Comprehensive care of a patient with diabetic foot syndrome – a report of two clinical cases

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Summary

Diabetic foot syndrome (DFS) is an external symptom of diabetes mellitus that has been ongoing for many years, usually uncontrolled. Systemic treatment must be carried out in parallel with local treatment. The basic element of the therapy is a diagnosis, followed by implementation of causal treatment and proper local management. Because of the increased risk of malnutrition in this group of patients, many studies also indicate the need to implement nutritional treatment. Therefore, in the comprehensive treatment of a patient with DFS, it is also advisable to educate the patient and their family about nutrition and encourage them to choose better nutritional options. This paper presents 2 case reports of patients with DFS in whom nutritional intervention was implemented.

Key words: diabetic foot syndrome, nursing care, nutritional treatments.

Introduction

Diabetic foot syndrome (DFS) is a common complication in patients with diabetes. The risk of ulcer formation during the lifetime of a diabetic patient is 12–25%. Risk factors for DFS include longer duration of diabetes, age, foot deformities, higher body mass index (BMI), and smoking [1]. According to epidemiological data, more than half of lower limb amputations worldwide are still performed in patients with diabetes, and the formation of an ulcer is the first step on the path to limb loss [2]. Unfortunately, DFS is often diagnosed too late, either at the time of ulcer formation or when the diagnosis of diabetes is established, and the reason for this is usually related to a lack of diligence in screening [3].

For practical purposes, a distinction is made between neuropathic and ischaemic (neuron oedematous) diabetic foot. These forms differ in their clinical picture, including the characteristics of ulceration, and they usually require different modes of care [4, 5]. The basic element of therapy is diagnosis, followed by implementation of causal treatment and proper local management [6]. Because of the increased risk of malnutrition in this group of patients, many studies also indicate the need to implement nutritional treatment [7, 8]. Therefore, in the comprehensive treatment of a patient with DFS, it is also advisable to educate the patient and their family about nutrition and encourage them to choose better nutritional options [9, 10].

Case studies

Patient 1

An 81-year-old woman was admitted to the Chronic Wound Management Clinic due to an ulceration of the left lower limb. The patient was self-treating the callus until she noticed a serous exudate on her sock. The patient had no previous examinations related to the diagnosis of the ulceration.

Subjective examination:

- type 2 diabetes for around 3 years (oral medication),
- hypertension,
- wound developed 8 months earlier,

- so far used "corns patches" and soaking feet alternately in soap suds and potassium permanganate,
- lack of complaints of the nature of intermittent claudication and rest pain,
- visual analogue scale (VAS) – 3 points,
- patient has severely limited physical activity – noticeable muscular atrophy due to mobility difficulties,
- nutritional risk screening-2002 (NRS-2002) – 3 points,
- the patient consumed meals irregularly and consumed products of low nutritional value, no vegetables and fruits or meat, occasionally protein products, e.g. yogurt, milk.

Physical examination:

- ankle-brachial index: left limb – 1.08,
- toe-brachial index: left limb – 0.93,
- test of pressure and touch sensation with Semmes-Weinstein monofilament in the area of increased pressure – impaired,
- BMI – 19.5.

The patient did not use specialized pressure relief at the site of increased pressure.

Description of the ulceration and surrounding skin

Wound located on the sole of the right foot, under the base of the hallux valgus toe. The ulceration had a total area of 19.25 cm^2. The depth of the ulceration at a measurable location was 0.35 cm^2. The wound surface was 90% covered with keratinized epidermis, and 10% of the defect was yellow necrosis. The skin around the callus slightly reddened, on the rest of the foot especially in the heel area, covered with keratinized epidermis-hyperkeratosis. The nail plates were long, keratinized, with abnormal direction of growth, directed towards the centre of the foot.

