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Case Report

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Are enteral nutrition solutions effective in patients with diabetic foot wounds?

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ABSTRACT

According to the study entitled "Turkey Diabetes, Hypertension, Obesity and Endocrinology Diseases Prevalence Study-II" that was conducted in Turkey, the prevalence of diabetes was 13.7%. An important complication that concerns most medical disciplines involved in the treatment of diabetes patients group is the development of diabetic foot ulcers. The most important risk factors for the development of this complication are neuropathy, overpressure-induced foot deformity, external trauma, infection, and peripheral arterial disease. In the treatment of diabetic foot ulcers, the ideal treatment goals are effective removal of the necrotic tissues with sharp dissection, if possible; dressing to facilitate the absorption of the exudate and healing of the ulcer area; and selection of appropriate shoes or materials to reduce the pressure on the ulcer floor. If necessary, vacuum wound dressings, hyperbaric oxygen therapy, and granulocyte stimulating factor may be used. Moreover, bypass surgery or angioplasty methods can be used in patients with low peripheral blood flow to reduce the rate of ischemia. In the presence of clinical findings that indicated infection, tissue sampling should be performed from the ulcer tissue, and antibiotic treatment should be given as per the results of the culture antibiogram. Delay in treatment can lead to the progression of infectious agents into deep tissues and undesirable orthopedic interventions. After amputation, the disease starts affecting the social life of the patient. The required long-term physical therapy and rehabilitation program should be planned in consideration of the considerable psychological disruption caused by the condition and treatment. The healthcare cost associated with this disorder also poses a problem. Two important points that need to be remembered during this process, and are easy to control are good glycemic control and healthy food intake. Good glycemic control and effective nutritional support can sometimes heal the ulcer and make treatment possible. In this regard, it is important to understand the value of nutritional supplements that replace glutamine and arginine, which are normally present in sufficient amount in our body but become essential in catabolic processes.

Keywords: Arginine, diabetic foot ulcer, enteral nutrition, glutamine

Introduction

Patients with type 1 and 2 diabetes mellitus (DM) have a 34% probability of developing diabetic foot ulcer (DFU) during their life time, and DFUs are the cause of 20%–30% of non-traumatic lower limb amputations (1, 2). Most ulcers are polymicrobial and usually involve 5–7 infectious agents (3). In the treatment of infected wounds, the treatment goal is to remove the infection agents from the wound primarily via surgical debridement and dressing. Thus, the ulcer area is expected to shrink by 1%–2% per day, and 40%–50% of the area is expected to close in about 4 wk (4). Wound healing involves the regeneration process of the damaged tissue and is managed by many humoral and cellular factors. The effective execution of the process requires adequate and balanced nutrition that is as important as debridement and appropriate antibiotic use. Nutrients, such as vitamins A, C, D, and E; zinc; copper; magnesium; and iron, that are known to be beneficial need to be present in adequate amounts in the body. Glutamine and arginine become essential in the catabolic process; therefore, the supplementation of these two amino acids should also be considered. Glutamine is the energy source for inflammatory cells in the wound, and arginine increases the effectiveness of the lymphocyte response and the insulin growt factor 1 level. The use of antioxidants, such as selenium, enhances the effect of both, glutamine and arginine. Their positive contribution to the wound healing process should be known. After healing, the reported recurrence rate for DFUs is 40% a 1 y, 66% at 3 y, and 75% at 5 y (2).

Surgical debridement could not be performed, and appropriate antibiotic treatment could not be given to our patient

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with diabetic foot injury who did not want to undergo medical intervention in a clinical setting. Only wound care and 24 g hydroxy methyl butyrate L-arginine L-glutamine solution administration were performed. Thus, the wound was completely closed in about 10 wk and was expected to show a positive treatment outcome.

