Negative-pressure wound therapy: a snapshot of the evidence

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ABSTRACT

Topical negative pressure (TNP) is a mode of therapy used to encourage wound healing. It can be used as a primary treatment for chronic/complex wounds or as an adjunct to surgery. Based on the evidence to date, the clinical effectiveness of negative-pressure therapy is still unclear. Although case reports and retrospective studies have demonstrated enhanced wound healing in acute/traumatic wounds, chronic wounds, infected wounds, wounds secondary to diabetes mellitus, sternal wounds and lower limb wounds, there are very few randomised controlled trials, with unclear results. The evidence is lacking for the use of TNP therapy for other indications to enhance wound healing such as patients with decubitus ulcers, diabetes and peripheral vascular disease and to improve skin graft take. There have been, as yet, no quality-of-life studies available for negative-pressure therapy. Despite this, the usage of TNP has increased. This review provides an overview of clinical studies using TNP and proposes avenues for further research to elucidate the exact mechanism of TNP, in addition to large randomised controlled clinical trials of patients undergoing this therapy.

Key words: Negative-pressure wound therapy • Suction therapy • Topical negative pressure • Vacuum-assisted closure

NEGATIVE-PRESSURE THERAPY

The vacuum-assisted closure (VAC) negative-pressure technique, also called topical negative pressure (TNP) or negative-pressure wound therapy (NPWT), has been extensively described in the literature to assist wound closure in Plastic and Reconstructive Surgery (1–5), Cardio-Thoracic (6), Gynaecologic (7) and General Surgery (8). The technique is designed to remove chronic oedema fluid, thereby leading to decrease in the afterload to blood flow, resulting in increased localised tissue perfusion. Together with applied negative-pressure forces, the formation of granulation tissue is enhanced. The negative-pressure technique has been demonstrated to be an extremely efficacious method to stimulate healing by secondary intention (1,2).

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LITERATURE REVIEW

The literature was reviewed on Medline, PubMed and Cochrane databases from 1995 to present. The key words searched were 'vacuum assisted closure', 'VAC', 'vacuum therapy', 'sub atmospheric pressure therapy', 'sub atmospheric pressure dressing', 'vacuum sealing', 'negative pressure dressing', 'foam suction dressing', 'topical negative pressure' and 'suction therapy'. This search yielded more than 200 papers, of which most were isolated case reports of negative-pressure therapy. There were five randomised controlled trials, 10 case series and five basic science studies investigating TNP therapy. This review covers the key papers involving the usage of TNP in different clinical conditions.

Key Points

- topical negative pressure is a mode of therapy designed to remove chronic oedema fluid, thereby leading to decrease in the afterload to blood flow, resulting in increased localised tissue perfusion
- the negative pressure technique has been demonstrated to be an extremely efficacious method to stimulate healing by secondary intention
- this review covers the key papers involving the usage of TNP in different clinical conditions

Key Points

- the precise mechanism by which the TNP technique brings about wound closure is still unknown
- it is apparent that cells are able to sense mechanical forces and respond through the regulation of specific genes and the induction of cellular programs
- however, there is still no evidence that negative pressure directly influences cell growth
- the Cochrane Wounds Group reported a systematic review on the application of TNP for treating chronic wounds in favour of TNP
- due to the small sample sizes and the methodological limitations of these studies, these findings must be interpreted with extreme caution
- Table 1 illustrates the results of the studies along with their conclusions

EXPERIMENTAL BASIC SCIENCE STUDIES

The physiological basis of TNP is based on the early work of Dersch *et al.* (9), who showed that positive pressure leads to a decrease in skin perfusion and hypoxia, while negative pressure increases skin perfusion. The precise mechanism by which the TNP technique brings about wound closure is still not known. Morykwas *et al.* (2) demonstrated that peak blood flow levels were fourfold higher than baseline values in a pig model while using the TNP technique at continuous pressures of 125 mmHg. They found a significantly higher rate of granulation tissue formation and a significantly reduced bacterial count after 4–5 days of treatment using this technique. Clinical and experimental studies (1,2) have shown that removal of third-space fluid resulted in a decrease in tissue turgor and capillary afterload, which promoted improved capillary circulation and inflow.

