CASE REPORT

Emerging evidence in diabetic foot wound care: a paradigmatic study

Evidenze emergenti in vulnologia del piede diabetico: uno studio paradigmatico

Gaia Maestoso^ Francesco Piccirilli° Sonia Masullo§ Ivan Sciarretta* Pietro Antonino Renda Alberto Serra°°**

Abstract: Skin ulcers are a priority clinical issue for healthcare professionals worldwide, representing a shared patient safety concern. In Europe, an estimated 1.5-2 million people experience a chronic wound. Some 64% of wounds are managed at home. Of these, an estimated 24% has lasted 6 months or more, and almost 16% have remained unhealed for a year or more. It is estimated that 5% of lower limb ulcers are of diabetic origin, a condition that affects more than 3.5 million people in Italy. The most significant complication associated with diabetic foot injury is the risk of amputation. Indeed, the literature shows that about 80% of such injuries do in fact heal if properly managed by qualified personnel. These case reports have highlighted and consolidated the emerging evidence in the field of Wound Care and above all the importance of the multidisciplinary team in the planning and treatment of complex wounds, such as diabetic wounds. Further studies on the management of complex wounds in the area of the diabetic foot would be desirable in the future, with the intention of not only improving clinical practice, but above all the outcomes defined which will be decisive for the future quality of life of patients.

Riassunto: Le ulcere cutanee rappresentano una tematica clinica di prioritaria importanza per gli operatori sanitari di tutto il mondo, rappresentando un condiviso problema di sicurezza per pazienti. In Europa, si stima che circa 1,5-2 milioni di persone manifestano una ferita cronica. Il 64% delle ferite sono gestite a domicilio; tra questi, si stima che il 24% abbia vissuto con la ferita per 6 mesi o più, e quasi il 16% è rimasto non guarito per un anno o più. Si stima che 5% delle ulcere dell'arto inferiore siano di origine diabetica, una patologia che in Italia colpisce oltre 3,5 milioni di persone. La complicanza più rilevante legata alla lesione da piede diabetico è il rischio di amputazione, del resto in letteratura emerge che circa l'80% di tali lesioni guarisce se opportunamente gestite da personale qualificato. Questo case report ha consentito di evidenziare e consolidare quali siano le evidenze emergenti in ambito del Wound Care e soprattutto dell'importanza dell'equipe multidisciplinare nella pianificazione e trattamento delle ferite complesse, quali quelle diabetiche. Del resto nel futuro Sarebbero auspicabili ulteriori studi in merito alla gestione di ferite complesse in ambito del piede diabetico, con l'intento non solo di migliorare la pratica clinica, ma soprattutto gli outcomes definiti che risulteranno determinanti per la futura qualità di vita dei pazienti.

Key words: Wound care, Diabetic foot, Advanced dressings.

Key messages:

- The role of the multidisciplinary team in the management of a complex diabetic foot case is crucial in improving clinical outcomes.
- The use of rating scales is essential in assessing the healing process of a wound and its appropriate clinical treatment.

^ Nurse. Intensive Care Unit, Villa Mafalda, Rome. Former student of the Degree Course in Nursing, La Sapienza University at the Policlinico Militare Celio.
° Nurse NCO, Italian Army. Specialist in Wound Care. Orthopaedics and Traumatology Unit, Rome «Celio» Military Hospital.
§ Nurse. Neurosurgery Unit, San Giovanni Addolorata Hospital, Rome. Specialist in Wound Care and Enterostomy.
* Surgeon. Specialist in General Surgery and Aesthetic Medicine. Lecturer at the Scuola Superiore Internazionale di Studi Universitari, Ricerca e Formazione in Rome.
** Surgeon. Specialist in Plastic and Reconstructive Microsurgery. Lecturer at the Scuola Superiore Internazionale di Studi Universitari, Ricerca e Formazione in Rome.
°° Colonel (Italian Army), MD. Specialist in Orthopaedics and Traumatology.

