Successful Use of Vacuum-Assisted Closure Therapy for Leg Ulcers Caused by Occluding Vasculopathy and Inflammatory Vascular Diseases – A Case Series

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Key Words

Vacuum-assisted closure · Leg ulcer · Vasculitis · Vaso-occlusion

Abstract

Background: Leg ulcers caused by vasculitis, small vessel occlusion or other rare conditions often prove to be very difficult to treat. Despite polypragmatic, systemic and localized therapy, many of these wounds are progressive and characterized by severe pain. **Methods and Results:** We here portray the cases of 5 patients with ulcers resistant to systemic therapy for the underlying disease, who were treated successfully using vacuum-assisted closure (VAC) for wound management. We present the advantages and disadvantages of this method, as well as illustrating the essential and known therapeutic principles. **Conclusions:** Our experience shows VAC to be an excellent and effective alternative in the treatment of therapy-resistant chronic wounds caused by vasculopathy (small vessel occlusion or vasculitis). We did not observe any pathergy or proinflammatory effects caused by VAC.

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Background

Particularly in the case of vasculitis, small vessel occlusion and other rare causes of skin and soft-tissue defects effective treatment is often not achieved. In spite of intensive polypragmatic, systemic and localized therapy, many of these wounds are progressively deteriorating and characterized by pain.

We here present a group of patients with leg ulcers resulting from vasculitis, small vessel occlusion and pyoderma gangrenosum who were successfully treated using vacuum-assisted closure (VAC) for wound management while systemic therapy for the underlying disease was continued.

Case Studies

Patient 1

A 50-year-old female suffered from painful ulcers on her right lower leg and the dorsal region of her foot recurring since 13 years. A pyoderma gangrenosum accompanying chronic persistent hepatitis B was diagnosed. The arterial and venous statuses were normal. Multiple treatments had been attempted, resulting either in progression or recurrence of the condition. These included immunosuppressive, immunomodulating and vasodilatory therapy using azathioprine, prednisolone, cyclosporine, dapsone, mycophenolate mofetil, high dose dexamethasone pulse therapy as well as intravenous infusions with iloprost. These were accompa-

Fig. 1. Week 1, after split-thickness skin grafts, 24 months.

nied by treatment with standard wound dressings and medical compression. Before VAC therapy was started, the bases of the ulcers were covered with a yellow slough. The ulcer on the right lateral lower leg was approx. 12×5 cm in size, the ulcer on the dorsum of her right foot approx. 4×4 cm. VAC was applied to both ulcers (initially as inpatient, continued in outpatient care) and medical compression therapy was also used. After 8 weeks sufficient granulation tissue had developed and the defects were covered with split-thickness skin grafts using mesh graft technique. The grafts took successfully and the ulcers healed completely. Currently the patient has experienced 24 months without relapse. Systemic therapy consisting of mycophenolate mofetil, periodical dexamethasone and iloprost infusions was continued throughout the whole observation period (fig. 1).

Patient 2

A 75-year-old female presented with a very painful ulcer on her left leg, which had considerably increased within the previous 2 years. Livedoid vasculitis caused by cryoglobulinemia with occlusion of capillaries and venules by cryoprecipitates was diagnosed. Furthermore, the patient suffered from insulin-dependent diabetes type 2. There was no arterial or venous circulatory disorder. Previous attempts to treat the ulcer with prednisolone, dapsone, azathioprine, sulfasalazine and intravenous immunoglobulins in combination with a local therapy and medical compressions proved ineffective.

Before starting VAC therapy there was an approx. 10×15 cm sized ulcer on the left leg uncovering the peroneus tendon. VAC was applied in combination with compression treatment for 16 weeks. In addition, an immunosuppressive and vasodilatory therapy with mycophenolate mofetil, cyclophosphamide pulse therapy as well as iloprost infusion cycles was used. Slowly the defect filled with granulation tissue covering the peroneus tendon and in due course epithelialization took place so that the ulcer

healed without requiring skin grafting after 16 weeks of VAC therapy. Twenty-eight months have now passed without relapse or the need for immunosuppressive treatment (fig. 2).

Patient 3

This 57-year-old woman had a painful ulcer on her right lateral lower leg which was rapidly increasing in size. Immune complex vasculitis accompanying rheumatoid arthritis was diagnosed. No arterial or venous macroangiopathy was diagnosed. The ulcer appeared while the patient's rheumatoid arthritis was being treated with dexamethasone pulse therapy, leflunomide, prednisolone and methotrexate.

