Two-stage treatment for diabetic foot: Surgical peripheral revascularization and minor amputation in day-surgery admission

Nicola Rivolta*, Gabriele Piffaretti, Matteo Tozzi, Chiara Lomazzi, Simona Maida, Francesca Riva, Elena Buscarini, Patrizio Castelli

Vascular Surgery, Department of Surgical Sciences, University of Insubria, Varese, Italy

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ABSTRACT

Diabetic foot is complex and difficult to treat. More aggressive treatment using peripheral distal by-pass frequently combined to minor amputations has greatly improved limb salvage in most patients. However, diabetes-related amputations are at high risk of non-healing or superinfection, thus requiring a second-step surgical revision treatment more frequently than in non-diabetic patients. Several advanced technologies have been developed to improve the treatment of diabetic foot wounds including Vacuum Assisted Therapy: we present 3 cases of diabetic patients treated with preliminary surgical peripheral revascularization, subsequent minor amputation in combination with Vacuum Assisted Therapy performed in a day-surgery regime.

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1. Introduction

Diabetic foot still remains a clinical and technical challenge for the vascular surgeon; local or extensive infection still threaten those presenting with critical limb ischemia (CLI). The results of successful peripheral revascularisation potentially improve limb salvage allowing to be more conservative in terms of amputation.1,2

Peripheral by-pass graft surgery or endovascular treatment such as percutaneous transluminal angioplasty (PTA) achieved progressively improved results but revascularization alone often still might not avoid minor amputations.1,2 Amputation wounds in diabetic patients are one of the most challenging to heal, especially in the foot: they are wide with exposed bone and tendons, and occurred in people with compromised healing capacity.3,4 In the last years new advanced technologies have been developed to improve the treatment of diabetic foot wounds: negative-pressure wound therapy (NPWT) has recently emerged as an adjunct for the treatment of complex wounds with reported excellent results but in limited series or anecdotal reports.5–7

We present 3 cases of diabetic patient with foot gangrene treated with a multimodal approach consisting of conventional preliminary peripheral revascularization, and subsequent minor amputation with NPWT adjunct to support wound healing performed in a day-surgery regimen.

1.1. Case report #1

She is an 80-year-old female affected by type-II diabetes and arterial hypertension; on initial admission, she complained right foot rest pain and localized wet gangrene of the first toe (grade III, category 5 according to the Rutherford classification reported in the TASC II document8). Preoperative ankle-brachial index was 0.40; computed-tomography angiography (CT-A) revealed a totally occluded superficial femoral artery with absence of run off (class D according to the TASC II9 classification). We performed a thromboendarterectomy of the common femoral artery and tibio-peroneal trunk, and a subsequent conventional surgical femoro-popliteal by-pass with in situ vein graft. Bacterial culture of the wet gangrene resulted positive for Escherichia coli: hence, she started intravenous specific antibiotic therapy with cefotaxime (Zarivix®, Sanophi-Aventis, Milano-IT) for two weeks. She was discharged on day seven postoperatively on oral anticoagulation with symptoms relief, and admitted to the rehabilitation ward for two weeks. Clinical visit two weeks after the intervention revealed an improved right ankle-brachial index of 0.68. When the first toe lesion was delineated, on a day-surgery regime we performed a minor amputation, and applied the NPWT assisted therapy (VAC®-KCI Medical, Assago-MI, IT) in the same session. The patient went home the day after. A steady increase in the percentage of granulation tissue coverage was noticeable; NPWT was continued for a total period of six weeks, the overall wound dimensions decreased to lie flush with surrounding tissue. At 3-months follow-up visit, color-Doppler scan revealed the patency of the by-pass graft and continue integrity of the wound.

* Corresponding author. Tel.: +39 0332278224; fax: +39 0332278581.
E-mail address: nicolarivolta@yahoo.it (N. Rivolta).
1.2. Case report #2

He is a 71-year-old male affected by type-II diabetes and history of smoking; his medical history included a prior coronary artery endovascular revascularization PTCa-stent. He presented at our Department with right digital gangrene and rest pain (grade III, category 5 according to the Rutherford classification). Resting ankle-brachial index was 0.38; CT-A revealed a totally occluded superficial femoral artery, and one-vessel run-off on the posterior tibial artery (class D according to the TASC II classification). Surgical femoro-posterior tibial by-pass was performed with in situ vein graft. The bacterial culture of the wound material was positive for E. coli, meticillin-sensitive Staphylococcus aureus and Proteus mirabilis; hence, he started an intravenous antibiotic therapy with association of glycopeptide (Vancocina®-Hikma, Pavia-IT) and carbapenem (Merrem®-AstraZeneca, Basiglio-IT) for the following two weeks. He was discharged on day ten postoperatively, on a regimen of oral anticoagulation with resolution of rest pain, and admitted to rehabilitation ward for two weeks. Two weeks follow-up visit revealed a right ankle-brachial index of 0.70. Two weeks later, a trans-metatarsal amputation was performed in a day-surgery regime; during the same session a NPWT was assessed. Complete remission of the wounded area had been reached within two months.