Case Presentation

A 63-year-old male patient presented with DFU in the fourth toe of his left foot. He was on oral anti-diabetic therapy because she had type 2 DM. He had no other known diseases or history of surgery. Physical examination showed that his wound was present between the distal of the fourth metatarsal bone and the proximal phalanx, and extensor tendon was seen. Its boundaries were irregular, and the surface had crests and exudate. The color of the skin was natural, the surface was dry, and the turgor tone was low around the wound. The amount of hair was reduced in the distal portion of the foot. The light touch test with 10 g Semmes Weinstein monofilament revealed a finding consistent with loss of sensation in three areas of the foot. The arteria tibialis posterior pulse was palpated, while the arteria dorsalis pedis pulse could not be palpated. In the ankle-arm index evaluation with hand Doppler, the rate of lower extremity systolic tension and upper extremity systolic tension were measured as 1.1. Based on this finding, lower limb perfusion was considered sufficient. Arterial Doppler ultrasonography was performed to evaluate the vascular flow patterns. The lumen of the peripheral arterial structures was reportedly open in the left lower extremity, and monophasic flow was observed in the arteria dorsalis pedis. The metatarsal bone and extensor tendon were observed, and direct foot radiography was performed to rule out osteomyelitis. No signs of osteomyelitis were detected on direct foot radiography. The presence of a foreign body in the soft tissue was ruled out. The biochemical parameters of the patient were as follows: glycosylated hemoglobin level was 8.7%, fasting blood glucose level was 264 mg/dL, sedimentation rate was 34 mm/h, and urea-creatinine levels were within normal limits. Debridement surgery for both performing wound culture antibiogram and removing necrotic tissues was recommended to the patient. He stated that he was engaged in farming, and therefore, did not wish to be transferred to another institution or hospitalized. Thus, dressing was performed by wiping the wound edge with 10% povidone iodine and closing the ulcer surface using gauze moistened with sterile saline; the procedure was described in detail to the patient and his relative. Thereafter, twice-a-day oral administration of 24 g hydroxy methyl butyrate L-arginine L-glutamine nutrition solution, known to exert a positive effect on wound healing, was started. He was regularly followed up in the outpatient clinic every week, and the wound was completely closed at the week 10 (Figure 1-3). The diabetic foot wound that developed in the lower extremity, known to have sufficient perfusion level, was closed using only nutritional product support and regular dressing. This case presents a good example for understanding the positive effects of nutritional support in patients with such wounds.

Main Points

- The contribution of nutritional support in wound healing should be well known. Effective infection control, proper wound care, and necessary surgical interventions may be insufficient for wound healing.
- The replacement of glutamine and arginine that become essential in the catabolic process and cause malnutrition should be remembered.
- DFU is a difficult and unwanted situation for the patient and the society with long-term treatment, requiring teamwork in the treatment process, and social and psychological aspects.
- There is an insufficient number of centers that are equipped to treat diabetic foot ulcers, and the healthcare cost is high. Thus, the occurrence of DFUs needs to be prevented, and diabetic patients need to be adequately educated on this issue.
- Certainly, proper glycemic control and nutritional support are as important as the other treatment methods in this patient group.

Figure 1. Diabetic foot infection with running, deeply located, with exudate on the surface located in the region of the left foot back that fits the fourth metacarpal distal and the proximal phalanx. Wound appearance in the second week after the use of 24 g HMB L-Arginine L-glutamine powder orally twice a day

Figure 2. Wound appearance at the fourth week

Figure 3. Wound appearance at the eighth week

Written informed consent was obtained from patient who participated in this study.