We treated the patient with a combination of leflunomide, prednisolone and iloprost infusion cycles. VAC was applied for a total of 10 weeks. Rapid healing of the ulcer was observed. Systemic therapy using low dose prednisolone and leflunomide was continued and the patient is without relapse 11 months later (fig. 3).

Patient 4

An 80-year-old patient presented at our clinic with an extremely painful leg ulcer uncovering parts of the Achilles tendon. The patient had suffered from this ulcer for 6 months. Due to the preliminary diagnosis of pyoderma gangrenosum, immunosuppressive therapy with azathioprine and prednisolone was administered orally. During the treatment her condition worsened. Following further diagnostic measures (histology of the ulcer edge and laboratory tests) we diagnosed cryoglobulinemia type III accompanying paraproteinemia. As a co-factor we diagnosed peripheral arterial disease of the lower leg type, which was, at the time, well compensated. There was a stenosis of the arteria poplitea with collateralization and normal peripheral arterial indices (>0.8).

Fig. 2. Week 1, week 8, week 8, week 12, 28 months.

Fig. 3. Week 1, week 4, week 8, 11 months.

At the start of VAC there was a deep, approx. 20 × 10 cm sized ulcer exposing large parts of the Achilles tendon. We treated the patient with VAC for 18 weeks (mainly in outpatient care).

The immunosuppressive treatment described above was discontinued and because of the cryoglobulinemia the leg was kept warm. We also added pentoxifylline and acetylsalicylic acid to improve the rheology and the patient had regular compression treatment, lymphatic drainage and physiotherapy. Granulation tissue developed and the ulcer decreased in size. After 18 weeks

the Achilles tendon was completely covered by granulation tissue, allowing skin grafting by split-thickness technique. The graft took successfully and an ultimate healing of the ulcer was achieved. The patient is without relapse 4 months later (fig. 4).

Patient 5

A 66-year-old female suffered from painful ulcers on both lower legs recurring since 4 years. Necrotizing vasculitis with cryoglobulinemia accompanying rheumatoid arthritis was diag-

Fig. 4. Week 1, week 4, week 10, 4 months.

Fig. 5. Week 1, week 4, after split-thickness skin grafts.

nosed. The arterial and venous statuses were normal. Multiple treatments had been performed, resulting either in progression or recurrence of the condition. These included split-thickness skin grafts and immunosuppressive therapy using prednisolone and hydroxychloroquine sulfate. These were accompanied by treatment with standard wound dressings and medical compression. Before VAC therapy was started, the base of the ulcer was covered with a yellow slough. The ulcer on the right lateral lower leg was approx. 12 × 5 cm in size, uncovering parts of the peroneus tendon. After removing necrotic tissue with *Lucilia sericata* larvae VAC was applied. Already after 1 week sufficient granulation tissue had developed and the defect was covered with split-thickness skin graft using mesh graft technique. The graft took successfully and the ulcer healed completely. Systemic therapy consisting of mycophenolate mofetil, oral prednisolone and hydroxychloroquine sulfate was continued (fig. 5).

Discussion

In the synopsis of the 5 cases described here, each presenting with a therapy-resistant 'problem ulcer', in most cases with an exposed tendon, great efficacy and efficiency of VAC can be claimed.

VAC was described in the 1990s by 2 separate teams working independently of one another and has been increasingly applied ever since [1, 2].

The VAC technique consists of the application of a foam dressing to an acute or chronic wound and a vacuum of 75–125 mm Hg. This is believed to have the following effects: VAC leads to a decrease in wound size due to retraction of the wound periphery by the vacuum. VAC

generates granulation tissue through a moist wound milieu. VAC cleans the wound through the vacuum extraction of tissue remnants. Due to extraction of wound secretion VAC therapy results in fewer dressing changes. VAC improves the microcirculation through reduction of interstitial edema.

Before the application of VAC it is mandatory to remove all necrosis and eschar. Therefore, in the case of wound contamination (e.g. necrotic tissue), surgical debridement is absolutely necessary prior to the application of VAC.

At present only 1 company in Germany commercially supplies VAC equipment. This comprises an open-pored sponge adapting to the wound contours, a connecting tube, a suction system attached to the end of the tube, as well as an airtight, steam-permeable, germ-impermeable, transparent polyurethane adhesive dressing and a source for creating a vacuum.