Implemented management

During the first visit, the wound and surrounding skin were thoroughly cleaned of keratinized epidermis, ointment residues, dressing fabrics, and other foreign bodies. Subsequently, material was collected from the deepest part of the wound for microbiological examination, using the zigzag method, from which *Streptococcus pyogenes*+ was isolated. For the first week, the frequency of visits to the outpatient clinic was every 2 days. Antimicrobial dressings with low absorbent properties were applied to the wound surface. An emollient (Epaderm) was applied to the keratinized skin. The patient was also prescribed a nutritional intervention: a high-protein, high-energy Nutridrink Skin Repair nutritional formula containing arginine, zinc, and antioxidants (200 ml twice a day). Depending on the stage of the healing process, the amount of secretion, and microbiological status, different types of specialized dressings were used, including thin hydrocolloids and mesh dressings. The patient and her family were educated on self-care and wound care. The education also included encouragement to improve her diet by eating more low-fat sources of high-quality protein, vegetables, complex carbohydrates, and fewer simple carbohydrates. The patient was advised to purchase specialized orthotics to relieve the pressure area. To improve the condition of the nails, including shortening them, the patient was referred to a podiatrist (Table 1).

Achieved result

After 3 months of intensive therapy, healing of the ulceration was achieved. The patient was educated in

Table 1. The course of the healing process as a reduction in area of the ulcer

Therapy week	Area/depth of ulcer [cm^2]
First	19.25/0.35 (Fig. 1)
Fourth	5.75/0.2 (Fig. 2)
Eighth	0/0 (Fig. 3)

Ryc. 1. First week of therapy

Ryc. 2. Fourth week of therapy

Table 2. The course of the healing process as a reduction in the area and depth of the ulceration

Therapy week	Area/depth of ulceration [cm^2]
First	25.50/1.20 (Fig. 4)
Fourth	2.25/0.5 (Fig. 5)

the prevention of ulcer recurrence, self-care, hygiene and foot care, and maintenance of optimal nutritional status. The patient systematically used customized orthotics to reduce pressure associated with pressure.

Patient 2

A 69-year-old man admitted to the outpatient clinic for the treatment of chronic wounds due to an ulceration on the left lower limb.

Subjective examination:

- wound of a recurrent nature; the first ulceration was formed around 8 years earlier, another one 3 years ago, and the current ulceration – a year earlier,
- to date, the patient has used emollient ointments, specialty dressings purchased independently at the pharmacy,
- comorbidities: type 2 diabetes for the last 10 years, hypertension,
- VAS – 4 points,
- NRS-2002 – 3 points,
- the patient mainly consumed meals low in protein, vitamins, and minerals; his diet was based on artificially processed products consumed in excessive amounts,
- occasional use of a cane or crutch (in only when going out for a long walk).

Physical examination:

- ankle-brachial index: left limb – 1.4,
- toe-brachial index: left limb – 0.88,
- test of pressure and touch sensation with Semmes-Weinstein monofilament in the area of increased pressure – impaired,
- BMI – 33.0.

Description of the ulceration and surrounding skin

The wound was located on the left lower limb, on the sole of the foot, on its outer side. The total area of the ulceration was 25.50 cm^2. The depth of the defect at the deepest measurable point was 1.2 cm^2. The surface of the wound and surrounding skin was 80% covered with hard, keratinized epidermis, covered with remnants of clots, fabrics, hair, and other foreign bodies. The rest of the surface comprised granulation tissue. The edge of the wound was mostly covered with thick, keratinized epidermis.

Implemented management

After cleaning the wound, material was collected for microbiological examination using the zigzag method, from which *Escherichia coli*++ was isolated. During the first week the therapy, outpatient clinic visits were made every 2 days. The wound bed was systematically cleaned, and dead tissue was surgically removed. In the first stage, an antimicrobial mesh dressing was applied to the wound surface, which ideally filled the deep skin defect, and an absorbent dressing was applied secondarily. To eradicate pathogenic microorganisms, the wound and surrounding skin were washed with a broad-spectrum antiseptic. After clinical improvement, the frequency of visits to the outpatient clinic was reduced to once a week. Local management was modified primarily by the clinical condition of the wound and the amount of exudate produced. From the beginning of therapy, the patient was advised to consume high-protein and high-energy nutritional supplements containing arginine, zinc, and antioxidants (Nutridrink

Ryc. 3. Eighth week of therapy

Ryc. 4. First week of therapy

Skin Repair) twice a day. Throughout the therapy, he used pressure relief in the form of specialized footwear, relieving pressure in the forefoot area (Table 2).

