrotic tissue decreased, granulation tissue began to appear	Blood glucose is now under control, education on wound care at home

Time / Week	Treatment	Clinical Finding	Clinical Notes
Week 4	Continued treatment + routine check-ups	Extensive granulation, minimal exudate	No signs of infection, patient compliant with follow-up appointments
Week 8	Continued treatment + routine check-ups	The wound has shrunk to approximately 40% of its original size, with healthy granulation	Controlled blood sugar levels during fasting and non-fasting periods
Week 12	Advanced wound care	The wound is almost closed, with active epithelialization at the edges	Minimal pain, normal mobilization
Week 16	Final evaluation	The wound closed perfectly without any sign of infection	The patient was declared fully recovered, and received education on preventing recurrence of ulcers

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