FIELD REPORT

sNPWT: How effective is a circular V.A.C.-Prevena™ dressing? Clinical observations of an advanced application procedure

Application observations of a circular V.A.C.-Prevena™ dressing as a new application method for improving wound healing and reducing swelling and inflammation

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ABSTRACT

The V.A.C.-Prevena™ dressing (Prevena Incision Dressing) is suitable for the treatment of surgical high-risk wounds (closed surgical incision management). It leads to the reduction of wound infections and to improvement of wound healing in patients with relevant secondary diagnoses (e. g. diabetes mellitus, obesity, nicotine abuse, vascular problems, etc.). This dressing is placed directly on surgical sutures and a vacuum device is used to create suction. This results in a reduction of possible complications in wound healing (wound infections, wound dehiscence, haematomas, seromas, oedema. The dressing can be left in place for several days. We were interested to find out whether a circular bandage, which is not only applied directly to the wound site but also to the wider wound environment, is more effective and whether there are new indications for this.

We applied this new dressing technique and wrapped it snake-like tightly and circularly from distal to proximal, e. g. around a leg, in 11 patients with haematomas, oedema, seromas and exuding congestion dermatitis This is intended to have a suction effect in a much wider area than directly on the affected skin area and thus increase the effectiveness of the dressing. The results were evaluated in clinical and descriptive terms and photo-documented. Furthermore, in two patients the approximate fluid volume removed from the tissue by this new spirally applied method was calculated using a simple formula.

All patients showed a significant reduction in swelling, inflammatory reactions or haematomas within a few days. The longer the dressing was left in place, the better the results were. The approximatively calculated fluid volume removed by the new application method was 215 ml in one patient after 3 days and 601 ml in another patient after 5 days, supported by DPC (Dual Pressure Concept).

Despite the higher cost, the V.A.C.-Prevena dressing, which is wrapped around a limb in a modified snake-like way (surface Negative Pressure Wound Therapy [sNPWT]), is at least as good, if not more effective than other decongestive methods in reducing swelling, oedema (phleb-, lymphoedema), haematoma and congestion. The most effective application producing the best results appears to be achieved with the dressing in DPC (Dual Pressure Concept).

KEYWORDS

V.A.C.-Prevena dressing, oedema, phleboedema, lymphoedema, seroma, haematoma, congestion dermatitis, microdeformation, angioneogenesis, lymphangioneogenesis, wound healing disorder, volume reduction, compression

Introduction

Negative Pressure Wound Therapy (NPWT) has been established for almost 25 years and has become an integral part of wound therapy [1–3]. The indications have been continuously expanded. In the meantime, there are several forms of application for different types of wounds. These range from the classic application form for wounds to V.A.C. therapy (systems from KCI, San Antonio, Texas, USA) for the open abdomen (ABTHERA™), instillation therapy and incisional management, V.A.C.-Prevena™ therapy for critical surgical wounds

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[4,5]. There are also other forms, such as portable devices (Via™) and the latest disposable devices with mechanically generated negative pressure (Nanova™, SNAP™; dNPWT, disposable) [33], or devices for superficial removal of skin cells (CelluTome™) for wound coverage.

Our main focus is on V.A.C.-Prevena used for the treatment of postoperative risk wounds (for example, in patients with diabetes, vascular problems, chemotherapy, nicotine abuse, obesity, radiotherapy, steroid medication) [6]. The main effect is the reduction of surgical wound infections by improving the blood circulation in the scar area which ultimately leads to an acceleration of wound healing and reduction of oedema and secretions [7, 8]. The difference between the V.A.C.-Prevena system and other types of application is that the special foam dressing is not applied into a wound, but directly onto the suture of a surgical wound and immediate surrounding skin. The underside of the foam is provided with a special protective layer so that the skin is not damaged or macerated. The foam is covered as usual with a special foil and connected via a track pad and hose to the vacuum pump, which applies continuous or intermittent suction (sub-atmospheric pressure); usually 125 mmHg. The applied dressing can be left in place for 5–7 days.