Morykwas and Argenta (10) applied controlled subatmospheric pressure (125 mmHg) in an artificially closed space to partial-thickness burns in pigs, which significantly decreased the cellular death under the burn. When the pressure was applied within 12 hours after the burn injury, a decrease in cell death was noted even when subatmospheric pressure was applied for as little as 6 hours. In summary, the application of the negative pressure to partial-thickness burn injuries prevented the progression of the wound to a deeper injury in an experimental pig model. It is this 12- to 24-hour postburn window that affords the physician the opportunity to maintain or improve microcirculation by various manipulations and prevent progressive loss of tissue (2). The results of this study may be extended to human wounds since the swine model is mammalian tissue. Human wounds may differ in that the wounds are complex, multifactorial and associated with systemic problems. In addition, the removal of excess exudates from the wound is believed to remove inhibitory factors present in the fluid. These fluids contain high levels of matrix metalloproteinases (11), and these have been shown to degrade extracellular matrix proteins (12).

It was shown that only those cells that stretch could divide and proliferate in response to soluble growth factors, whereas cells that do not stretch assume a more spherical shape and are cell cycle arrested, with a tendency to undergo apoptosis (13,14). Directional growth of capillary sprouts is also promoted by tension application in three-dimensional angiogenesis models (15). It is apparent that cells are able to sense mechanical forces and respond through the regulation of specific genes and the induction of cellular programs. However, there is still no evidence that negative pressure directly influences cell growth. In a recent study, Saxena *et al.* (16) noticed that although the suction fluid theory may be an important mechanism for a selected subset of patients with discharging wounds, they observed many VAC-treated wounds in which minimal fluid was extracted, nevertheless dramatic healing responses were noted. They hypothesised that application of micromechanical forces to wounds in vivo can promote wound healing through this cell shape–dependant mechanical control mechanism.

COCHRANE REVIEW

The Cochrane Wounds Group reported a systematic review on the application of TNP for treating chronic wounds in favour of TNP (17). The objectives were to undertake a systematic review of all randomised controlled trials using TNP. Second, whether there was an optimum TNP regime in terms of dressings type, mode of delivery of negative pressure, and degree, application (continuous or intermittent) and the duration of negative pressure was also investigated. The strongest evidence was likely to be provided by trials where the control dressings were the same as the one used to transmit TNP but that was not subjected to negative pressure. Only two small trials with different outcome measures that fulfilled the selection criteria were reported. Trial 1 (Joseph *et al.* 2000) (18) considered any type of wound, and Trial 2 (McCallon *et al.* 2000) (19) considered diabetic foot ulcers. Both trials compared the rate of wound healing with the traditional saline gauze dressings. Trial 1 reported a statistically significant difference in the percentage change in wound volume after 6 weeks in favour of TNP. Trial 2 reported a difference in the number of days to healing and a difference in the percentage change in wound surface area after 2 weeks in favour of

TNP. However, due to the small sample sizes and the methodological limitations of these studies, these findings must be interpreted with extreme caution. There was no meta-analysis completed because of the limited number of randomised controlled studies. The parameters considered were percentage change in surface area of the wound, number of days to healing and percentage change in volume of the wound (17).

Table 1 shows an outline of the clinical studies in negative-pressure therapy along with outcome measures. Although, the table does mention the methodological flaws in these studies, it illustrates the results along with their conclusions.

