

Vacuum-assisted closure (VAC) therapy in the management of wound infection following renal transplantation

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Abstract

Objectives: Wound infection in the setting of immunosuppressed state such as renal transplantation (RT) causes significant morbidity from sepsis, prolongs hospital stay and is expensive. Vacuum-assisted closure (VAC) therapy is a new technique of management of wound based on the principle of application of controlled negative pressure. The aim of this study was to assess the efficacy of VAC therapy in the management of wound infection following RT.

Materials and methods: This is a prospective study of a cohort of 180 consecutive RTs performed over a period of 4 years, where the data were retrieved from a prospectively maintained computerised database and case-notes.

Results: 9 of 180 (5%) patients developed wound infection following RT which led to cavitations and dehiscence with copious discharge, and refused to heal with conventional treatment. All 9 cases were treated with VAC therapy. The VAC system was removed after a median of 9 (range 3-30) days when discharge from the wound ceased. Four patients were discharged home with portable VAC device and managed on an outpatient basis, where the system was removed after a median 5.5 (range 3-7) days. The median hospital stay after initiation of VAC therapy was significantly shorter (5, range 2-12 days) than on conventional treatment prior to VAC therapy (11, range, 5-20 days) ($p=0.003$). Complete healing was achieved in all cases.

Conclusions: The use of VAC therapy is an effective and safe adjunct to conventional and established treatment modalities for the management of wound infection and dehiscence following RT.

Key words: Renal transplantation, wound infection, vacuum-assisted closure therapy

Wound infection and dehiscence in the setting of immunosuppressed state such as renal transplantation (RT), causes significant morbidity, which results in prolonged hospitalisation, and delays recuperation. Despite improvement in the surgical techniques and perioperative antibiotics prophylaxis, post-operative wound infection, particularly deep wounds with cavitations, continues to remain a serious and expensive problem. Vacuum-assisted closure (VAC) therapy is a new modality of managing open wounds which is taking its place as an effective and inexpensive treatment for acute and chronic wounds and is being used increasingly in all surgical specialties.¹ We report our first-hand experience of managing deep wounds by using VAC therapy in 9 patients following RT and discuss the pertinent evidence which supports its use in surgical practice.

Materials and methods

Nine out of 180 (5%) patients, who underwent RTs over a period of 4 years beginning October 2002, developed deep wound infection with dehiscence which was associated with copious discharge. All 9 patients had received kidneys from deceased donors and their demography is shown in Table 1.

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Table 1 Patient demography

Patient	Age	Sex	Immunosuppressive regimen	Days with VAC Therapy
1	46	F	C,MM,P	5
2	59	F	C,A,P	10
3	30	M	C, A, P	8
4	55	M	C, A, P	10
5	39	M	C,MM,P	5
6	55	F	T,A,P	15
7	41	M	C, A, P	3
8	67	M	C,MM,P	30
9	56	F	T,MM,P	5

C: Ciclosporin A, A: Azathioprine, P: Prednisolone, T: Tacrolimus, MM: Mycophenolate mofetil, M: Male, F: Female

The Device and the Principles of VAC therapy

The VAC system consists of open-cell white polyvinyl alcohol (PVA) foam or the black polyurethane (PU) ether foam dressing which is fashioned to specific size and shape of the wound and placed into the wound. An evacuation tube with side ports is embedded in the foam (Fig 1 and 2), thus ensuring equal distribution of pressure to all spaces within the system. The wound site is then covered with an adhesive drape, thereby converting an open wound into a controlled closed wound. The evacuation tube is connected to a canister where the effluent fluid from the wound is collected, and the latter is connected to the adjustable vacuum pump (Figures 3 and 4), which generates a negative pressure between 25-200 mm

Hg. The foam is changed at the bedside every 48 hours and the wound is re-examined.

The principle of this therapy is based on the application of uniform negative subatmospheric pressure, which helps draw wounds closed, and removes infectious material and interstitial fluid. This leads to tissue decompression, enhances dermal perfusion and promotes granulation tissue formation and healing.²⁻⁴ VAC device should not be used if it causes excessive pain, psychological intolerance or if there has been no healing response after two successive dressings. Likewise, it is contraindicated in the presence of pus or excessive bleeding.