We wanted to find out if a circular V.A.C.-Prevena dressing is even more effective than the usually linear dressing. It was assumed that the positive tissue effects (see background MDWT), which are generated by the suction directly on the skin, are even more effective due to the significantly larger surface coverage of the wider wound area. The foam panels were not applied lengthwise, as with the conventional V.A.C.-Prevena dressing, but in a spiral, e. g. wrapped around a whole leg (snake-like), and also left for 5–7 days. It was also used where there were no surgical scars or open wounds, e. g. in the case of extensive haematomas, oedema or in cases of congestive dermatitis and hypodermitis. New indications thus arose. After removal of the dressing, the effect is immediately visible in the form of a decrease in the limb circumference following a reduction in swelling (oedema, seroma) and haematomas and improved wound healing [9]. It was also of interest whether instead of continuous suction, the DPC mode (Dual Pressure Concept) produced better clinical results (alternating suction and relaxation phases).

Background MDWT (Micro-Deformational Wound Therapy)

The "vacuum principle" of micro-deformation also works if the dressing is applied to the uninjured normal skin instead of an open wound, possibly in a somewhat attenuated form. The suction creates a micro-deformation which acts vertically on the cells and, depending on the strength of the acting forces triggers increased cell differentiation and proliferation. The cells convert these mechanical forces into biological signals (mechanotransduction) [10, 11]. The cells thus respond better to growth factors. In normal cells – especially fibroblasts – there is an isometric tension along the cell axis, i. e. parallel to the anchoring in the tissue. Since these cells are well anchored with the extracellular matrix (ECM) proteins, the tension forces (caused by physical exercise) have a stimulating effect on the cells and they react with differentiation and proliferation [12]. In the case of cells in wounds, however, such anchoring is usually no longer completely present. Here an externally applied suction (sub-atmospheric pressure) can exert the necessary tension on the cells, whereupon they can differentiate and proliferate again. The suction also creates a hypoxia gradient, where angiogenic inhibitors are removed and the cells are stimulated to secrete more pro-angiogenic factors; i. e. in the end more growth factors are generated by the cells (e. g. hypoxia induced factor-1-(α HIF-1α), vascular endothelial growth factor (VEGF)), which stimulate angioneogenesis [13]. Through further growth factors and cytokines, structurally reinforced fibroblasts, which build up the ECM and granulation tissue, grow into the wound area and vessels [14]. In addition to the increase in arterial blood flow due to a denser capillary network, venous and lymphatic drainage is also improved [15]: At the wound edges the density of the lymphatic vessels is increased by a new formation [11, 16, 17]. Overall, the diffusion distances and hydrostatic capillary pressure are reduced, ultimately resulting in the removal of excessive extracellular fluid and thus noticeably reducing oedema of any kind (venous, lymphogenic) [18]. MDWT has also been shown to stimulate the neurocutaneous system by releasing neural growth factors and neuropeptides [19]. The intermittent MDWT, e. g. in the form of the DPC mode, showed a stronger effect than continuous suction [20].

Indication for circular dressing

A circular dressing, e. g. on one leg, can significantly increase the total effective area on the skin far beyond the affected area. Thus, improved blood circulation is also achieved in the "healthy" skin area with an additional positive effect on the affected skin region. This results in more effective decongestion not only in the area of a suture, wound or haematoma, but also in the wider environment and generates new granulation tissue in open wounds. Table 1 lists the proposed indications. The circular V.A.C.-Prevena dressing can also be used as a combination dressing, e. g. simultane-

Table 1: Proposed indications for a circular VAC-Prevena™ dressing

Congestive oedema of any cause (phleb-, lymphoedema)
Hypodermitis in chronic venous insufficiency
Secreting skin changes (e. g. congestive dermatitis)
Haematomas, large area
Seromas
Superficial wound healing disorders
Open wounds (possibly additionally inserted foam)
As compression therapy
As lymph drainage therapy
All previous indications of incisional management/VAC-Prevena™

Table 2: Proposed contraindications for a circular VAC-Prevena™ dressing

Florid or chronic infection
Open festering wound
Erysipelas, phlegmons
Necrotic tissue
Malignancies
Deep vein thrombosis
Severe PAOD
Severe cardiopulmonary decompensation
Severe renal insufficiency
Allergies to the material (foam, foil)

ously over skin graft sites and as a postoperative compression dressing, e. g. after vein surgery with Thiersch skin graft and weeping skin sites (exudative congestive dermatitis).