DISCUSSION

The experimental studies have shown that negative-pressure therapy enhances the formation of granulation tissue and angiogenesis. Micromechanical forces exert distraction forces, which draw the wound edges together. The suction force decreases the wound exudate and has been shown to alter bacterial counts (1). However, we still do not know the precise mechanism by which negative pressure brings about wound healing. The growth factors and cytokines responsible for initiating the process of cell migration and angiogenesis are yet to be elucidated, nor is there any evidence to show that negative pressure influences cell growth. Although models of negative-pressure therapy have been created, it is yet to be demonstrated in vitro or in vivo that traction forces on the wound surface are related to the biologic changes within the wound environment (16). Moreover, biomechanics surrounding the ideal negative-pressure settings and the mode of delivery (intermittent/continuous) have yet to be investigated. These gaps in our knowledge of the biological mechanism of negative-pressure therapy are avenues for future research.

There were no randomised controlled trials evaluating the effectiveness of different TNP regimes. In the study by Joseph *et al.* (18), the assignment schedule appeared to be generated using true randomisation, but the adequacy of allocation concealment was unclear, whereas in the study by McCallon *et al.* (19), it was absent. There is some empirical evidence to suggest that trials, in which concealment is unclear or inadequate, yield larger estimates of treatment effects (17). In the studies by Joseph *et al.* (18) and McCallon *et al.* (19), the experimental groups received TNP delivered via a foam dressings, whereas the control groups received saline-moistened dressings, so it was impossible to blind those providing and receiving care. In the study by Joseph *et al.* (18), the outcome assessors were blinded regarding treatment allocation, whereas in the study by McCallon *et al.* (19), this was not made explicit, so the latter study was possibly at risk of detection bias. Study by Joseph *et al.* (18) was single blinded, whereas that by McCallon *et al.* (19) lacked blinding. There is also some evidence to suggest that trials that are not double blinded yield larger estimates of treatment effects (17). Both studies were very small, which increases the probability that the samples were not completely representative of the populations from which they were drawn (17).

Negative-pressure therapy has been shown to decrease the need for free tissue transfer in acute traumatic wounds with exposed bone/hardware and tendon (20). It prepares the wound bed for definitive skin grafting or local muscle/fasciocutaneous flap. Although, it may not abolish the need for free tissue transfer in massive wounds with exposed bone/hardware, it may result in less extensive procedures as shown by Song *et al.* (6). Studies are also needed in the long-term outcome following reconstruction regarding tissue bulk, wound breakdown, scar assessment, functional outcome and quality of life.

Negative-pressure therapy has been shown to enhance chronic wound closure with decreased time to healing (19), decreased exudate (21) and lower bacterial count (1). The verdict is unclear for patients with concomitant diabetes mellitus and peripheral vascular disease (22). The need for less radical surgery has been shown in patients undergoing negative-pressure therapy, and the incidences of readmissions after healing have also been reduced (23). However, there is still a paucity of randomised controlled trials for the use of negative-pressure therapy on chronic wounds. The two trials reported (18,19) had small sample sizes, which makes accurate data comparison unreliable. Future randomised controlled studies of negative-pressure therapy must involve blinding, an

Key Points

- the experimental studies have shown that negative pressure therapy enhances the formation of granulation tissue and angiogenesis
- although models of negative pressure therapy have been created, it is yet to be demonstrated in vitro and in vivo that traction forces on the wound surface are related to the biologic changes within the wound environment
- these gaps in our knowledge of the biological mechanism of negative pressure therapy are avenues for future research
- studies are also needed in the long-term outcome following reconstruction regarding tissue bulk, wound breakdown, scar assessment, functional outcome and quality of life

Table 1 Outline of clinical studies of negative-pressure wound therapy for various clinical conditions*

