



Multidisciplinary treatment of a complicated crural degloving injury in a diabetic patient[☆]

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ABSTRACT

Diabetes is a common disease that potentially interferes with healing processes after lower limb trauma. In our presented case a trimalleolar ankle fracture with undiscovered serious soft-tissue injuries resulted in chronic soft-tissue complications in a diabetic patient, requiring three and a half months of hospitalization in a higher level center and the application of state-of-the-art wound treatment, including vacuum-assisted closure therapy, Integra bioengineered skin substitute, split-thickness skin-grafting, and methods enhancing wound healing, such as polarized light therapy and transdermal CO₂ delivery. The presented case emphasizes the importance of soft-tissue care and multidisciplinary approach in diabetic trauma patients with poor compliance.

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Introduction

Epidemiologic studies shows that diabetes affected 6.4% of the world's adult population in 2010. It is estimated that the number of affected diabetic patients will rise to 7.7% by 2030, meaning a 54.1% increase in the total number of adult diabetic patients [1]. Regionally speaking, approximately 6.9% and 10.2% of the adult European and North American population was diabetic in 2010, with the numbers expected to rise to 8.1% and 12.1% by 2030, respectively [1].

A 2008 study by Vamos et al. showed that 6.2% of Hungarians over the age of 18 are suffering from diabetes and its complications [2]. It is estimated that about 591,000 Hungarians and 68.9 million Europeans will suffer from diabetes by 2035 [3]. This high prevalence will result in a significant economic burden on world health care of approximately 376 billion USD in 2010, and 490 billion USD in 2030 [4].

It is currently well-established that several factors can contribute to impaired wound healing in diabetes; diabetic neuropathy, vasculopathy, or increased susceptibility to infections [5]. Large-scale retrospective analysis performed by Wukich et al. have concluded that diabetic patients have a fivefold risk of developing postoperative infection, when compared to those without diabetes (foot or ankle surgery) [6]. This fact has been reinforced later on by the same research group; a prospective study involving 1465

patients concluded that a significantly greater number of surgical infections were observed in diabetic patients when compared with those without the disease [7]. Peripheral neuropathy has been identified as the largest contributor of postoperative infectious complications [6,7].

Our report describes and emphasizes the importance of multidisciplinary treatments of postoperative soft tissue complications following lower limb traumas and ankle osteosyntheses in cases of diabetic patients with insufficiently controlled glycaemic status.

Case report

A 68-year-old male patient was admitted to the emergency department of a community hospital with a trimalleolar ankle fracture and massive soft tissue contusion after suffering a forklift truck accident at his workplace.

The patient had a history of hypertension and type 2 diabetes known for 14 years, requiring NPH insulin treatment. Following admission to the emergency room the following treatment, fracture-fixation with tension band wiring of the medial malleolus and neutralization plating of the fibula was performed (See Fig. 1). Tetanus prophylaxis was administered and the wounds were closed after a thorough wound washout. Soft tissue degloving was not identified by the time of the primary intervention. On the tenth postoperative day the patient was febrile and necrotic area had appeared around the medial ankle which became progressively larger.

Following the development of necrotic complications the patient was referred and to our level I trauma center a septic shock with a poorly controlled glycaemic status. The skin was necrotized around the anterior surface of the shin, medial ankle and around

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Fig. 1. Post-operative X-ray following internal fixation of trimalleolar ankle fracture.



Fig. 2. Large soft-tissue defect of the lower leg.

the heel, with the tension-band wires visible (See Fig. 2). On examination a large hematoma was found on the lateral side of the lower leg. Mangled Extremity Severity Score (MESS) was used to assess the patient's condition. An initial score of 6 was calculated when the patient was transferred to our facility. A score of over 7 is highly indicative of amputation. With careful consideration between amputation or long-term combined limb-salvage approach, the latter was chosen.

Extensive surgical debridement and jet lavage irrigation was performed. The skin covering the area of the degloving injury was removed, the hematoma evacuated and drained. Split-thickness autografting was not possible because of the infection. The lesions



Fig. 3. Application of Integra® Bilayer Matrix Wound Dressing on the wound.

were covered with Epigard synthetic skin substitute and gauze pads were also applied. Postoperative therapy was the following; empirical antibiotic treatment, microbiological sampling, Low-molecular-weight heparin (LMWH) for thrombosis prophylaxis, antihypertensive treatment. Wound control and blood sugar control was strictly managed daily.

After two days, the patient became afebrile and his blood sugar level was stabilized. The first microbiological analysis revealed gram-positive cocci without granulocytes, with a bacterial culture was negative. Ten days postoperatively a new area of necrotizing skin and fatty tissue appeared on the area of the injury and the adjacent surface. Extensive necrectomy and another microbiological analysis was performed. Surgical debridement, jet lavage irrigation was repeated every two days. After another ten days there were no signs of necrotizing tissue, and vacuum-assisted closure (VAC) therapy was initiated for two weeks.