Corresponding: Email: gaiamaestoso@gmail.com

Introduction

In recent years, skin ulcers have become a significant health concern, particularly in light of the ageing population and the increasing prevalence of chronic degenerative diseases (1). Skin ulcers are a clinical priority for healthcare professionals worldwide and represent a shared patient safety concern. Despite numerous national and international awareness and health education campaigns focusing on prevention and management, their incidence in hospital and community settings remains high (2). In Europe, it is estimated that 1.5–2 million people have a chronic wound. Around 64% of these wounds are managed at home, with an estimated 24% lasting six months or more and almost 16% remaining unhealed for a year or more. In their 2019 study, Ligresti et al. drew up a classification of skin ulcers based on their frequency and aetiology (3). Venous ulcers have the highest incidence, accounting for 70% of lower limb ulcers. Arterial ulcers are next in order of prevalence, accounting for 15% of cases, followed by mixed ulcers with an incidence of 7–10%. It is estimated that approximately 5% of lower limb ulcers are of diabetic origin, while 3% are secondary to other pathologies and/or conditions such as vasculitis, neoplasms, haematological problems and post-traumatic events (4). In Italy, according to the National Statistics Institute (ISTAT), it is estimated that 5.9% of the population, i.e. over 3.5 million people, have diabetes, and this figure has been slowly increasing in recent years. The most commonly encountered clinical complication in patients with diabetes is diabetic foot syndrome, which the International Working Group on the Diabetic Foot (IWGDF, 2019) defines as *'an infection, ulceration, or tissue destruction in the foot of a person with currently or previously diagnosed diabetes mellitus, usually accompanied by neuropathy and/or peripheral arterial disease (PAD) in the lower limbs*' (5).

A diabetic ulcer is a chronic lesion that affects the skin tissues, from the surface to the deeper layers. Depending on its severity, it can lead to infections and fistulas, which can result in necrosis and amputation of the affected area. Given that amputation is the most significant complication associated with diabetic foot injuries, literature indicates that 80% of these injuries heal with proper management by qualified personnel (6). Consequently, the involvement of a multidisciplinary team of medical specialists and nurses in wound care is becoming increasingly important in the management of patients with diabetic foot conditions.

Recent studies have conclusively shown that a moist environment is necessary for the healing of diabetic foot wounds and other types of wounds because it promotes the healing process.The decision on the type of dressing to be used is often key for vulnologists and should be based on data gathered from clinical observation, the degree of potential infection or established infection, and other complications. Indeed, hydrocolloids have been shown to be more appropriate for wounds that do not secrete large amounts of exudate than gauze, which causes patients pain during dressing changes. Hydrocolloids are also less costly as they do not need to be removed daily as gauze does (8). In contrast, in cases of very heavy exudate, traditional gauze appears to be more effective and less expensive, and the pain experienced by patients during dressing changes does not differ between types (9).

Some types of advanced dressings are more expensive than others, especially compared to gauze. However, the modest increase in cost caused by using a polyurethane film dressing is offset by reduced costs and fewer wound complications associated with gauze and tape (10). This case report therefore aims to document the instrumental role of the multidisciplinary team in improving clinical outcomes in the management of a difficult diabetic foot case.

Purpose

This case report outlines the role of the multidisciplinary team in managing a complex diabetic foot case by implementing emerging best practices in wound care.

Materials and methods

This study was conducted from February to November 2023 at the Orthopaedics and Traumatology Unit of the Celio General Military Hospital in Rome. The clinical case was managed by a multidisciplinary team comprising orthopaedic surgeons, plastic surgeons and nurses specialising in wound care. The patient consented to the study by signing an informed consent form.

The following rating scales were used: the Bates-Jensen Wound Assessment Tool (BWAT), which investigates clinical wound progression; the SF-12, which investigates the patient's quality of life; and the NRS for pain. The three scales were administered by the team nurses and then analysed by a physician and a nurse expert in medical statistics. Specifically, seven surveys (T0 to T3) were carried out for the BWAT scale and the NRS was administered at each protocol

change. The range of scores from 35 to ≥60 identifies wound degeneration; from 30 to ≥13, the beginning of the tissue repair process; and from ≤13 to ≥1, healing. For pain, the scores range from 0 (no pain) to 10 (very painful), and the SF-12 considers quality of life to be sufficiently acceptable at a score of ≥50. These instruments were used to investigate characteristics concerning both the wound and the patient, such as wound site, BWAT score, time spent on care, dressing products used, patient age, admission pathology, pain, and quality of life. Data were analysed using SPSS v21 software.

Clinical case presentation

Patient A.S., aged 78, retired military personnel. He was admitted to the UOC of Orthopaedics and Traumatology at the Policlinico Militare in Rome on 22 February 2023 due to complications arising from diabetic neuropathy in his right foot. He underwent a first surgery to amputate his left forefoot in 2022 and amputation of his right foot in 2023.

Remote pathological history: three weekly dialysis sessions for chronic renal insufficiency (CRI) secondary to diabetic nephropathy; ischemic-hypertensive heart disease due to previous acute myocardial infarction (AMI), treated with percutaneous transluminal coronary angioplasty (PTCA) and stent; chronic obstructive pulmonary disease (COPD); episodes of atrial fibrillation; and arteriovenous fistula (AVF) carrier. He underwent left forefoot amputation surgery in 2022 and right foot amputation surgery in 2023, resulting in severe walking impairment.