Study	Design	Number of patients wounds	Inclusion criteria	Outcome	Comments
Microbiology					
Argenta and Morykwas (1997) (1)	Prospective	300 patients	Acute and chronic wounds treated with VAC therapy; bacterial counts investigated	Significant decrease in bacterial count after 3–4 days	Decrease in bacterial load by suction effect
Moues *et al.* (2004) (32)	Prospective randomised controlled trial	54 patients	Wounds ineligible for wound closure/chronic wounds; randomised to NPWT and moist gauze; wound biopsies for culture	Mean reduction of wounds 3·8%/day for NPWT and 1·7%/day for gauze; bacterial load constant during treatment; increase of *Staphylococcus aureus*, anaerobes not changed	Concluded that bacterial load is similar, hypothesised that increased *S. aureus* may have induced healing
Weed *et al.* (2004) (33)	Retrospective	25 patients	Patients undergoing VAC therapy for acute and chronic wounds	Increase in bacterial colonisation; 43% increase in bioburden	NPWT actively increased bacterial counts in acute and chronic wounds; no correlation between high bacterial count and failure rate of therapy
Chronic wounds					
Joseph *et al.* (2000) (18)	Prospective randomised controlled trial	24 patients, 36 wounds	Chronic wounds present for more than 1 month; half received VAC, other half received saline dressings	Significant difference in percent change in wound volume at 6 weeks in favour of VAC (78 vs 30%)	Blinded study; concluded that NPWT has a positive impact on wound healing rate
Page *et al.* (2005) (23)	Retrospective analysis of patients undergoing VAC therapy and traditional treatment		Postamputation stumps; infected wounds	Median time to wound filling with VAC 38 days (26–70), traditional 80 (55–98); 76% decrease in need for further surgery, 80% decrease in readmission, 83% decrease in complications	Concluded that NPWT enhanced wound filling during the early part of treatment

Anthony and Terrazas (2004) (21)	Retrospective review	42 patients	12 sternal, 16 spinal and 14 lower limb wounds; wounds that failed traditional treatment	Decreased exudates, increased granulation tissue, decreased days to healing, decreased hospital stay	Reported bleeding from sponge if dressing not changed more than 48–72 hours
Argenta and Morykwas (1997) (1)	Prospective study	300 patients	175 chronic wounds, 94 subacute wounds and 31 acute wounds	296/300 (98%) had a favourable response to therapy; increased granulation tissue; 32% decubitus ulcers healed	First and largest clinical study; serves as a benchmark for future studies
Loree *et al.* (2004) (34)	Prospective, controlled, open, non comparative study	15 patients	All chronic ulcers that have failed previous treatments	Decreased fibrinous tissue by 28% on day 3, 40% by day 6; concluded that VAC is effective for wound debridement	No wound dimension described; not clear what constitutes debridement: surgery/cleansing
Clare *et al.* (2002) (26)	Retrospective review	17 patients with 17 wounds on lower extremity	Chronic non healing wounds on lower extremity; all patients failed previous treatment	14/17 (82%) healed, of which four required skin grafts, four needed growth factors and six needed further dressings; 3/17 (18%) failed treatment; these three had diabetes, two of three had PVD	Recommend that those with PVD may not be suitable for NPWT and patients with small wounds may not benefit from NPWT
Mendonca *et al.* (2005) (22)	Retrospective study	15 patients with 18 wounds	Chronic complex wounds; all were surgically debrided before VAC treatment	13/18 wounds healed; five of eight failed treatment, of whom three required amputations, three of five had DM and PVD; wound area decreased from 7·41 to 1·58 cm^2	Conclude that NPWT may fail in both DM and PVD
Traumatic wounds					
Hersovici *et al.* (2003) (20)	Consecutive non randomised	21 patients	High-energy wounds; six tibial, 10 ankle, five upper limb	Nine patients (43%) required free tissue transfer; 12 wounds needed less extensive procedures (57%)	77% had their sponge changes at bedside; concluded that this could be performed as a bedside procedure; May decrease the need for extensive reconstruction

