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Kazim Abbas and Shovkat Mir Ahmad

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Case Report

MECHANISM OF VACUUM ASSISTED CLOSURE THERAPY FOR ARTERIAL LEG ULCERS: CASE SERIES AND REVIEW OF LITERATURE

Kazim Abbas*[1] and Shovkat Mir Ahmad[2]

[1,2]Department of Surgery, York Hospital, York, UK

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ABSTRACT

Leg ulcers are the result of peripheral vascular diseases that are both venous and arterial. A relatively new technique has been developed for the treatment of difficult to heal ulcers. This is called Vacuum Assisted Closure (VAC Therapy). This treatment involves application of negative pressure to wounds resulting accelerated healing of wounds. This therapy is useful in treating non-reconstructable vascular diseases that usually end in the amputations of the legs. This papers describes the beneficial effects of the VAC therapy, its mechanism of action as well as clinical effectiveness in the light of two case reports.

INTRODUCTION

The prevalence of leg ulcer is approximately 1% to 2% (Mekkes JR *et al*, 2003). Peak prevalence is between 60 and 80 years of age (Gonsalves CF *et al*, 2003). Venous ulcers (Callam MJ *et al*, 1985) are more common form of ulcers while the arterial ulcer account for only 10% to 20% of all the leg ulcers. Tucson Expert Consensus Conference (osteotomy/wound management 2004; 50 (4 Suppl B): 3S-275 have shown that even after surgical intervention ulcers healing may be too slow or not progress at all In the case of failure of the revascularization of the leg or progressive disease, amputation is the usual sequalae. The risk of leg amputations in patients with intermittent claudication at five years in approximately 5% (Hooi JD *et al*, 2004; Twine CP *et al*, 2009). This situation requires a special ulcer management plan for the healing of leg ulcers. Negative pressure wound therapy as known as Vacuum Assisted Closure of the leg ulcers has been found to promote the ulcer healing. This case series highlights the usefulness of VAC therapy in the management of the complex leg ulcers in the light of database reviews.

Case Study 1

An 81 year old female patient with known history of peripheral vascular disease was admitted through out-patient clinic in the vascular surgery unit) with 6 weeks history of swelling and redness of the left lower leg. She had been admitted repeatedly with worsening of the leg ulcers since 1998. The patient was non-smoker and had an extensive interventional radiology (left sub-intimal SFA, popliteal and peroneal artery angioplasty in Sep 2004 and 2005), surgical (left profundoplasty April 1998, left lumber phenol sympathectomy Sep. 2002),) and medical management attempts (maggot therapy in September 2004) at improving the blood supply of the left leg. The patient was apyrexial on admission. On examination of the lower leg, pedal pulses were not palpable. The patient had one ulcer on the left lower leg (3x2.5cm) and two on the medial malleolus (5x5cm) (Fig 1). Both the ulcers were infected with cellulites of the legs. Further investigation revealed a non-reconstructable vascular disease in the left leg. Tissue viability nurse led ulcer management with dressings was attempted along with culture sensitive antibiotic therapy. Despite this the ulcers became confluent into one large ulcer on the medial side of leg and foot. It was likely that further extension of ulcer with cellulitis would result in amputation of the leg. She was under enormous physical and emotional stress.

Before VAC Therapy

It was decided in the multidisciplinary team meeting to commence the VAC therapy for the treatment of the ulcer. VAC dressing was changed every 48 hours and wound progressed well with reduction in size. The left leg ulcer was infected and sloughed before negative pressure therapy.

*Corresponding author: **Kazim Abbas***
Department of Surgery, York Hospital, York, UK

Figure 1 Ulcer medial malleolus of left leg

The VAC therapy continued for 2 months. This resulted in decrease in size of ulcer. Also it changed sloughed base to granulation tissue (Figure 2) with island of new epithelium (Figure 3).

Other factors to aid rehabilitation were also considered e.g. physiotherapy, orthotic shoe fitting etc. The ulcer management thereafter shifted to conventional dressing therapy. She was discharged after a further week patient. Follow up in the vascular clinic at 2 months revealed further improvement in the healing of the left leg ulcer.