Achieved result

During the one-month follow-up, the clinical condition of the wound improved. Both the area and depth of the defect decreased significantly.

Discussion

Diabetic foot syndrome is an external symptom of diabetes that has been ongoing for many years, usually uncontrolled. Systemic management must be carried out in parallel with local management. Its course is determined by the aetiology of the ulceration and the current condition of the patient, including the presence of comorbidities. First, a history of the ulceration, the mechanism of injury, and previous wound management is taken. It is necessary to focus the history and specialized examinations on the detailed aetiology of the ulceration, asking about risk factors, and presenting complaints and symptoms of additional comorbidities. The examination also includes an assessment of social and economic conditions, the expectations of the patient, and their motivation and willingness to cooperate in the process of holistic treatment, nursing, and wound healing [3, 11]. Due to the high risk of malnutrition in patients with diabetes, especially in the elderly, it is necessary to assess nutritional status [8, 12].

The first case report presents a patient with diabetes mellitus who developed a callus during a foot and valgus toe deformity. Foot deformities in patients with diabetes can be related to the underlying disease (deformities resulting from motor neuropathy, atrophy of the small muscles of the foot), but can also be independent of it (e.g. the common valgus toe) [13]. Overtraining, friction, and repetitive injury associated with walking and repeated mechanical stress result in the formation of calluses (foci of hyperkeratosis) – areas of increased hardness that cause pressure on underlying tissues and are a risk factor for wound formation [14]. Patients with neuropathy and limited joint mobility have a 12-fold higher risk of ulceration [15].

Some studies [7, 12] show a high risk of malnutrition in patients with diabetes, especially in the elderly. In the present case report, the patient's nutritional status was also assessed. The body mass index was 19.5, and the patient scored 3 on the NRS 2002 scale, with one point added due to her age (> 70 years), so this result indicated the need for further observation of nutritional status and implementation of nutritional support. Based on the patient's history, it was evident that she was not consuming enough and the right quality of foods to guarantee a normal nutritional status. According to Evert *et al*. [16], a patient who does not have a sufficient and balanced diet, and who consumes the required energy but does not consume adequate nutrients, is considered malnourished. Maier *et al*. [17] evaluated the dietary intake of patients with DFS and showed that they met only 55% of the reference intake values for energy (p = 0.008) and consumed 0.57 g protein/kg body weight, which is alarmingly lower than the adult intake standard (0.8 g protein/kg body weight). They also had significantly ($p < 0.05$) lower intakes of vitamins and minerals such as vitamin E, B1, B2, B3, B6, magnesium, calcium, iron, potassium, and sodium, which are needed for wound healing. Similarly, Sajid *et al*. [18] showed that the protein intake of men and women with DFS was significantly lower than recommendations (76.9 g and 56.8 g compared to 219.5 g and 130.2 g, respectively). Although studies assessing the nutritional status of ambulatory patients are rarely cited in the literature, in a study by Tasci *et al*. [19] malnutrition was more common among elderly patients with type 2 diabetes mellitus. Therefore, in the case report presented herein, after general treatment and the implementation of relieving and local management in accordance with recommendations [20], nutritional treatment was also included. Good nutritional status contributes to good health, independence, and quality of life, especially in the elderly. Nutrition is an important mediator for maintaining skin continuity,

Ryc. 5. Fourth week of therapy

strengthening tissue immunity, and promoting tissue repair [21 ,22]. Skin regeneration is an important aspect of wound healing, supported by adequate nutrition. Nutritional support therefore plays a key role in wound healing. Furthermore, based on the results of 2 randomized controlled trials in patients with pressure ulcers, it appears that certain nutrients play an active role in wound healing independently of protein and energy provision [23–25]. Both studies showed that the use of a high-protein diet enriched with arginine, zinc, and antioxidants in patients with ulcers accelerated the healing of chronic wounds and reduced the frequency of dressing changes, which probably reduced the overall cost of treating ulcers. In one of our studies [26], we showed that nutritional support enriched with arginine, zinc, and antioxidants significantly accelerates the healing process of venous ulcers. In contrast, in a multicentre study by Neyens *et al*. [8] conducted on a group of 29 patients, DFS (n = 9), ischaemic ulceration (n = 5), venous ulceration (n = 8), and decubitus ulceration (n = 7), showed that 13 ulcers (6 DFS, 3 arterial ulceration, 4 venous ulceration) reduced in area by 25–88% during the 12-week observation period. In contrast, 10 (3 DFSs, 3 arterial ulcers, 4 decubitus ulcers) achieved complete healing, while the remaining 3 patients (2 arterial ulcers, 1 venous ulcer) did not improve.

