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The application of negative pressure wound treatment in oncoplastic breast surgery

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Abstract

After breast surgery, wound complications are not uncommon. In patients with breast cancer, delayed wound healing may cause poor cosmesis and postpone the start of adjuvant therapy. Since there is now disagreement about the use of preventive negative pressure dressings in closed wounds following breast surgery, the goal of our research was to examine the literature regarding the usefulness of negative pressure wound management in oncoplastic breast surgery.

Keywords: breast, surgical wound infection, wound healing, negative pressure wound therapy, wound infection, and wounds

Introduction

The most popular method for administering negative pressure wound therapy (NPWT) is a vacuum-assisted closure (VAC) device as shown in Figure 1 that is sold commercially. When uniform local negative pressure is applied to the wound surface, an airtight film and a wound dressing are applied to cover the open wound. [1] After being connected to the control unit by a number of suction tubes, the fluid that is taken from the wound is stored in a container, allowing the wound's negative pressure to be adjusted. [2] Depending on the goal of the treatment and the type of wound, the length of the therapy might range from a few days to many months. [3] Furthermore, it has been demonstrated that the kind of dressing and foam utilized may change the blood flow response and target pressure, which could affect how well the therapy is delivered. [4] NPWT is utilized for difficult wounds such as pressure wounds, diabetic wound ulcers, burns, necrotizing fasciitis, and post-traumatic wounds. [5] NPWT is specifically used to bring non-healing wounds closer to closure or to enable healing through secondary intention. [6]

Closed incisions NPWT (ciNPWT) have been used in oncoplastic breast surgery (OBC), but their use was sluggish at first. This is because wound healing is a challenge with this kind of surgery, partially because of the incisions nature (which are particularly prone to skin necrosis at T junctions and wound dehiscence) and the thin skin flaps needed for implant-based reconstruction. [7] However, increasing data indicates that NPWT might benefit from ciNPWT as well and could even be used as a preventative measure. [8] Soon after oncoplastic surgeries, wound morbidity might complicate and interrupt systemic anti-cancer medication and/or external beam radiation, thereby impairing oncological prognosis. [9] Furthermore, after significant breast surgery, achieving an ideal aesthetic result is crucial to patient happiness and confidence in one's body image. ciNPWT might be a helpful supplement. In fact, 20% of all infections related to healthcare are surgical site infections (SSI). [10] In order to measure wound illness (dehiscence, infection, and late healing) and cosmesis in OBC using NPWT and ciNPWT, a review of the literature was conducted.

NPWT's mechanism of action. [11]

As shown in Figure 2 many theories have been put forth regarding how NPWT works. These include fostering a moist wound setting, applying mechanical forces to trigger a biological reaction, encouraging perfusion, decreasing edema, changing the composition of the wound fluid, and aiding in the formation of granulation tissue. [1] It is important to highlight that although mechanisms for ciNPWT are not well understood, NPWT studies can suggest them. [12]