Table 1 Continued

Study	Design	Number of patients wounds	Inclusion criteria	Outcome	Comments
Defranzo *et al.* (2001) (5)	Retrospective	75 patients	Lower extremity wounds with exposed bone and hardware	71/75 wounds had successful coverage with skin graft/local flap; in 3–5 days diminished surface area; No free tissue transfers were required	Concluded that large, superficial exposed plates and large areas with exposed bone are not good candidates for VAC
Pressure ulcers					
Mullner *et al.* (1997) (35)	Prospective study	17 patients	Sacral pressure wounds not responding to traditional treatment	12/17 (80%) had favourable response, of whom 9/12 had a skin graft and 3/2 had local flaps	Claimed that VAC facilitated earlier application of skin grafts; however, no evidence to support this claim; no control used
Ford *et al.* (2002) (36)	Randomised controlled study	28 patients with 41 wounds	Randomised pressure ulcers to NPWT and gel products	42% decrease in wound dimensions by gel and 52% decrease by VAC therapy; reduction in polymorphonuclear cells, lymphocytes and mean number of capillaries increased by VAC	VAC promotes increased rate of wound healing, favourable histological changes in soft tissue and bone compared with gel products
Wanner *et al.* (2001) (37)	Consecutive study, randomised into two groups: VAC and saline dressing	22 patients	Pressure ulcers secondary to paralysis, not responding to traditional treatment	Mean time to 50% of initial volume: 27 days in NPWT, 28 days in saline dressings; no significant difference in the days to healing in both groups	Concluded that NPWT is no more effective than traditional group; no advantage with NPWT treatment
Diabetic wounds					
McCallon *et al.* (2000) (19)	Randomised controlled study	10 patients	Diabetic feet wounds, randomised to receive NPWT and moist-gauze dressings	Decrease the number of days to satisfactory healing, favouring VAC. VAC: 22·8 ± 17·4 days, gauze: 42·8 ± 32·5 days; change in %surface area in favour of VAC	Lacked blinding; concluded that NPWT promotes faster healing and reduction in wound surface area than saline dressings

Eginton *et al.* 2003 (24)	Prospective randomised cross-over design	7 patients	Diabetic wounds; wound dimensions were calculated	Decrease in all wound dimensions with VAC; more rapid decrease in wound depth	Concluded that VAC is most effective in first 2 weeks of treatment
Infected wounds					
Wongworawat *et al.* (2003) (25)	Prospective	14 patients	Orthopaedic infected wounds >20 cm on lower limbs	Average wound reduction in size by 43% in 10 days	Concluded NPWT enhances wound reduction; advantage in minimising exposure of infected wounds to staff
Sternal wounds					
Fleck *et al.* (2002) (38)	Retrospective case series	11 patients	Sternal wound infection after cardiac surgery	Six patients, NPWT adjunct to reconstructive surgery with pectoralis major flap; five patients had rewiring of sternum	Concluded that NPWT is a valuable adjunct to conventional treatment of sternal wound infection
Song *et al.* (2003) (6)	Retrospective comparative study	35 patients	Sternal wound complications	VAC group had shorter interval between debridement and closure (6·2 days); decreased number of soft tissue flaps and decreased complexity of flaps	Concluded that VAC may decrease the complexity of reconstruction
Luckraz *et al.* (2003) (39)	Retrospective comparison	27 patients	Poststernotomy mediastinitis; A: 14 patients NPWT; B: 13 patients NPWT and flap closure (due to failed NPWT)	A: 8/12 (64%) wound healed; B: 10/13 (77%) wound healed	Concluded that NPWT is reliable and reproducible treatment for cardiac surgery patients
Negative pressure and skin grafts					
Scherer *et al.* (2002) (40)	Prospective comparative study	61 patients	Level 1 trauma centre, traumatic wounds: burns (32), soft tissue (27), fasciotomy (2)	VAC decreased the need for repeat skin grafts than standard bolster dressings	Concluded that VAC provided effective method for securing skin graft; hypothesised that VAC provides uniform distribution of pressure, apposition, but no data to support this