Contraindications

There are contraindications for the use of a circular dressing. The list is not complete and may need to be supplemented. Here is a selection: basically for infections, severe cardiopulmonary and nephrogenic limitations and malignant skin changes (Table 2).

Patients and method

Several patients have been treated in this way at the outpatient wound clinic of the Cantonal Hospital Obwalden since December 2015. Patients were selected consecutively e. g. in the presence of haematomas, seromas and oedema of the lower extremities (see list of indications). The indication for the application of a circular V.A.C.-Prevena dressing was provided by the physician. In some patients, the necessary internal clarifications had to be carried out beforehand, e. g. exclusion of deep vein thrombosis, arterial vascular occlusion, severe cardiopulmonary decompensation and severe renal insufficiency. After prior clarification, all patients gave their full consent. The patients had given their verbal consent for the therapy and the anonymous publication of the results and photos. In the event of discomfort or pain that could be caused by the bandage, there was the option of removing it immediately, but this measure was never necessary. The dressings were documented photographically on application and removal. The results were primarily assessed in clinical and descriptive terms since the effects were immediately visible after removal of the dressing. The approximate volume of tissue fluid removed in two patients was also calculated. To that effect, the leg circumferences were measured at 10 cm intervals before and after treatment. These values were recorded and the approximate volume was calculated before and after treatment. The sum of the volume differences per segment gave the approximate net loss of tissue fluid (see below).

Practical implementation

The initial use of the original purple foam panels of the V.A.C.-Prevena dressing proved to be too rigid and unwieldy, so that the foam was cut in half lengthwise (Fig. 1), allowing a limb to be wrapped much more dynamically and tightly. If possible, no skin should be exposed in between. The suction effects only occur directly under the foam.

The dressing was applied by three persons, one person holds the leg in an extended position, while the other two wrap the foam sheets circularly from distal to proximal. The whole foam is covered with foils in an airtight manner and connected to a vacuum device via a track pad. The basic setting is a continuous suction of 125 mmHg. For greater effectiveness (more effective and faster) the DPC mode (Dual Pressure Concept with the V.A.C.-ULTA™ unit) can be selected. Such intermittent suction oscillates between 125 mmHg and 25 mmHg and never drops to 0 mmHg. With such a dressing around both legs, the patient can be mobilised normally. The dressing is usually left in place for 5–7 days, after which it can be removed or reapplied. Other dressings can be applied over the circular V.A.C.-Prevena dressing, e. g. an elastic bandage, a foam heel guard, a V.A.C.O® ped or a brace.

Clinical results based on three selected examples

To date, a total of 11 patients have been treated with a circular V.A.C.-Prevena dressing (also called “Sarner Schlange”) between December 2015 and December 2018. There were five male and six female patients, one female patient was treated twice at intervals of 1 year; in the first treatment both legs were wrapped, in the second only the left leg was wrapped. The patients were between 18 and 93 years old. Ten patients were treated as inpatients and one patient as outpatient. The indications are shown in Table 3. The dressings were well and painlessly tolerated by all patients. Pain caused by swelling reduced in most cases shortly after the spiral dressing was applied.

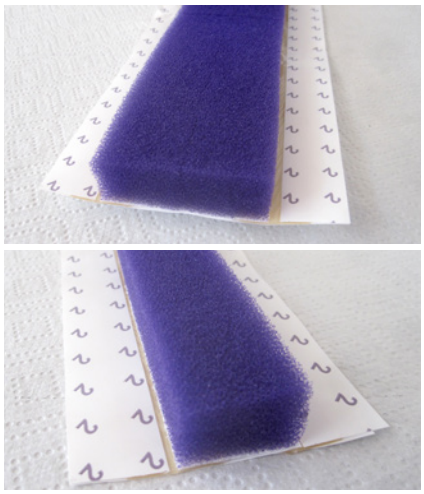

Fig. 1 Top: the original foam sheet with a width of approx. 5.3 cm. Bottom: the halved foam sheet with a width of approx. 2.7 cm. This can be wrapped around an extremity much better and easier.