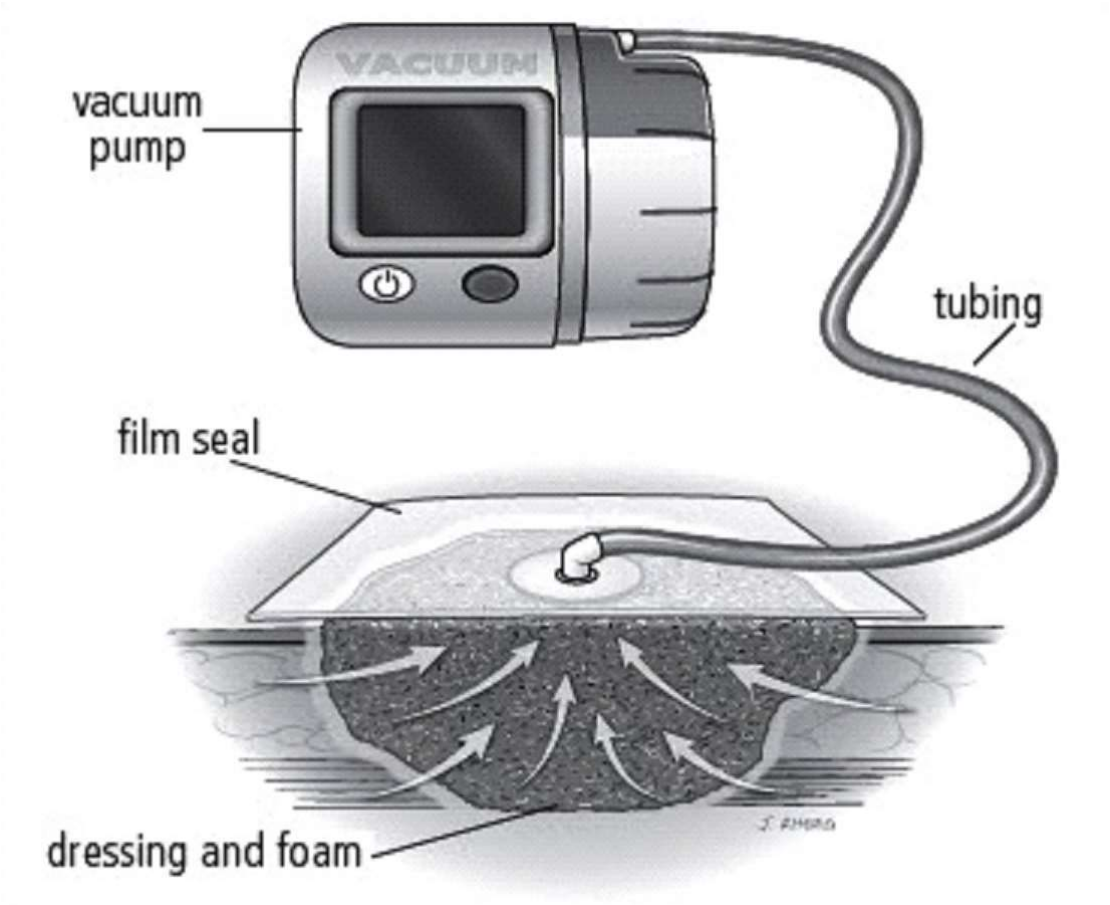

Figure 1 Vacuum-assisted closure device

Because it decreases tissue dryness, promotes angiogenesis, speeds up the breakdown of dead tissue, and enhances the interaction of growth agents with their target cells, a closed, moist wound environment is thought to help in healing. [13] In addition, there should be less exposure to infection .[14]