It is possible to choose between 2 different sponges: a black and soft polyurethane foam (pore size 400–600 μm) will be infiltrated by granulation tissue 3–4 days after application, thus creating a firm connection to the wound base. Therefore, dressing changes are necessary every 3–4 days. The white polyvinyl alcohol sponge (pore size 200–1,000 μm) is stable and less easily molded. Since granulation tissue cannot infiltrate this sponge, the intervals between dressing changes can be extended up to 7 days. At the time of dressing changes we did topical wound disinfection with octenidine, corresponding to the experiences of wound disinfection [3].

The biological mechanisms by which VAC exerts its effects can only be incompletely explained. There are in all only a few studies which systematically deal with this subject. Using a wound healing model in pigs, Morykwas et al. [2] showed that VAC increases the local, functional blood flow in the wound being treated. The authors were able to show this effect with laser-Doppler-flux measurements. They also observed less bacterial contamination of VAC-treated wounds [2]. According to Kopp et al. [4], VAC treatment increases the concentration of the growth factors PDGF, VEGF, TGF β 1 in the wound secretion. This could be shown for patients with the diabetic foot syndrome compared to a control group treated without VAC. VAC may decrease metalloproteinase synthesis (MMP-1, MMP-2), although so far the data are derived from 5 patients only and controls are missing [5].

To summarize, the mechanisms operative in VAC therapy are not completely understood. On the other hand, the effectiveness of the method is apparent.

VAC is indicated in cases with large soft-tissue defects where primary suture is not possible or even contradicted (e.g. crushing, fasciotomy wounds, split muscle compartments, traumatic or postoperative wounds). It is also used in patients with infected wounds after medical debridement, abscesses, bite injuries, necrotizing fasciitis and secondary-healing acne inversa. The medical literature particularly emphasizes the effectiveness of VAC in the treatment of soft-tissue wounds uncovering bradytrophic tissue (e.g. bone, tendons, metal implants) [6]. The cases presented here support the effectiveness in the treatment of ulcers with uncovered tendons. Besides these well-known indications in the surgical field VAC is also being described for dermatological indications such as diabetic foot, leg ulcers and decubitus [6]. VAC is not contraindicated in patients with severe arterial occlusion [6].

The contradictions of VAC are based on a consensus conference of the German and Austrian societies for wound healing and wound management in 2003 [7]. The method is clearly contraindicated where there is bleeding or danger of bleeding. It should not be used over naked blood vessels either. VAC should not be used in patients with necrotic tissue damage, severe inflammation, infections or osteomyelitis [7].

The most common side effects of the treatment are pain, caused by the suction of the vacuum pump and by change of dressings, maceration and pressure damage to the surrounding tissue. Wound infections through anaerobe bacteria [8], loss of blood/volume [9] and toxic shock syndrome [10] may be rare complications. Besides pain during the treatment period and especially during change of dressings, in our cases we observed a slight and easily treatable irritation of the area surrounding the wound caused by the foam dressing and the adhesive polyurethane foil. Pain could be reduced through an analgetic basis therapy and short-acting analgetics prior to changing the dressings. In a few cases intermittent breaks of 1–2 days were made to allow treatment of the irritated or slightly macerated wound surroundings (e.g. local antiseptic, hydrating measures).

With the use of a portable vacuum pump system, the patients can be mobilized early. Our patients were very satisfied with the method; the ability to move around freely with the portable system was rated particularly positive.

Unfortunately there exist few cost analyses of 'conventional' dressing techniques in comparison with VAC. According to a study in the USA with a large cohort of patients [11], VAC proved to be more economic than conventional dressing techniques. In the USA VAC has

become the state of the art, also as an outpatient treatment.

Unfortunately in Germany presently the costs for VAC are not covered by medical insurance companies for outpatient treatment, with the result that for each individual outpatient case payment has to be applied for in a lengthy process. The treatment of our patients was initiated in hospital so that the effectiveness of the initial treatment was already proven and could be used in the argumentation with the patient's medical insurance to continue treatment on an outpatient base.

We conclude that one should not hesitate to use the VAC therapy also for the treatment of vasculopathic ulcers. In our experience in spite of the risk of causing pathergy in cases of pyoderma gangrenosum or proinflammatory effects caused by suction of wound secret into the ulcer (e.g. cryoglobulinemia or dysproteinemia), the patients benefited from the VAC therapy. VAC brought a distinctive breakthrough in wound healing and resulted in pain reduction in all cases. In most cases it can be applied in an outpatient setting. However, the problems concerning the financing of outpatient treatment described above do exist.

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