The second case report presents a patient with diabetes who developed an ulcer for the third time. The patient, despite previous recommendations at the outpatient clinic, did not systematically apply pressure relief. The patient underwent diagnostics, based on which the neuropathic aetiology of the ulceration was established. It is known that ulcers in neuropathic DFS typically develop on the sole side, in areas of increased pressure and internal pressure of the foot. Typically, these areas are around the convex heads of the metatarsal bones, the toes, and sometimes the heel. The wound has a regular shape, surrounded by a characteristic thick, rolled edge, which is very often covered with keratinized epidermis [20]. In the treatment of a patient with DFS, the relief of the limb plays a crucial role. The use of pressure relief on the foot after the ulcer has healed is also of prophylactic importance. This is because it significantly reduces the risk of callus recurrence and recurrent ulceration in the future. Therefore, in the presented case report, education was systematically carried out, and the importance of using specialized footwear was emphasized.

The patient was also evaluated for nutritional status. Based on the patient's history, it was determined that he was not consuming sufficient products to ensure a normal nutritional status. The patient was single and consumed mainly fast-food products. He had increased his body weight by 10 kg over the past 3 years, which had resulted in a significant reduction of physical activity. His body mass index was 33.0, suggesting grade 1 obesity, and the patient scored 3 on the NRS 2002 scale, indicating the need for observation and the inclusion of nutritional treatment. The American Society for Parenteral and Enteral Nutrition defines as malnourished individuals who have at least 2 of the following symptoms: inadequate energy intake, weight loss, muscle loss, loss of subcutaneous adipose tissue, regional or extensive fluid accumulation, and decreased handgrip strength [27]. Although obesity due to excessive and unbalanced nutrition often accompanies diabetes, malnutrition is another complication of diabetes [7]. It is often omitted that some patients with diabetes type 2, whose main problem is overnutrition and positive energy balance, also have a significant risk of malnutrition. In a study of hospitalized diabetic patients, 29% of patients with type 2 diabetes had malnutrition or an increased risk of malnutrition. In this study, 72% of patients were overweight or obese [28]. Langemo *et al*. showed that [29] the dietary intake of energy, protein, and micronutrients essential for wound healing in patients with DFS was very low, even compared to recommendations for a healthy population. These findings are in line with other studies that have shown far too low intake of energy, protein, and micronutrients in this population [19, 30]. In addition, the presence of a wound causes the demand for energy and nutrients – especially protein, zinc, and vitamin C – to increase significantly [31], and the usual intake of these nutrients with the diet in diabetic patients is not sufficient and a real risk of deficiencies arises. In turn, deficiencies negatively affect the healing process because nutrients are an essential element at all stages of regeneration of damaged tissues. Tatti *et al*. [32] and Sipahi *et al*. [33] have shown that nutritional intervention reduces the cost of antibiotics and improves the overall appearance and depth of the wound. Therefore, in the patient, in addition to general management, i.e. debridement and local management in accordance with the TIMERS strategy, nutritional treatment was implemented.

Conclusions

Comprehensive care of a patient with DFS requires systemic, causal, and local management measures. A factor that significantly improves ulcer healing is the maintenance of proper nutritional status and the enhancement of healing potential by incorporating nutritional treatment with a product designed for the patient with a hard-to-heal wound – Nutridrink Skin Repair. The risk of malnutrition in patients with diabetes should not be ignored, and it should be remembered that these 2 clinical conditions can co-occur.

Authors declare no conflict of interest.

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