Pharmacological therapy: Sevelamer carbonate: 1 tablet, three times a day; pantoprazole: 1 tablet a day; cardioaspirin; bisoprolol: 1.5 mg; acenocoumarol: 4 mg; atorvastatin: 10 mg; linagliptin: 5 mg; allopurinol: 300 mg, one tablet on the day of dialysis; insulin glargine: 4 units in the evening.

Recent medical history: admission for hyperpyrexia (39 °C), vomiting and severe weakness. Blood chemistry tests revealed the following results: glycaemia 190; azotemia 91.3; creatininemia 8.20; sodiemia 135; potassemia 5.4; CPK 286; protein C 11.08; CBC 2.94; Hb 10; HCT 31.4; PLT 128; INR 2.92; PTT 56; AT III 82. A chest X-ray showed no evidence of inflammatory foci in the active phase.

On 22 February (identified as T0), the end of the stump was covered with a dry, necrotic eschar. Ultrasonic debridement was performed, exposing the metatarsal heads of the first and third toes, which were surrounded by diffuse fibrin and devitalised tissue. The perilesional skin appeared slightly reddened, and the margins were jagged. ***(Fig. 1)***.

Medication protocol

- Cleansing and irrigation with PHMB (polyhexanide) solution.
- Antisepsis with hypochlorous acid (HOCL) solution.
- Application of a spray that forms a transparent, protective barrier film to protect the perilesional area.
- Application of a black honeycomb polyurethane foam dressing over the entire wound area.
- Placement of NPWT (vacuum therapy), blocking it with an adhesive film to isolate and promote vacuum to the lesion area ***(Fig. 2)***.
- Closure is achieved by making a soft bandage with a self-adhesive dressing.

The BWAT scale score was 57. The NRS score was 8. The SF-12 score was PCS-12 (Physical Score): 22.80085 and MCS-12 (Mental Score): 24.43928.

Antibiotic therapy was started for a wound swab culture positive for Pseudomonas aeruginosa and Staphylococcus aureus.

The photo taken on 27 March shows necrotic areas mixed with granule-like areas ***(Fig. 3)***. The photo taken on 22 April shows a large amount of mixed slough and fibrin. Shortening of the stump was then opted for, with the margins being brought into contact with each other using stitches to facilitate closure ***(Figs 4, 5)***.

On 5 May, stump reduction surgery was

Fig. 1 - T0 (22 February – Before and after ultrasonic debridement).

Fig. 2 - T0 (March – After ultrasonic debridement, NPWT repositioning at pressure -125 mmHg).

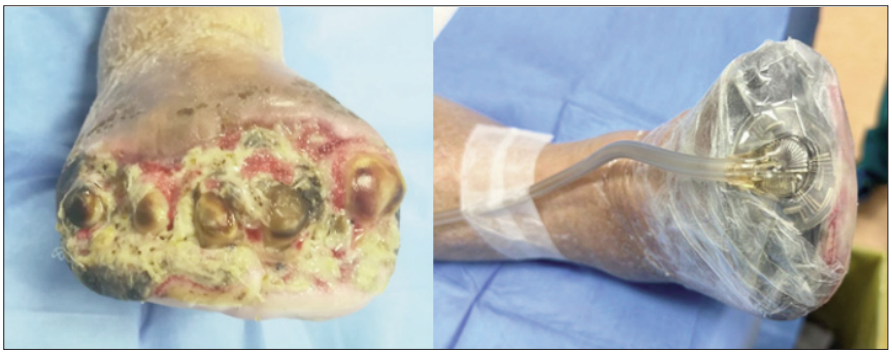

Fig. 4 - T1 (22 April: NPWT repositioning and preparation for surgery to shorten the stump).

Fig. 5 - T1 (5 May: Surgery to shorten the stump, NPWT repositioning at a pressure of -100 mmHg).

Fig. 3 - T0 (March – After ultrasonic debridement, NPWT repositioning at pressure -125 mmHg).

scheduled, as the lesion was not closing and the healing process had stopped. Post-operatively, NPWT was applied ***(Fig. 5)***.

Medication protocol - Time 1

- Cleansing and irrigation with PHMB (polyhexanide) solution;
- antisepsis with HOCL (hypochlorous acid) solution;
- application to protect the perilesional area of a spray that forms a transparent and protective barrier film;
- application of a silicone dressing with holes, designed to adapt to the moist wound, capable of reducing pain and easy to remove;
- subsequent application of a black honeycomb polyurethane foam dressing over the entire wound area;
- placement of the NPWT, blocking it with an adhesive film to create and isolate the lesion area and thus promote 'vacuum';
- closure by making a soft bandage with a self-adhering bandage;
- continued antibiotic therapy for pseudomonas and staphylococcus aureus.