Fig 1 Wound packed with PVA foam



Fig 2 Evacuation tube over the PVA foam



Fig 3: Suction pump (Front View)



Fig 4 Suction pump with canister in situ (Side view)

Methods

The wound were managed initially in the conventional manner with percutaneous drainage of localised collections and regular change of dressings. Appropriate antibiotics were administered when swab from the wound grew pathogenic organisms. As the wounds were deep with cavities and discharge persisted, they were treated with institution of VAC device (KCI Medical Limited, UK) (Fig 1-4). After cleaning the wounds with saline the device was fitted as described above, and a continuous suction at a pressure of 100 mm Hg was applied. Every 48 to 72 hours, the VAC system was changed under aseptic conditions in the ward. After removal of old dressing, the wound was inspected and swab was taken for bacterial culture and sensitivity tests. One patient required debridement of necrotic tissues under general anaesthesia in the operating theatre on one occasion. The device was removed once the discharge has ceased and the wound was dressed regularly in the conventional manner until healed.

Results

The VAC therapy was tolerated well by all patients and remained comfortable and mobile with the device in situ. There was progressive reduction in the size of the wound and development of healthy granulation tissue was evident in all cases. Precise measurement of the volume of the discharge was not possible as the sponge present in the canister absorbed the fluid and also the continuous suction led to coagulation of the discharge. Removal of the VAC system was done after a median of 9 (range 3-30) days. 4 patients were discharged home with a portable version of the VAC device in situ and managed on an outpatient basis, where the treatment lasted for a median of 5.5 (range 3-7) days. The median hospital stay after initiation of VAC therapy was significantly shorter (5, range 2-12 days) than on conventional treatment prior to VAC therapy (11, range 5-20 days) ($p=0.003$). There were no VAC device-related complications and complete healing was achieved in all 9 patients.

Discussion

Surgical drainage is fundamental to surgical practice and is used with the aim of minimising post-operative collection formation and wound healing problems. The practice of exposing a wound to sub-atmospheric pressure for an extended period to promote debridement and healing was first described by Wim Fleischmann from Germany in 1993. He reported successful use of this technique in 15 patients with open fractures which led to marked proliferation of the granulation tissue with no bone infection.⁵ VAC provides a new paradigm that can be used in concert with a wide

variety of standard existing surgical techniques. Louis Argenta and Michael Morykwas from the USA were the first to introduce VAC therapy in 1997 for the treatment of pressure sores and chronic wounds and since then, its use has been extended to other specialities, particularly to the infection and dehiscence of infected sternal wounds following cardiac surgery.^{6, 7} VAC therapy has helped treat more than 800,000 patients globally in all care settings, from acute to extended home care settings.⁷⁻⁹ Up to date, there are over 300 peer-reviewed articles published as the body of clinical evidence, which support VAC therapy.

Soft tissue loss from infectious, vascular, and traumatic disorders often results in poor healing and painful wounds, where VAC therapy has been used as an adjunct to prepare the wounds for definitive treatment at a later date. The successful use of VAC therapy for the treatment of pressure sores, exposed bones following deep burns, ulcers of vascular aetiology, abdominal wall defects in neonates with giant omphalocele, and wound dehiscence following laparotomy for peritonitis and trauma have been well documented in the literature.¹⁰⁻¹⁴ The contraindications for application of VAC therapy are presence of fistulae related to the site of VAC therapy, necrotic tissues in the eschar, untreated osteomyelitis and malignancy in the wound.¹⁵

Research endeavours are underway to elucidate the biomechanical effects induced by VAC therapy and it is hypothesised that the application of micromechanical forces may stimulate wound healing through promotion of cell division, angiogenesis, and local elaboration of growth factors.^{16, 17} Animal studies have demonstrated that this technique optimizes blood flow, decreases local tissue oedema, and removes excessive fluid from the wound bed. These physiologic changes facilitate the removal of bacteria from the wound.¹⁸ Additionally, the cyclical application of sub-atmospheric pressure alters the cytoskeleton of the cells in the wound bed, triggering a cascade of intracellular signals that increases the rate of cell division and subsequent formation of granulation tissue.^{19, 20}

In our own experience, use of VAC therapy assisted healing of the wound, reduced hospital stay significantly and simplified the management of wound, both for the patients and the nursing staff. Four patients, who were managed as outpatients with the VAC device in situ, attended hospital for change of dressings and assessment of wound on alternate days, managed the device at home without any problem. The device provided a sterile and closed system of drainage with reduced

risk of cross-infection, which has serious implications in the setting of immunosuppression. The VAC therapy is a valuable adjunct in the management of wound infection following RT and a prospective study to examine the usefulness of VAC therapy will be worthwhile.

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