Original Research Paper

Volume - 15 | Issue - 04 | April - 2025 | PRINT ISSN No. 2249 - 555X | DOI : 10.36106/ijar

General Surgery

A STUDY ON EFFECT OF NEGATIVE PRESSURE INTERMITTENT WOUND THERAPY ON WOUND HEALING

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ABSTRACT NEGATIVE PRESSURE INTERMITTENT "WOUND THERAPY (NPWT)is a type of therapy to help wounds heal. During the treatment, a device decreases air pressure on the wound. This can help wounds heal more quickly. Gases in the air around us put pressure on the surface of our bodies. A wound vacuum device (wound vac) removes this pressure over the area of the wound. This can help a wound heal in several ways. It can gently pull fluid from the wound over time. This can reduce swelling and may help clean the wound. It's unclear if it reduces bacteria. NPWT also helps pull the edges of the wound together. And it may stimulate the growth of new tissue that helps the wound close".

KEYWORDS : Negative pressure, intermittent, VAC

INTRODUCTION

Delayed wound healing, is an enormous problem especially when it is difficult wounds along with older people with co-morbidities. Morbidity, pain, prolonged therapy, along with need for major reconstructive surgery result from it, putting an enormous financial and social burden on society.

Substitute for wound management as compared to traditional approaches can be VAC(Vacuum-assisted closure). Applying negative pressure optimizes wounds to heal rapidly or with fewer reconstructive procedures. VAC is a non-surgical/ nonpharmacologic means to modulate wound healing; Argenta and Morykwas made the initial proposal in 1997. Vacuum's use increases local blood flow along with reducing oedema, infection this promotes healing. It is being utilized as alternate or adjunct to surgery for variety of wounds which aims to increase patient comfort as well as decrease in cost, morbidity, hospitalization duration.

CASE STUDY

Method of VAC application[7]

Wound is completely irrigated with normal saline, debrided, achieves adequate hemostasis, as well as peri-wound skin, is dried. Since sterile foams evenly distribute negative pressure throughout whole wound bed, they are utilized for dressings. For thoracic as well as abdominal cavity wounds,2 forms of foam have frequently been utilized: black (polyurethane ether), which is hydrophobic, lighter, and is having pore-size 400e600mm. White (a dense, hydrophilic polyvinyl alcohol with a 250mm pore size) is utilized for superficial surface wounds[8]. Foam is attached to a vacuum pump via a fenestrated evacuation tube. After that, an adhesive drape is used for sealing wound. To ensure an airtight/watertight seal, drapes should cover the foam, tubing, and at least 3e5cm of surrounding healthy tissue. 3rdday, dressing is typically changed. Negative pressure mode which ranges from 50to 125mmHg can either be continuous or intermittent. Intermittent mode is consisting cycle of 5min on as well as 2min off phase. Particularly for painful chronic wounds pressure setting could be kept low (50e75mmHg). Large cavity as well as exhudative wounds are treated with Higher pressures (150mmHg plus).

DISCUSSION

Negative pressure therapy has 1st been employed to hasten wound preparation at bedside. For evaluating impact of topical negative pressure therapy on granulation tissue formation, local blood flow, bacterial clearance, as well as flap survival, Morykwas and Argents[1,2] carried out a number of animal experiments. They then employed a vacuum pump as well as foam dressing for managing wounds, which allows them to choose among continuous as well as intermittent modes and modify vacuum pressure.

Crush injuries, burns, fasciotomy wounds, sternal/abdominal wound dehiscence, diabetic foot ulcers, extravasation wounds, flap salvage, skin graft fixation, bed sores, as well as frostbite/ animal bites have been among conditions where VAC has been indicated. Patients with untreated osteomyelitis, malignant wounds, fistulae to body or organ cavity, necrotic tissue's presence, or exposed nerves, arteries, anastomotic sites, or organs should not receive vacuum therapy. Patients with anticoagulant users, blood dyscrasias, or actively blooding wounds have been examples of relative contraindications. Surrounding invasive sepsis, excessive or active bleeding elevated pain, infection symptoms including foul-smelling discharge, fever, or pus as well as an allergic reaction to adhesive are all red flags during VAC therapy. VAC therapy complications include allergies, infection in wounds, bleeding, skin excoriation pain, adhesive drape, tissue adherence, limited to foam, skin necrosis, lack of patient compliance, as well as (power failure, loss of seal, as well as blockage of drainage system) VAC system failure[9]. VAC therapy decreases oedema, lowers bacterial load, improves skin perfusion, reduces dressing change frequency, improves patient comfort, reduces hospitalization, as well as it provides a closed, moist wound healing environment.

Mechanism Of Action

Studies on both animals as well as humans have demonstrated VAC therapy diminishes the size of the wound, increases blood flow, increases granulation tissue growth, and regulates the inflammatory response[1,10]. VAC results in microdeformation of cells, wound contraction, wound environment stabilization, and reduced edema with the evacuation of wound exudates. Through lower bacterial load, increased blood flow, as well as improved wound bed preparation for subsequent covering, these factors enable VAC to speed wound healing[11,12]. Negative pressure compression of tissue results in local vasodilatation because of nitric oxide release and tissue hypoxia because it reduces perfusion beneath the foam, thereby stimulating angioneogenesis[13–15]. This occurs during VAC therapy's "suction off" periods. As a result, intermittent VAC is more efficient than continuous VAC.