The BWAT scale score was 41 and the NRS score was 7 pre-surgery, and 25 and 4 post-surgery, respectively.

A swab of the lesion for germs, accompanied by an antibiogram, was also carried out on 1 June (Time 2). No staphylococcus or pseudomonas were present. Antibiotic therapy was suspended. The BWAT scale score was 38. The NRS score was 7.

Medication protocol - Time 2

- Cleansing and irrigation with PHMB (polyhexanide) solution;
- antisepsis with HOCL (hypochlorous acid) solution;
- placement of a green, close-meshed, bacterial-capture gauze treated with a fatty acid derivative (DACC) inside the fistulas created internally and laterally at the stump closure ***(Fig. 6)***;
- application to protect the perilesional area of a spray that forms a transparent and protective barrier film;
- foam-based (polyurethane) secondary dressing;
- NPWT repositioning;
- closure with adhesive film and soft bandage.

Since 28 July, a fistula has appeared on the central part of the closed stump. We proceeded to:

- 'squeeze' and remove a free filament of tendon ***(Fig. 7)***;
- the fistula and other unclosed stump areas were flushed with HOCL using a cannula;
- green, close-meshed gauze treated with a fatty acid derivative (DACC) was applied;
- it is closed by placing secondary absorbent dressing and then a self-adherent bandage was used for final closure.

At the re-evaluation at T3 on 18 August, the fistulas appeared closed, with only the outer lateral part of the stump still unclosed ***(Fig. 8)***.

Fig. 6 - Fistulisation of the wound laterally after surgery.

Fig. 7 - T2 (28 July - Cleaning of the bottom of the lesion and washing of the fistulas with a syringe).

Medication protocol time 3

- Antisepsis with HOCL-based solution of the fistula at the dorso-plantar level;
- surgical debridment of the bottom with a scalpel is performed;
- Placement of secondary absorbent dressing with bacterial-capturing gauze interface;
- closure by making a soft bandage with a self-adhering bandage.
- Result of the protocol at 20 days maintained 2 months ***(Fig. 9)***.

Fig. 8 - T3 (18 August - Antisepsis of the dorsoplantar fistula).

Fig. 9 - T3 (Evolution of the lesion: reduction in the size of the dorsoplantar fistula).

Fig. 10 - Start of follow-up.

The BWAT scale score was 27. The NRS score was 6.

After one and a half months (September/October 2023), almost complete closure of the lesion could be observed; only a small lateral area of disepithelialisation remained ***(Fig.10)***. From this moment on, the remodelling phase begun.

The BWAT scale score is 13. The NRS score is 3.

The SF-12 score is: CS-12 (Physical Score): **84.24;** MCS-12 (Mental Score): **74.43**

Analysing the multiple surgical and wound care treatments implemented from T0 to T4 showed that they reduced pain, improved the lesion and quality of life. In particular, stump reduction surgery at T2 improved the lesion abruptly, promoted reparative processes, and improved quality of life; however, a complication due to fistulisation worsened the lesion and quality of life after 20 days ***(Fig. 11)***.

The wound care protocols applied had an effect on the improvement of the lesion and pain. Specifically, it should be noted that NPWT was used from protocols 0 to 3, which significantly improved the lesion and supported advanced medication. This certainly justified the progressive improvement in scores, in addition to the implementation of contextually adaptable pain therapy ***(Fig. 12)***.

Since Protocol 3, during which the stump reduction surgery took place, there has been an improvement in pain and injury; unfortunately, the complication of fistulisation has delayed healing. Overall, quality of life is quite satisfactory. The results of the SF-12 scale, which measures physical and mental health, show that the two dimensions do not progress in the same way. At T3, the cause of the fistulisation led to a sudden worsening of physical and mental quality of life, with the latter being worse than the former ***(Fig. 13)***.

Discussions

Diabetic foot disease remains one of the most serious complications of diabetes mellitus. This case demonstrates that, despite the complexity of the pathology in clinical terms, all clinical activities are based on existing scientific literature. In this regard, surgical wounds and wounds caused by primary diseases, such as diabetes, require a moist environment to heal. Decisions on the type of dressing to use should be based on data collected through observation, taking into account the degree of infection and other complications (8). The implementation of assessment scales by the specialist nurse in wound care, such as the BWAT, would provide valuable data for the objective assessment and monitoring of wound healing processes (8).