Discussion

Diabetic foot ulcer is a complex and difficult-to-treat complication of DM that concerns many medical disciplines. This condition can progress from a superficial wound to sepsis and may require amputation. Foot ulcers are reported to increase the mortality rate by 2.5 times in patients with DM (5). The main negative effect of hyperglycemia is the development of neutrophil dysfunction. Neuropathy and vasculopathy occur due to poor glycemic control and form the underlying pathophysiology of DFU. Sensory neuropathy reduces a patient's perception of heat and pain, resulting in delayed observation of the wound. The development of autonomic neuropathy reduces sweat secretion while standing, resulting in dry and brittle skin. This facilitates the spread of the infection to deep tissues. In contrast, motor neuropathy, causes the development of pressure-induced tissue damage owing to the development of foot deformity. Angiopathy is observed in about 50% of the patients with neuropathy. Ischemia caused by insufficient perfusion causes resistant infections. For evaluating perfusion, the ankle-arm index can be measured; a value <0.9 and >1.2 indicates peripheral artery disease (6). As DFU can be observed with only epithelial loss, it can also be purulent and necrotic. At the time of admission, 58% of the patients have an infection in their wound (7). There are several wound infection factors that vary based on the type and depth of the wound (8). The most common factor is staphylococcus aureus infection. Mild infections can be treated with erythromycin, clindamycin, or amoxicillin/clavulonic acid for 1–2 wk. More severe infections require 2–4 weeks of intravenous antibiotic therapy; the duration of therapy should be increased to 4–6 wk for patients who have osteomyelitis (9). Surgical debridement in DFU aims to remove all necrotic, fibrin-containing, and hyperkeratotic tissues until they reach the tissues that are considered alive (10). Sharp debridement is recommended every 7–14 d, depending on the wound healing status (11). After debridement, it is necessary to moisten the dry wound and reduce the moisture of the exudative wound. The 50% reduction in the wound area in the first 4 wk of treatment shows the potential for good prognosis and indicates that the wound would close within 12 wk with epithelialization. When 15% of the wound does not heal within 1 wk or 50% of the wound does not close within 1 month, the wound is termed chronic wound. Nutrition plays a significant role in wound healing and should thus be emphasized. Patients with chronic or non-healing wounds and nutritional deficiencies often require special nutrients. Energy, carbohydrate, protein, fat, vitamin, and mineral metabolism are all involved in this process

(12). Vitamins A, E, C, and D, magnesium, zinc, copper, and iron positively influence wound healing (13). Glutamine has an important role nucleotide synthesis. It is an important source of energy for fast-growing cells in patients entering the fast catabolic process and easily becomes essential. It is rapidly metabolized to glutamate and ammonia by the liver, the kidney, and the splanchnic organs.

Goswami et al. (14) showed that the oral administration of glutamine enhances wound healing and the epithelialization, wound contraction force, wound tension force, and wound surface closure rate in newly formed vascular structures. Arginine becomes essential in patients with similar critical diseases because it is consumed rapidly. Arginine is crucial for immunity and wound healing, plays a role in ammonia and nitrogen metabolism, and is required for nitric oxide formation. Increased nitric oxide level in the wound area positively affects the vascular permeability, bactericidal activity, and angiogenesis. It highly contributes to the healing of chronic wounds. Moreover, ornitine, a metabolite of arginine, can be converted into proline that is crucial for matrix development via collagen synthesis, cell growth, and differentiation (15, 16).

Treatment of patients with DFUs requires multidisciplinary work and the use of proven methods. Every stage requires careful monitoring. The burden of the treatment process that sometimes lasts for months and the healthcare cost of the procedures also warrant consideration. Repeated surgical debridement procedures and dressings, long-term antibiotic treatments, resources used for managing undesirable conditions developing during the process, and vascular and orthopedic surgical interventions needed in some cases demonstrate the complexity of this condition and its management. The most effective solution would involve the prevention of DFU development to avoid such situations.

At this stage, patient training of patients, performing regular polyclinic controls, use of treatments that will provide accurate glycemic control, and providing nutritional support that will keep body resistance high will play a key role. Further, 24 g hydroxy methyl butyrate L-arginine L-glutamine nutrition solution is an easy-to-use nutritional supplement product that can make positive contributions. Its positive effect on wound healing has been scientifically demonstrated. The daily use of 48 g hydroxy methyl butyrate L-arginine L-glutamine in our patient supports this situation in the treatment of DFUs.

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