Table 1 Continued

Study	Design	Number of patients wounds	Inclusion criteria	Outcome	Comments
Moisidis *et al.* (2004) (41)	Prospective randomised blinded trial	22 patients	After skin grafting, each wound randomised to receive VAC, standard bolster dressing; assess at 2 weeks by blinded observer	VAC encourages epithelialisation by 30%, no change in 45% and decreases epithelialisation by 25%; the quality of skin grafts improved by 50%, remained the same 35% and decreased by 15%	Not clear how quality is better but concluded that VAC brings about epithelialisation equal to or better than the control in 85% cases
Cost analysis					
Hersovici *et al.* (2003) (20)	Retrospective study	21 patients	Cost calculation on patients with high-energy wounds and VAC	\$103/day for VAC; \$100/day for dressings	Overall cost of VAC higher, but justified since VAC prepares the wound bed, debrides necrotic tissue, which leads to less extensive procedures; hence long-term cost benefit
Philbeck *et al.* (1999) (27)	Retrospective cost-effective analysis		Comparison of material, nursing cost of treating pressure ulcer with NPWT and saline dressings	Materials cost: NPWT, \$107/day; gauze, \$10/day; nursing cost: NPWT, \$42·5/day; gauze, \$85/day; total cost/day: NPWT, \$149; gauze: \$95; total cost to treat: NPWT, \$14546; gauze: \$23465	Justified its use by increased rate of healing and overall reduction in costs

***VAC, vacuum-assisted closure; NPWT, negative-pressure wound therapy; PVD, peripheral vascular disease; DM, diabetes mellitus.

objective method of assessing wound dimensions and rigorous methodology.

There is no clear evidence to suggest that use of TNP in pressure ulcers results in enhance wound healing (24). The mode of application of the TNP is unclear from many studies, whether therapy was started after surgical debridement or without any debridement. This is important because in the former case, a chronic wound is converted to an acute one. Gaps in the published literature exist in the long-term outcome of pressure wounds healed by TNP therapy. There are no studies investigating the recurrence rate of pressure wounds posthealing. It is also not known whether TNP decreases the need for tissue transfer, as shown in acute traumatic wounds. Moreover, it is not known why negative-pressure therapy is most effective in the first 2 weeks and subsequently tends towards a plateau phase (25). Last, there are no randomised blinded controlled studies of negative-pressure therapy in pressure ulcers, which is an avenue for future research.

There are important differences between study of Eginton *et al.* (24) and that of McCallon *et al.* (19) on diabetic wounds. Study design of Eginton *et al.* (24) of repeated measures having each wound serve as its own control eliminates a potential bias in the study of McCallon *et al.* The trial of McCallon *et al.* (19) examined only surface area, which may not give a good indication of the healing of larger, deeper wounds of the foot. Finally, the timing of measurements in trial of McCallon *et al.* (19) was not standardised and may have led to inaccurate results with different time points. However, study of Eginton *et al.* (24) is small and could itself be a source of bias. Nevertheless, Eginton *et al.* (24) postulated that the VAC therapy is well suited to diabetic wounds by improving microcirculation, enhancing bacterial clearance and improving granulation tissue; however, this is yet to be confirmed by further laboratory research specifically in diabetic patients.

Clare *et al.* (26) studied 13 patients with complicated foot wounds who had diabetes mellitus, three of whom failed VAC treatment and required further amputations. Two out of the three had peripheral vascular disease and had failed previous attempts at revascularisation. Clare *et al.* (26) believed that such patients with both peripheral vascular disease and diabetes mellitus might not be suitable candidates for VAC therapy and recommended alternative methods of treatment, a view further substantiated by Mendonca *et al.* (22). In summary, it is clear that the negative-pressure therapy is beneficial in diabetic wounds by decreasing the time to healing, and also may have a role in limb salvage. It is not known how diabetic wounds behave when subjected to negative pressure at the cellular level.

Negative-pressure therapy has been shown to aid in the healing of skin grafts (27). The reasons for this are still unclear although it is hypothesised that negative pressure results in increased apposition of the graft with the wound bed, suction of haematoma and decreased shearing effect, which have a direct bearing on graft take. However, it is still not known why negative pressure results in a better take of grafts. Moreover, the criteria used to assess the quality of graft take are subjective (27). Further research is needed to determine the role of the wound bed (example, cavity wounds, flat wounds) and the anatomical site in the take of skin grafts with negative therapy.

