

Negative Pressure Wound Therapy as an Artificial Leech to Save a Congestive Flap: Case Report

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Summary: Historically, patients with lower limb defects have represented a challenge for plastic surgeons because of their higher rate of complications. One of the main complications is venous congestion. Recently, various studies have suggested the use of negative pressure wound therapy as a salvage flap therapy, showing promising results. In this case report, we will outline the case of an elderly patient with different comorbidities in whom we used negative pressure wound therapy (as an artificial leech) to reverse venous congestion in the flap, with a satisfactory clinical outcome and without any more surgical procedures. (*Plast Reconstr Surg Glob Open* 2022;10:e4162; doi: 10.1097/GOX.0000000000004162; Published online 7 March 2022.)

Osteomyelitis has long been one of the most challenging situations on the lower limb,¹ due to its high rate of recurrence and amputation.² There are several risk factors for limb amputation in these patients, including advanced age, smoking, and intra-articular injuries.³ Furthermore, Beals and Bryant⁴ show that the distal third of the tibia has a worst prognosis because of the decreased soft tissue coverage and poor vascularity. Nevertheless, when possible, efforts should be made to salvage the limb. Therefore, once the surgical debridement has been completed, soft tissue reconstruction must be performed, which, in most cases, requires a flap.

One of the main causes of flap necrosis is venous congestion. Different venous congestion treatments have been described. Recently, various studies have suggested the use of negative pressure wound therapy (NPWT) as a salvage flap therapy, showing promising results. We will outline the case of an older patient with different comorbidities in whom this therapy was used.

CASE DESCRIPTION

An 86-year-old man with a history of hypothyroidism and Alzheimer's dementia presented an abscess in the distal third of the right leg associated with osteomyelitis of the tibia, which was managed with antibiotic therapy

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and surgical debridement on two occasions. As a result, he presented a residual defect in the distal third of the right leg, with exposure of 3.5 cm of the bone (Fig. 1). He required a new surgical procedure, in which the orthopedic surgeon performed reconstruction of a bone defect with bioactive glass, and the plastic surgeon performed a transposition local flap with partial thickness skin grafts in the donor site.

Two days after that procedure, the patient presented clinical signs of venous congestion in the distal area of the flap (Fig. 2). Initially, it was managed with a gauze impregnated with unfractionated heparin as a topical agent, yielding no improvement of the venous congestion. Then, we decided to use an NPWT to decrease the flap congestion.

The procedure consisted of making small punctures (approximately six) with a number 20 needle, 0.5 cm apart from each other, through the congestive area of the flap. An interface was placed with a gauze impregnated with petrolatum, and over it, a Granufoam silver was applied. The subatmospheric pressure system (VAC therapy Granufoam silver 3M-KCI) was left at a continued pressure of -75 mm Hg and medium intensity.

After 3 days, we found a partial improvement of the venous congestion of the flap (Fig. 3). The same procedure described previously was performed, and the NPWT was continued for 4 more days, with an evident improvement of the venous congestion. One month later, there was a total automatization of the flap and adequate integration of the grafts (Fig. 4).

DISCUSSION

The reconstruction of lower extremity defects is a challenge for the plastic surgeon, given its high rate of

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Fig. 1. Defect in the distal third of the right leg with exposure of 3.5 cm of the bone.

complications. These might be due to different factors, such as the thinness of the skin and its lack of expandability,⁵ and its predisposition to venous stasis related to its anatomical position.⁶

The main etiologies of lower limb defects are trauma, oncological resection, chronic diseases, and infections.⁵ The patients with osteomyelitis represent an additional risk of amputation. In these patients, soft tissue defects should be reconstructed with well-vascularized flaps, which provide a barrier between the bone and the environment to prevent the recurrence of infection.

Among the complications of flaps, ischemia and venous congestion are the most frequent ones. In a systematic review, Gir et al described the venous congestion as the second most common complication in pedicled-perforator flaps for lower extremity reconstruction with an incidence of 8.1%.⁷ Meanwhile, Bhullar et al reported a venous congestion rate of 8.7% in a lower limb reconstructed with local flaps, and of 23.5% in those reconstructed with free flaps.⁸

Venous congestion has an extrinsic or intrinsic etiology; the first one is related to mechanical causes and the second one, to microcirculatory problems. If the cause is extrinsic, it requires a return to the operating room. If a mechanical cause is not identified or if the venous congestion persists, there are different medical options, such as medicinal leeches, local subcutaneous injection of heparin with scarification known as “chemical leeches,” topical agents, and NPWT. The medicinal leeches are the most studied, and their effectiveness is attributable to mechanical and biological effects.⁹ As for the mechanical part, the leech drains the blood, generating an active flow.¹⁰ The biological effects are due to the production of vasodilators and anticoagulant substances that generate a passive drainage.⁹ In a systematic review, Boissiere et al⁹ reported that medicinal leeches remain the gold standard for the



Fig. 2. Venous congestion of the distal part of the flap 2 days after the procedure.

management of venous congestion, with a success rate of over 70%.⁹

Recently, it has been proposed the use of NPWT for salvage of flaps. Qiu et al¹⁰ explained that the NPWT could manage the venous congestion through three mechanisms: enhancing local blood flow, reducing interstitial space pressure, and increasing the rate of revascularization. The latter occurs mainly because NPWT generates microdeformation of the vessels, which generates hypoxia and cell deformities, resulting in production of growth factors, cell proliferation, and differentiation, promoting the formation of small vessels.¹¹ In addition, NPWT decreases fluid collection produced in venous congestion. In the case reported in this study, a silver foam was used as well, which has the additional advantage of reducing the microbial load, as shown in an in vitro study by Ellenrieder et al,¹² which can improve flap survival, especially in a defect secondary to a severe infection such as osteomyelitis.

Later on, Yu et al,¹³ in a systematic review, evaluated the role of NPWT, reporting a salvage flap rate of 96.9%. To our knowledge, there are only two articles on the use of NPWT for flap salvage after lower limb reconstruction with regional flaps. The first one, published by Vaianti et al,¹⁴ is a retrospective study of four cases of venous congestion



Fig. 3. Three days after the NPWT was initiated. There is a different color showing initial and partial reversion of the venous congestion in the proximal part of the flap.

requiring all but one partial debridement before the application of the NPWT. The other article, published by Gabriel et al,¹⁵ presented a case report in which a lower limb local flap developed signs of vascular compromise, in which a closed-incision NPWT was used, showing viability of the flap at the end. These two previously described methods are different from the case reported in this article, since in this case, partial debridement of the flap was not necessary because the NPWT was placed when clinical signs of venous congestion were present but before there was partial or total necrosis, to reverse this situation. In addition, it was preferred to perform punctures and to place NPWT instead of a closed-incision NPWT to generate a faster liquid collection so as to decrease the metabolic load of the flap.

The term artificial leech had previously been used by Robinson,¹⁶ who proposed the use of subcutaneous lacerations, infiltration of diluted heparin, and washing of clots with hydrogen peroxide as a salvage flap procedure. We believe this is more a modification of the “chemical leeches” concept because no artificial device is being used. Thus, the term “artificial” fits better with NPWT use for flap salvage.

CONCLUSIONS

In summary, NPWT is a good option for the salvage of flaps with venous congestion. Throughout this case



Fig. 4. One month follow-up with complete reversion of the venous congestion and salvage of the flap.

report, we share with the medical community of plastic surgeons a useful tool to manage and reverse venous congestion in lower limb flaps in patients whose successful reconstruction has historically been a challenge for the plastic surgeons.

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