The dressings were left in place for between 3 and 7 days. In one patient who was insisting on discharge the dressing was removed after only 3 days, although the treatment should have been continued. Tension bubbles were commonly observed in spiral applications that were too tight and with small distances between the windings. Leaving the foot free was usually more difficult, since mobilisation can quickly

Table 3: List of the indications in 11 patients for whom a circular VAC-Prevena™ dressing was applied

Number of patients	Indications
2	Painful subcutaneous haematomas on the leg after a fall while on oral anticoagulation, no wounds
3	Postoperative swelling, oedema and seromas: after surgical treatment of several metatarsal fractures; after revision of knee prosthesis; after several wound revisions in case of infection after tibial head osteosynthesis
1	Combined postoperative compression dressing and VAC dressing after varicose vein surgery with simultaneous ulcer debridement and Thiersch skin graft
3	Massive oedema with hypodermitis and skin maceration of the lower extremities of various causes
1	Debrided multiple lower leg necrosis lesions due to a drug reaction
1	Debrided wound on the lower leg after cessation of healing while receiving anti-α-TNF therapy

cause leaks in the foil dressing. The circular V.A.C.-Prevena dressing can be combined with other dressings. A normal elastic bandage can be applied over it, other protective bandages can be applied without disturbing the spiral dressing and the foil. It fits easily into a V.A.C.O® ped pressure pad or under a knee brace, for example.

Example 1

92-year-old female patient with massive bilateral leg oedema (phlebologic and lymphatic oedema, lipoedema) (Fig. 3). There was also an increased cardiopulmonary load. Deep vein thrombosis or arterial occlusion was excluded in advance. The narrow foam panels were applied a little tighter than before (Fig. 3). A dorsal skin area was resected on the right lower leg following haematoma-related skin necrosis. The wound was filled precisely with white foam and the circular V.A.C.-Prevena dressing was wrapped over the whole area (Fig. 3). Both dressings were connected to a vacuum device via a Y-piece (Fig. 4) and a continuous suction of 125 mmHg was set. With these dressings the patient could be well mobilised. After 5 days both dressings were removed. By wrapping more tightly, oedema and haematomas were better reduced (Fig. 5). The wound under the white foam already exhibit good granulation tissue. Follow-up examination just under 1 year later showed complete healing of the wound defect through spontaneous healing (Fig. 6).

Example 2

A combination dressing, as a wound dressing for Thiersch skin graft areas and as a postoperative compression dressing, was applied in a 73-year-old female patient following varicose vein surgery and Thiersch skin graft of the debrided ulcer wounds. Due to the Thiersch skin graft on several wounds on the right leg, a standard compression dressing could not be applied, but a postoperative bandage was still needed. The skin was removed from the right lateral thigh. Thus, the application of a circular V.A.C.-Prevena dressing was an obvious choice. In this way the patient was completely mobile and had no discomfort whatsoever while wearing the dressing (Fig. 7). The dressing was removed after 5 days. The tight winding caused tension bubbles at some points between the adhesive strips, where there was still exposed skin. The other positive effects manifested as decreased oedema and haematoma with a good healing of the treated areas (Fig. 8).

Example 3

The second patient was the same, now 93-year-old patient as in example 1, who presented again almost a year later due to massive exuding leg oedema on the left side (Fig. 9–11). The calculated fluid volume reduced in 5 days was 601 ml. The V.A.C. apparatus canister contained approximately 650 ml serous fluid (Fig. 12). The DPC mode which proved to be more effective than continuous suction was used in this patient. The interval therapy produced a massage-like effect. The intervals were set arbitrarily: Suction to 125 mmHg for 6 minutes, then decreasing suction to 25 mmHg for 6 minutes, etc. In clinical and descriptive terms there was a significant decrease in swelling and erythema, following a reduction in inflammation. With this calculation method, it remains unclear what volume was drained directly via the venous and lymphatic system, since in this example it was mainly the transcutaneous loss that was recorded. The rough volume calculation thus seems to give a good approximation of the effective volumes.