After VAC Therapy

Figure 2 (Granulating tissue in ulcer base)

Figure 3 (Skin growing from the edges)

Case Study 2

A 69 years old patient was admitted through emergency with the cellulitis and ulcer right leg. He was known to have peripheral vascular disease with repeated ulcer formation on right lateral malleolus since 1999. He is smoker for last 27 years. Vascular imaging found a non-reconstractable vascular disease. The radiological intervention was also limited considering his diseased vessels. His ulcer dimensions were 7x5 cm along the lateral malleolus. He was given culture sensitive antibiotics and tissue viability nurse led dressing. The conservative treatment was continued for about 4 weeks with little improvement. It was decided to patient to treat leg ulcer with vacuum assisted closure (VAC) therapy. Ulcer had typical purple discoloration at margins, sloughed and necrotic base (Figure 1). Vacuum assisted closure therapy was continued for the period of 2 months with exceptionally good response. The ulcer margins started to heal showing epithelialization leading to the development of granulation tissue with change in color from yellow and sloughed to pink and vascular. Negative pressure therapy was followed by regular dressings. This resulted in complete healing of ulcer with new epithelial growth without the requirement for skin graft. He was then referred to care of elderly for rehabilitation.

Before VAC Therapy

Figure 1 Infected ulcer right malleolus

Figure 2 Completely healed ulcer

DISCUSSION

Vacuum assisted closure (VAC) is designed to promote the formation of granulation tissue for faster the healing in the ulcer beds of the patients with acute and chronic ulcers._The VAC Therapy is a non-invasive technique which uses negative pressure mechanism for the treatment of ulcers and difficult to heal chronic ulcers. A porous foam dressing (such as polyurethane) is sealed to the wound with an adhesive dressing. An evacuation tube is inserted into the wound (Fig. 0) permeable_adhesive drape facilitates the gas exchange and protects the wound base. The evacuation tube applies the negative pressure-creating vacuum. This vacuum creates pressure range of 50-150 mm of Hg, which can be set at a continuous, or intermittent rate to draw off the exudates and stimulate wound healing. Dressing changes are recommended every 48 hours for adults with non-infected wound and daily for infants and adolescent.

Four mechanisms (Huang C *et al*, 2014) have been described in the literature that help promote the healing of the ulcer. Firstly VAC therapy leads to wound contraction along the edges of the ulcer. Secondly, it results in fluid removal through protease and metalloproteinase rich exudate suction. Studies have shown that protease and metalloproteinases hamper tissue healing. Furthermore, the reduction in the tissue pressure through oedema management promotes blood flow and healing. Third mechanism is described as optimized wound environment through provision of moisture, infection control (Collier, 1997) and thermoregulation. Lastly VAC therapy has been reported to cause stimulation of the endothelial, epithelial and fibroblast cells growth as well as inflammatory modulation promoting healing of the ulcers.

Fig. 3

VAC therapy not only promotes ulcer healing but the rate of healing also improves significantly in the patients with peripheral vascular disease (Vikatmaa P *et al*, 2008). VAC therapy has been recommended for use in complicated and resistant ulcers (Argenta LC *et al*, 1997; Vuerstaek JD *et al*, 2006). Although some studies (Gregor S *et al*, 2008) have questioned the quality of evidence that maintains the beneficial effect of the VAC therapy. On the contrary, a meta-analysis (Zhang J *et al*, 2014) on diabetic foot ulcers suggest effectiveness of VAC therapy compared with conventional therapy. A randomized controlled trial also observed a significantly reduced amputations in the patients receiving VAC therapy (Blume PA *et al*, 2008). The complications associated therapy are uncommon. However, acute ulcers may be at risk of bleeding with VAC therapy. With the clinical effective reported in the literature, VAC therapy is likely to prove cost effective. A randomized controlled trial (Braakenburg A *et al*, 2006) for acute and chronic wounds found significantly reduced cost of nursing staff but no overall cost was similar for all the patients. However VAC therapy for treatment of diabetic foot ulcers (Flack S *et al*, 2008) did prove to be cost effective compared with the conventional wound dressing.

CONCLUSION

Originally used in the field of plastic and reconstructive surgery, VAC therapy has now emerged as a useful therapy in other specialties such as vascular & general Surgery in the treatment of complicated and non-healing wounds and ulcers. In the cases documented in this article it promoted rapid healing in both men and women with peripheral vascular diseases of lower legs.

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