On the fourth week of admission, X-ray imaging showed signs of loosening of the tension band wires. Appropriate bone healing was evident, and the implants were removed to prevent osteitis. The second microbiological analysis showed a mixed infection with the following pathogens; *Enterobacter cloacae* and *ludwigii*, *Acinetobacter sp.*, *Proteus mirabilis* and *E. coli*. After consulting a microbiologist and an infectologist, the antibiotic therapy regime was altered to Gentamycin, taking the identified pathogens and the drug resistance into account.

(On the sixth week after admission, the patient started to complain of asthenia. Episodes of confusion were observed, and patients started to remove the dressings and his compliance decreased. The consultant internist recommended three units of blood transfusion based on the blood tests, low blood pressure, and weakness, while anti-diabetic insulin therapy was continued without major changes.)

(Psychiatric assessment revealed mild-severe depression and anxiety, and administration of SSRI (Selective Serotonin Re-uptake Inhibitor) and benzodiazepine was ordered.)

In the following period the medicational therapy, observation, and regular change of the dressings were continued. Any other sources of infection were negative.

Two months after admission a delayed precise necrectomy and application of *Integra® Bilayer Matrix Wound Dressing* on the affected area with the assistance of a plastic surgeon was performed (See Fig. 3). In the following period glycemic control worsened due to poor patient compliance.

Two weeks after the application of the *Integra® Bilayer Matrix Wound Dressing*, a full-thickness necrotic areas had appeared. The necrotic areas were excised and covered with a split-thickness skin graft taken from the left thigh (See Fig. 4).

2 weeks after the maggots (*Diptera Sarcophagidae*) were found in the area of the fresh skin graft. The larvae were removed. In the



Fig. 4. Covering the wound bed with a split-thickness skin graft.



Fig. 5. The chronic skin lesion was healed after three and a half months.

following period two methods were applied to enhance wound-healing; *Bioptron* polarized light therapy was applied to accelerate the healing process, and *D'Oxyva*® *deoxyhemoglobin vasodilator* treatment was applied to achieve better circulation in the affected area.

Following three and a half months of inpatient care the affected area of skin was macroscopically healed, and the patient was able to walk with crutches. He was discharged home. On the one-month follow up, the affected area appeared to be well epithelialized and the patient was able to walk independently (See Fig. 5).

Discussion

In the presented case an undiscovered severe soft-tissue injury combined with a poorly managed underlying diabetes resulted in serious soft-tissue problems. Despite an initial MESS score of 6 and the subjective clinical evaluation of the patient indicating amputation [8], limb salvation strategies were chosen after referral to a higher level trauma center.

In the acute phase the following strategies were applied; precise surgical debridement and the use of synthetic skin substitute, accompanied by antibiotic treatment and stabilization of glycemia and hypertension.

As chronic inpatient care resulted in poor patient compliance and exaggerated previously undiscovered psychiatric disorders, the chronic wound care strategy failed, and shifting to sophisticated wound care methods was needed.

Following patient admission and chronic management, long term wound care strategies failed due to poor patient compliance and psychiatric disorders. Advanced wound care methods were considered and carried out.

Several comprehensive reviews have concluded that vacuum-assisted closure is a justifiable method in the management of traumatic wounds [9,10]. Morykwas et al. have shown in their classic study that this method not only increases local blood-flow and enhances tissue granulation, but it also decreases the local bacterial count by a factor of 10^3 [11]. These evidences suggest that a suspected infectious wound, as in our case, can benefit from the application of vacuum-assisted closure.

After 2 months of treatment, application of bioengineered *Integra*® *Bilayer Matrix Wound Dressing* was chosen, as it has demonstrated good results in recent clinical studies [12].

Considering the chronic nature of the condition, the supposed microcirculatory impairment due to diabetes, and the application of a split-thickness skin graft, methods enhancing wound healing is a favored method. In our case, polarized light therapy was chosen, as Monstrey et al. have concluded that the use of polarized light results in significantly better wound healing in terms of the following; degree of epithelialization, the degree of inflammation, quality of the granulation tissue / scar tissue, and the comfort of the patient [13]. CO_2 was administered transcutaneously, as Brandi et al. have shown that it significantly increases tissue oxygenation [14].

Conclusion

The presented case underlines the importance of several aspects of traumatic limb care. Proper assessment of the soft-tissues on admission is crucial, while overlooking degloving injuries can lead to the development of complications. Multidisciplinary approach to diabetic trauma patients is highly advised, and should be taken in consideration. Hyperglycemia should be well controlled to facilitate the healing processes, to prevent local infections. Patients may benefit more from advanced wound care options and external techniques. The chronic condition of diabetes, combined with psychiatric disorders can be a challenge in maintaining patient compliance in terms of dietary restriction, physiotherapy participation and maintenance of hygiene. These further emphasize the importance of a multidisciplinary team approach.

Declaration of Competing Interest

None.

CRediT authorship contribution statement

Ákos Csonka: Formal analysis, Data curation, Writing - original draft. **István Gárgyán:** Formal analysis, Writing - review & editing. **Endre Varga:** Conceptualization, Writing - review & editing.

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