Edema forms following injury because of hypobaric interstitial pressure as well as rise in vessel permeability.[16] VAC results in increased tissue pressure, which compresses vessels as well as reduces intravascular hydrostatic pressure (Bernoulli's principle) via increasing intravascular fluid rate (principle of continuity). Both factors cause decreased edema as well as less efflux of intra-vascular fluid. Furthermore, Venturi principle states higher blood velocity draws extracellular fluid into vessel. Furthermore, negative-pressure wound therapy's compressive forces physically force edema out of wounded tissues. Reduced interstitial hydrostatic pressure along with improved cell oxygenation are outcomes of all these mechanisms. Immobilization of wounds caused by VAC therapy aids healing.[17,18]

With release of growth factors, microstrain/microdeformation of cells caused by VAC results in tissue expansion[19–21]. Differential pressure in tissues following negative pressure application causes this tissue expansion effect. While pressure outside cells as well as underdressing is negative, pressure inside cells is positive. This could all result in cell expansion, granulation tissue growth, as well as pulling wound edges closer to 1 another, decreasing wound size.

Nevertheless, current research has shown underlying wound pressure is paradoxically increased (hyperbaric).[22] Normal tissue has 10e35mmHg capillary perfusion pressure.[23]If vascular tree is normal,

Hyperbaric pressure in tissues is not likely in resulting capillary blockage. Hyperbaric pressure, nevertheless, can cause ischemia as well as necrosis in ischemic tissue. Particularly if they are circumferential, negative-pressure wound therapy should then be applied cautiously to ischemic tissues.

Optimum Negative Pressure

Optimal application of negative pressure is controversial. Research on animal models demonstrated that a 125mmHg vacuum formed more granulation tissue than either a low (25mmHg) or high (500mmHg) vacuum suction. Reduced fluid drainage from wound, reduced toxin removal, along reduced cell deformation are outcomes of low-pressure suction (25mmHg). As a result, rate at which granulation tissue forms is reduced. Reduced granulation tissue formation along with a localized drop in perfusion are results of increased mechanical deformation of tissues caused by high suction pressure (500mmHg). Consequently, Negative pressure of 125mmHg is considered as optimal pressure.[24]

Varying levels effects of negative pressure levels (10e175mmHg) in various wounds demonstrated that negative pressure amount should be adjusted according to wound kind. Optimum negative pressure for chronic non-healing venous ulcers is 50mm Hg at intermittent cycles, while 125mm Hg is required for acute traumatic wounds.[25,26]

Intermittent Vs Continuous VAC

It has been suggested to use intermittent negative pressure since it increases blood flow during vacuum "off" period. Studies indicate that pace at which granulation tissue forms under intermittent negative pressure is 2 times of continuous negative pressure (63% continuous V/s 103% intermittent).[27]

Avoiding air leaks in dressing is important because they cause a continual flow of air over wound surface, which causes desiccation of tissue as well as eschar to form. This eschar causes wound to deteriorate by sealing it with retained exudate. 28VAC dressings should be replaced after 48hours since pressure inside them gradually decreases over 2days course.[29] 1word of caution: terminating VAC therapy suddenly after just 1session can cause a rebound effect and make wound worse. As a result, 2e3VAC sessions should always be planned.

1 RCT provides objective evidence about VAC application for various indications. While application of VAC as a bridging therapy among multiple debridements is assessed as Grade "B," there is Grade "C" evidence for severe wounds. Only for the administration of skin grafting procedures Grade "A" is made as a strong recommendation.[30]

Cost

VAC may be more cost-effective than conventional wound care techniques since it needs less dressing changes and fewer reconstructive choices for wound healing, according to numerous studies on various wounds. Overall hospitalizations and treatment durations are shorter, and wounds heal more quickly. Though, Conventional dressings are less expensive than VAC dressing,but prolonged overall treatment costs less with VAC.[31,32]

Negative-pressure wound therapy is expensive as well as not readily available, as provided by Kinetic Concepts, Inc., Wound VAC system (KCI, San Antonio, TX) along with other commercial vendors. Instead of renting KCI equipment or buying Dressing material, which could cost over Rs7000/day, we used off-the-shelf components to give economical negative pressure therapy. To create a dressing, we utilized locally accessible materials such as foam sponges, Bactigras (Smith & Nephew), abdominal drain (Romsons), and ortho cling drape (Surgiware) (Fig. 1). Wall-mounted suction is attached to this to generate negative pressure (75–125mmHg). This dressing, which is produced locally, is extremely economical. The components are only Rs 500. In many instances, this Indigenous low-pressure dressing system was employed with equivalent outcomes to commercial systems also without complications (Figs. 2e4). Drawbacks of using Indigenous dressings include treating patients inpatient as well as not being able to utilize intermittent suction as wall-mounted suction is only having a continuous mode.

Key Points

1. Logistic benefits of VAC have been there over conventional wound care approaches.
2. Optimum pressure setting is 125mmHg.
3. It decreases extent of reconstructive procedures.
4. VAC is a useful adjunct/alternative for standard wound care particularly for complicated wounds.
5. Intermittent suction is preferable over continuous suction.

CONCLUSIONS

VAC/NPWT recovers tissue perfusion, decreases bacterial load, stimulates granulation tissue, stabilizes wounds, as well as reduces edema. It will decrease major plastic surgery operations requirements as well as increase wound healing possibility spontaneously. In terms of treatment time, reducing wound size, as well as expense, VAC therapy provides a simple as well as efficient alternative to conventional dressings for managing a variety of wounds.

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