Fig. 2, Example 1 Baseline situation of the local conditions on both legs.

Fig. 3, Example 1 The debrided wound area was covered directly with a precisely fitting white foam without skin edge protection and the circular dressing was applied over it.

Fig. 4, Example 1 The finished dressing. Both spiral dressings are connected to a V.A.C. unit via a Y-piece. Continuous suction of 125 mmHg during 5 days.

Fluid volume reduction with circular dressing

The aim was to determine how effective this circular V.A.C.-Prevena dressing really was and what amounts of tissue fluid could be removed in what time. To that effect, approximate volume calculations were performed for two patients. Volume calculations of irregular bodies can be captured or calculated in many different ways. We roughly estimated the volume of a leg as the sum of the differences of a sequence of several truncated cones before and after therapy (modified according to Kuhnke [21] as well as Lennihan and Mackereth [22]). Before application and after removal of the dressing, the circumferences of the leg were measured at 10 cm intervals and the volumes in each truncated cone segment were calculated. Circumferential measurements on a smaller scale, e. g. at 5 cm intervals, or the use of a perometer, which was not available to us, would have permitted greater accuracy.

The first patient had a traumatic and very painful haematoma on the left leg. The calculations showed a volume loss of approximately 215 ml in this patient in 3 days.

Discussion

We wanted to find out in clinical application how effective a circular V.A.C.-Prevena dressing was. A direct comparison with the conventional V.A.C.-Prevena dressing could only be made empirically, since there was no comparison group. The results in the 11 patients were evaluated in clinical and descriptive terms. Within a few days we

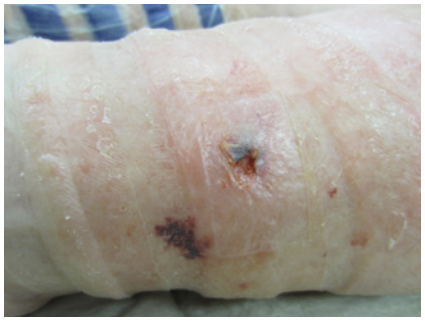

Fig. 5, Example 1 5 days after removal of the dressing. Detailed view of the left lateral lower leg. Redness and swelling are clearly regressing, as is the pain. The furrowed changes caused by the wide winding distances are still clearly visible. The skin is significantly drier.

Fig. 6, Example 1 Same area as in Fig. 3 after 11 months. The defect area has healed spontaneously and without covering the skin.

Fig. 7, Example 2 The dressing just before removal; the patient was fully mobile. Only the vacuum pump had to be carried around.

found a clear visible effect in terms of volume reduction of a limb, reduction of redness, swelling and inflammatory response and rapid pain reduction. The approximate fluid volumes extracted from the tissue were calculated for two patients. In the first case, 215 ml volume was removed in 3 therapy days (drainage via the venous and lymphatic system) and in the second case, 601 ml was removed in 5 days (drainage mostly directly via the circular V.A.C.-Prevena dressing). No side effects or adverse reactions have occurred so far. The circular V.A.C.-Prevena dressing extends the indication of the conventional V.A.C.-Prevena dressing from high risk surgical wounds to those mentioned in Table 1. A disadvantage of the circular dressing is the higher costs (equipment rental, additional foam material used), as well as the complex application and having to carry around the vacuum pump. Once the dressing has been applied, it can be left in place for 5–7 days, which is an advantage because during this time only very little nursing care is required (possibly canister replacement, removal of dressing after therapy). After weighing up the effort against the benefits, the final results attest to a very effective dressing with quick visible results.