1.3. Case report #3

He is a 60-year-old male affected by type-I diabetes, ischemic heart disease, dislipidemia and arterial hypertension; medical history included previous right iliac endovascular revascularization with stent supported angioplasty. He was admitted to our Department complaining right lower limb rest pain and a wet gangrene of the first and second toes (grade III, category 6 according to the Rutherford classification); resting ankle-brachial index was 0.32. Preliminary CT-A showed the stenosis of the superficial femoral artery, an occluded popliteal artery, and a two-vessels run-off of the anterior and posterior tibial arteries. The patient underwent surgical peripheral revascularization with below-knee femoro-popliteal with a composite graft of short segment autologous reversed great saphenous vein and armed heparin-bonded ePTFE graft (Propanet®-WL Gore & ass.). Bacterial culture of the wound material was positive for methicillin resistant Staphylococcus epidermidis, Corynebacterium sporidium and P. mirabilis; a specific antibiotic therapy with pipercillin/tazobactam (Tazocin®-WJETH-Lederle, Aprilia-IT) plus glycopeptide was commenced for four weeks. He was discharged to rehab ward two weeks after the intervention. One-month follow-up visit showed the presence of tissue loss involving all digits extending to the dorsum of the foot; the plantar aspect was spared. Color-Doppler scan confirmed the patency of the by-pass graft and the presence of the two-vessels run-off; on a day-surgery regime, we performed a trans-metatarsal amputation with partial closure of the wound supported by NPWT. At 3-months follow-up, the wound was healed.

2. Discussion

Patients with diabetic foot remains a clinical and surgical challenge for the vascular surgeon; most of the authors would agree that extensive heel or forefoot necrosis are the most important predictors for poor outcome in terms of limb salvage.9,10 Primarily, the aim of peripheral revascularisation is to provide sufficient blood flow to relieve rest pain and facilitate skin wounds healing; during the last decade, the results of peripheral revascularization (e.g. femoro-distal by-pass or PTA) in diabetic patients presenting with CLI have improved, with acceptable limb salvage rate and a peri-operative mortality of <5%.10-12 However, even after successful revascularization local wound treatment must be continued and minor amputation might be performed if appropriate in order to defend limb salvage. It is well-known that diabetics have altered wound healing, and a number of factors including impaired neutrophil chemotaxis and phagocytosis, decreased microperfusion, and increased degradation of important structural proteins, are involved to delay or worsen the healing process.3,7,10,12 Although several advanced technologies have been developed to improve the treatment of diabetic foot wounds, outcomes are still not completely acceptable and many technologies have been no more beneficial than simple care consisting of appropriate debridement.12,13 One of the most recently wound-care treatment involves the application of negative pressure to the wound.14,15 The sub-atmospheric (e.g. negative) pressure system uses latex-free and sterile polyurethane or polyvinyl alcohol foam dressing that is fixed at the bed-side to the appropriate size for every wound, and then covered with an adhesive drape to create a hermetic seal. A therapeutic regulated accurate care pad (TRAC®-KCI Medical, Assago-MI, IT) lies on top of the foam within the drape, and accurately senses, monitors, and maintains the target pressure at the wound site to provide controlled negative pressure. Tubing attached to the TRAC pad is connected to a fluid collection canister contained in a portable, computer-controlled vacuum pump creating negative pressure at the wound surface interface. A negative-pressure wound environment has been suggested to transiently increase blood flow with a peak increase at 125 mmHg; as a consequence, granulation tissue has been noted more vigorous in wounds treated with VAC therapy than in those receiving moist dressings or other available medica tion.14,15 In addition, VAC therapy enhances bacterial clearance from chronic wounds as measured by quantitative culture. These effects address many of the wound-healing deficits noted above in diabetic patients, and these wide foot wounds should benefit from the improved microcirculation, bacterial clearance, and promotion of granulation tissue.

Up to date, few anecdotal reports have been reported in literature dealing with VAC treatment of diabetic foot ulcers. Armstrong and Lavery,5 studied trans-metatarsal amputation wounds in 162 patients by comparing NPWT with modern moist wound treatment and concluded that the VAC system seems to be a safe and effective treatment for complex diabetic foot wounds. In a study by Etöze et al.5 on diabetic foot ulcers, the formation of granulation tissue in their VAC group of patients was faster and that the surface area of the ulcer improved more consistently if compared to those patients treated with saline bandages. In the report of Eginton et al.7 the authors compared the VAC system with moist wound treatment and concluded that the volume of the ulcer diminished more in the VAC system, but no significant difference of the surface area width was noted. Although no guidelines are not still available on this topic, it has been suggested to use the VAC system where no significant infection or gangrene in the wound are present10,13: the present series reported similar encouraging results in a particular subgroup of diabetic patients, those with delineated wounds after successful revascularization and minor amputation. Our experience supports the use of VAC system for those patients with complex wounds requiring prolonged and extensive complex medication in an anatomic setting at higher risk of infection or threatened healing; the selective use of VAC system in the here reported cases allowed to achieve the complete healing of the wounds in an average period of 2.5-months, quite better than the reported 4-months with the use of standard available medication.5-7 Of note, similarly to the previous reports we did not observe disturbing or adverse events such as superinfection, irritation of the skin and pain at the dressing change.11
In conclusion, few comments should be deserved: we strongly confirm that preliminary revascularization is mandated; VAC therapy seems to be effective and well tolerated to support complex medication after minor foot amputation, leading to a rapid ambulatory discharge of the operated patient. Nevertheless, it should be remembered that this complex medication does not replace surgical debridement, a manoeuvre to stimulate blood microcirculation and a relevant treatment to control local infection. Actually, major drawbacks of this new wound treatment could be related to the currently not user-friendly devices, that are also not widely available in most of the hospitals, and the costs of the prolonged period of pad rent and specific medication.

Conflict of interest
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None.

References