Advanced dressings are used in dressing protocols after analysis of the data collected on the case under study. For

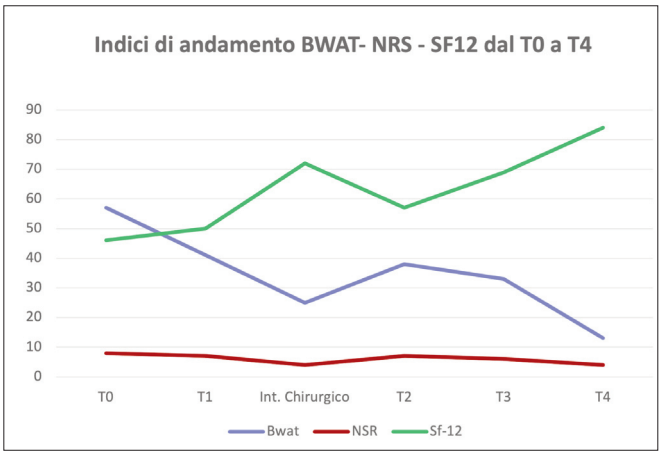

Fig. 11 - BWAT – NRS SF 12 trend from T0 to T4.

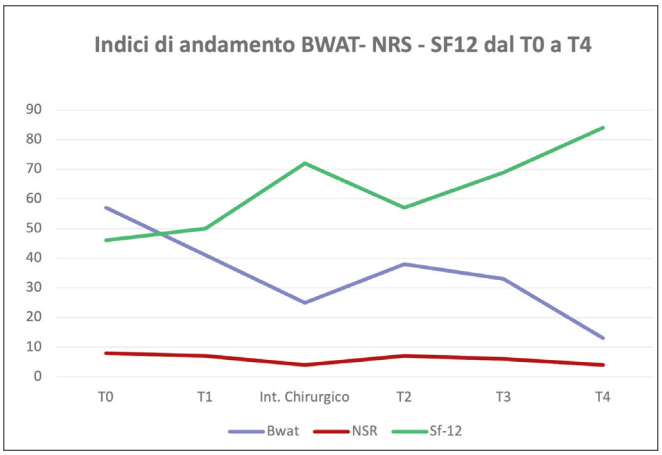

Fig. 12 - BWAT and NRS scores at each change of dressing protocol.

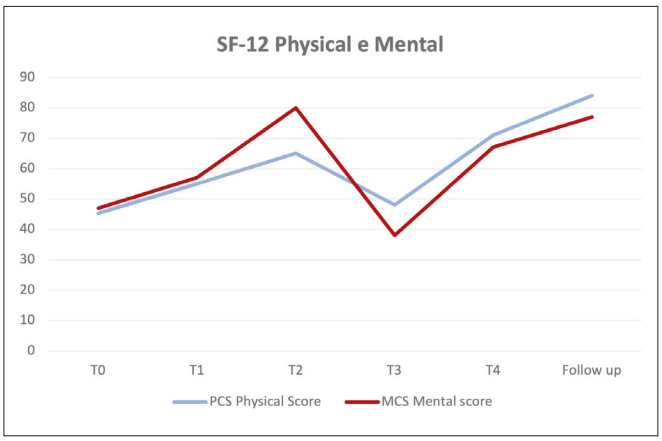

Fig. 13 - SF-12 scores from T0 to T4.

example, hydrocolloids were more appropriate for the wound in the above clinical case than gauze, as gauze caused patients pain during dressing changes. Hydrocolloids are also less expensive for this type of wound because, unlike traditional gauze, they do not need to be removed daily (9, 10).

NPWT is of fundamental importance in rapidly promoting healing processes. The literature on this subject is very thorough. Combining NPWT with supportive surgical techniques appears to be an effective way of treating a variety of complex wounds, including diabetic foot ulcers. Furthermore, it seems that implementing NPWT would reduce hospital bed days and costs related to the condition (11, 12).

Furthermore, pain assessment is an important consideration since, as in the presented clinical case, it affects the patient's quality of life. Its presence can lead to non-adherence to therapy and a shorter recovery time. Certain complications, such as post-surgery fistulisation, can lead not only to the lesion worsening, but also have a negative impact on the patient's quality of life, with the psychological sphere potentially being more affected than the physical one.

Conclusions

This work highlighted and consolidated the emerging evidence in the field of wound care, particularly emphasising the importance of multidisciplinary teams in planning and treating complex wounds. The clinical case study was a valuable tool for demonstrating how these processes adhere to a rigorous scientific approach based on EBM and EBN. Further studies on the management of complex wounds in the context of the diabetic foot would be desirable in future, with the aim of improving clinical practice and, above all, achieving defined outcomes that will be decisive for patients' future quality of life.

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