Nevertheless, other decongestion systems with wound healing support must also be considered as a therapy option before use. Not to be forgotten are the incalculable expenses, such as the provision of information to the patient, instruction, adjustment, measurement (e. g. of the stocking size), care, help with daily dressing and undressing, etc. The pros and cons in everyday clinical practice must be weighed up against the existing systems in terms of indication, application possibilities and costs. A short exemplary comparison with 4 other systems is presented here to demonstrate advantages and disadvantages: A class 2 **compression stocking**, which is most frequently used to reduce swelling, achieves an average pressure of 23–32 mmHg for lower leg length stockings (higher pressures for compression class 3–4: 34– >49 mmHg) [23]. There is a continuous static pressure exerted by the elastic elements of the stocking. It is known that the pressure on the tissue in the microscopic range results in a slightly denser capillary network after 2–4 weeks, which can be measured with incident-light microscopy [24]. A compression stocking is cheaper to buy (in Switzerland, depending on the model and company, between CHF 80 and 140). However, it becomes difficult to wear a compression stocking permanently under exuding skin conditions (e. g. in exudative congestion dermatitis). With the pneumatic system **ACT** (Adaptive Compression Therapy) there is a similarly good wearing comfort and approximately the same ulcer healing rate as with a 4-layer dressing. In the study consulted, the ACT system was worn for 11.5 hours on average daily and operated in IPC (Intermittent Pneumatic Compression) mode for 2 hours on average. The control unit is integrated into the dressing. The advantage is that the patient can remove the device as needed, which is not possible with the circular V.A.C.-Prevena dressing. The ACT is slightly better with regard to some characteristics compared to 4-layer dressings with approximately comparable effectiveness [25]. **Intermittent pneumatic compression therapy** (IPC) (e. g. lympha-mat® GRADIENT) is a similar system to ACT. It consists of two chambered cuffs for the legs and an electronic control unit with which the pressure gradients, intervals and treatment duration can be precisely adjusted. The patient is not mobile, and must lie down, during the therapy of 30 to 60 minutes, which can be repeated several times a day (a total of 3–4 hours). Numerous tissue changes (including positive haemodynamic changes, increased fibrinolytic activity and improved trans-

Fig. 9, Example 3 Massive and painful swelling of the left leg with phlebologic and lymphatic oedema as well as lipoedema. Congestive dermatitis and hypodermitis due to chronic venous insufficiency weeping through the skin. Deep vein thrombosis or arterial occlusion were ruled out before starting therapy. In cardiopulmonary terms, the patient was slightly decompensated, but tolerated the therapy well for 5 days.

Fig. 8, Example 2 After 5 days the dressing was removed. In some places, tension bubbles formed between the windings. The ulcers covered with Thiersch skin graft exhibited good acceptance of the mesh graft.

Fig. 10, Example 3 Status post application of spiral dressing. Shortly afterwards the leg pain decreased noticeably. The dressing was pleasant to wear.

Fig. 11, Example 3 After 5 days the dressing was removed. Tension bubbles formed in some places because the windings were too far apart, but these healed quickly.

Fig. 12, Example 3 After the 5-day therapy, there was approximately 650 ml serous fluid in the canister.

cutaneous oxygen saturation) have been demonstrated. The application is recommended especially for persistent ulcers lasting more than 6 months [32]. **VADOplex®** is another continuous pulse system. It works with cuffs that are only intended for the foot or hand. It exerts an intermittent pulse-like pneumatic compression on the foot or hand and can be used in case of swelling (venous, lymphogenic), as prevention of thrombosis as well as in peripheral arterial occlusive disease [26–31]. The equipment is provided, only the different cuffs, which are available in different sizes, have to be purchased. During the quickly applied and simple therapy, the patient is not mobile and must lie in bed and the control unit cannot be carried around. The total application time should be at least 4–6 hours daily. Clinically very good results were shown with regard to the reduction of oedema. When used in cases of impaired arterial blood flow (diabetics, peripheral arterial occlusive disease), significant reductions in pain at rest and improvement in microcirculation were found. Table 4 provides an overview.