REPORTED COMPLICATIONS

Certain complications of the VAC technique are documented such as overgrowth of granulation tissue into the sponge, with bleeding at dressing change, recurrent infections and maceration of adjacent skin (28). The exact extent of these problems is still not known, with only isolated reports of complications (1,5,29). Some patients experience pain associated with subatmospheric pressure therapy dissipated approximately 20 minutes after initial compression of the foam dressing (1). Once again, better studies are needed to quantify the number of patients experiencing pain during VAC therapy.

Excessive in-growth of granulation tissue into the foam dressing has been seen when the latter has been left in place for longer than 48 hours. Odour can be a problem in chronic wounds during treatment. DeFranzo *et al.* (5) reported three cases of osteomyelitis occurring as a complication of VAC therapy. Desiccation of tissue may occur when an inadequate seal has been obtained and large volumes of air are drawn across the wound surface by wall suction (1). One enteric fistula developed when

Key Points

- TNP is beneficial in diabetic wounds by decreasing the time to healing and may have a role in limb salvage
- negative pressure therapy has been shown to aid in the healing of skin grafts resulting in increased apposition of the graft with the wound bed, suction of haematoma and decreased shearing effect, which have a direct bearing on graft take
- further research is needed to determine the role of the wound bed (example: cavity wounds, flat wounds) and the anatomical site in the take of skin grafts with negative therapy
- certain complications of the V.A.C. technique are documented such as overgrowth of granulation tissue into the sponge, with bleeding at dressing change, recurrent infections and maceration of the adjacent skin
- some patients experience pain associated with subatmospheric pressure therapy and better studies are needed to quantify this
- odour can be a problem in chronic wound treatment
- another of the disadvantages of the V.A.C. method involve monitoring and maintenance of the machine. Periodic evaluation of the apparatus is required to ensure a proper seal around the wound and proper functioning of the machine
- there exists a clear cost saving advantage with TNP. The initial treatment costs are high but this is offset by the long-term savings of accelerated wound closure
- based on the evidence to date, the clinical effectiveness of negative-pressure therapy is still unclear. There are very few randomised controlled trials with mixed results

foam dressing was placed directly over compromised intestine.

Moreover, the disadvantages of the VAC method involve monitoring and maintenance of the machine. Periodic evaluation of the apparatus is required to ensure a proper seal around the wound and proper functioning of the machine (30). Patients report distressing moments when the battery power ran out triggering off a series of alarms, which can be disturbing (30). These concerns are addressed in the newer models of the machine. Chester and Waters (31) reported the case of a patient treated with VAC therapy for groin wound dehiscence following inguinal block dissection. During treatment, clinical signs of sepsis developed, in association with a progressively worsening anaerobic wound infection. This infection settled with antibiotic therapy and cessation of TNP treatment. They postulated that the air-free environment created by TNP potentiated the growth of the anaerobic bacteria, resulting in significant sepsis, and therefore recommend close surveillance of bacterial flora while using this therapy.

Last, there exists a clear cost-saving advantage with negative-pressure therapy (20). Although, the initial treatment costs are high, this is offset by the long-term savings of accelerated wound closure. The calculations vary from study to study depending on the health care system; nevertheless, all studies demonstrate a cost advantage.

SUMMARY

Since its introduction in 1997, NPWT is a technique that has been extensively used to enhance the rate of wound healing, prepare the wound bed for surgery and decrease the time to healing. Based on the evidence to date, the clinical effectiveness of negative-pressure therapy is still unclear. Although case reports and retrospective studies have demonstrated enhanced wound healing in acute/traumatic wounds, chronic wounds, infected wounds, wounds secondary to diabetes mellitus, sternal wounds and wounds located on the lower limb, there are very few randomised controlled trials with mixed results. The evidence for using TNP therapy to enhance wound healing in patients with decubitus ulcers, concomitant diabetes and peripheral vascular disease and to improve skin graft take is lacking. In order to justify its increasing use, further long-term randomised controlled trials are needed.

CONFLICT OF INTEREST

No benefits in any form have been or will be received from KCI International, San Antonio, Texas, USA.

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