The circular V.A.C.-Prevena dressing is the only system that works with suction (sub-atmospheric pressure). The vertical suction triggers the physiological aspects mentioned at the beginning (background MDWT: angioneogenesis, growth factor release, ECM build-up). This extends the suction effect to a much larger area of skin beyond the local findings; the wound region is thus additionally supported in healing. All other systems are based on pressure or compression (continuous pressure, intermittent pressure) and can sometimes lead to a slightly increased capillary density in the tissue when used for a longer period (at least 2–4 weeks). Dynamic pressure curves are seen in ACT and IPK (see Table 4). The **circular** V.A.C.-Prevena dressing opens up prospects for further applications (Tab. 1), e. g. application around a whole leg and on the closed skin without wounds or sutures (**sNPWT**; s = surface, skin) while maintaining full mobility. It is particularly indicated for severely swollen extremities of various aetiologies, e. g. exuding congestive dermatitis and in bedridden patients. In this case, the DPC mode, which also exerts a certain massage effect, is a good choice. No other dressing appears to be able to extract such an amount of fluid from the tissue in such a short time without damaging the skin (maceration) and without having to be replaced at certain intervals. While higher, the costs can be outweighed by the benefits derived from this dressing. All but one patient were hospitalised with the indications listed in Table 3. One patient was treated as an outpatient. Due to the effects of subatmospheric pressure on the skin and

Table 4: Brief overview of the methods mentioned in the text which contribute to decongestion and wound healing [VLU = venous leg ulcer]

System	Principle	Application (alone, with help, equipment)	Pressures/ suction	Indication	Mobility	Tissue changes	Costs
1. Compression stocking (various manufacturers)	Pressure, static	Simple to moderate, depending on independence	Cl II 23-32 mmHg; Cl III-IV 34->49 mmHg	Decongestion (phleb- and lymphoedema), VLU	Yes	Yes	Inexpensive to moderate
2. VADOplex®	Pressure pulses, adjustable strength	Simple, non-portable device	Pulses max. 1 s, pressures from 50-200 mmHg	Decongestion (phleb- and lymphoedema), improvement of arterial blood circulation	No	Yes	Inexpensive, purchase of pulse cuff, device made available
3. ACT (adaptive compression therapy)	Continuous pressure or intermittent pressure pulses	Moderate, device integrated	20-50 mmHg	Healing support for VLU, phleb- and lymphoedema	Yes	Not known (prob. yes)	Rental Multiple use (other costs ?)
4. IPK (lymphamat® GRADIENT)	Pressure and intervals, adjustable in strength and time	Moderate, poorly portable device	12-200 mmHg	Healing support for VLU, oedema	No	Yes	Rental Multiple use (other costs ?)
5. Circular VAC-Prevena™	Pressure and intervals, adjustable in strength and time	With help, portable device	50-125 mmHg	See table 1	Yes	Yes, extensive, quickly	High (equipment rental plus consumables)

tissue (microdeformation), the likelihood of extending the indications should be contemplated. In theory the capillary blood flow could be improved through angioneogenesis in patients with peripheral arterial occlusive disease (PAOD) or diabetes (DFS, diabetic foot syndrome), similar to the results achieved with VADOplex [26, 28]. It may also be possible in the case of burns to improve the blood circulation to the affected area through the formation of new capillaries and compression of the lymph vessel system. However, this would require further investigation.

Reimbursement

In Switzerland as well as in Germany, the costs of an NPWT dressing for an inpatient are covered by the flat rate case fee. For outpatients we are in the advantageous situation in Switzerland compared to Germany that the NPWT dressings are reimbursed within the legal framework when there is a medical indication [33].

Conclusion

A circular V.A.C.-Prevena dressing with spiral application around a limb is indicated for effective decongestion, anti-inflammatory activity and improvement of wound healing. These properties can be explained by the larger area covered by the dressing. It appears that this type of spiral application allows decongestion and wound healing to be achieved more quickly and effectively than with other conventional decongestion systems. However, the costs are higher with this method.

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