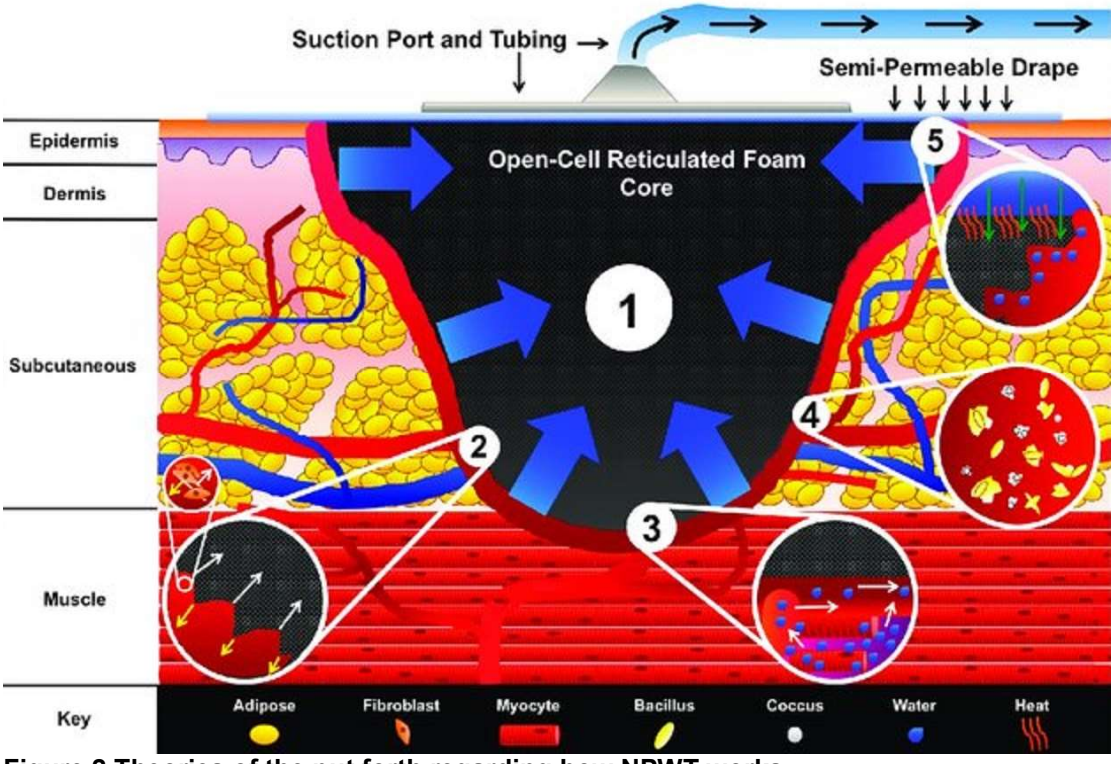

Figure 2 Theories of the put forth regarding how NPWT works

According to the literature, mechanical stimulation of cells causes them to proliferate more. VAC therapy creates stress both throughout the entire wound (macro strain) and within the cells (micro-strain). VAC therapy causes the wound edges to draw inwards centripetally, resulting in wound contracture and macro-strain. [15] Micro-strain happens when the surface of the tissue is dragged into the foam pores by negative pressure, causing micro-deformations in the places where there is foam contact. Additionally, the negative pressure removes fluid from the wound. [1] Additionally, multiple studies have reported positive effects of VAC therapy on tissue perfusion. [16-18] There was a difference between the areas with and without foam contact in the hard-to-heal wounds of the debilitated patients receiving VAC therapy intrawound; at weeks one and two of therapy, the microvessel density, as measured by immunohistochemistry, was significantly higher in the areas with foam contact compared to pre-treatment and the areas without foam contact ($p<0.05$). [19]

Elastase, plasmin, thrombin, and matrix metalloproteinases (MMPs) are found in abnormally high concentrations in hard-to-heal wounds. [20] Abnormal extracellular matrix disintegration is caused by excessive protease activity, which hinders wound healing. [21]

A study that measured the expression of the messenger RNA that is encoded in MMPs in hard-to-heal wounds and used VAC to treat them revealed alterations in MMPs. Finally, it was noted that using VAC therapy increased granulation formation, a crucial step in the proliferative wound healing stage. When VAC was used, a drop in MMP-1 and, more specifically, MMP-13. [22] Similarly, on days one, three, and seven following the start of VAC therapy, patients with pressure ulcers showed a decrease in the proinflammatory cytokine tumour necrosis factor-α (TNF-α) (n=8).

Perceived advantages

There is currently little research on the use of NPWT in breast surgery; tiny case series reporting oncological mammoplasties, mastectomies, or reduction mammoplasty (cosmetic cases) have been published. However, in other surgical specialties, NPWT has been demonstrated to reduce wound size more quickly. [23] The management of diabetic foot ulcer, which were photographed every week and had their sizes computed using spatial analysis software in a blinded manner, was the subject of a crossover randomized experiment comparing moist wound dressings with NPWT therapy (n = 6). When NPWT was used instead of wet gauze dressings, they found that the wound volume and depth were considerably reduced. [23] The results, however, might not apply to other situations because to the small sample size .

Furthermore, increased granulation tissue production and the previously discussed micro-deformational forces could potentially expedite wound healing. [1] A randomized study looked at 162 individuals who received VAC therapy and transmetatarsal amputations for diabetic foot ulcers. Patients undergoing VAC therapy achieved complete wound closure in a median of 56 days, compared to 77 days for patients receiving no treatment. Additionally, during the 112 day study period, a significantly higher percentage of patients treated with VAC therapy than those treated with control achieved complete wound closure. [23] Given that a randomized trial revealed a substantial difference in the median percent of successful skin transplants, this could potentially increase graft taking. [24]

Preventative usage

It was found that NPWT significantly decreased the incidence of SSIs. These did not depend on the kind of operation (colorectal, abdominal, or orthopaedic, for instance). [25] With ciNPWT, wound dehiscence significantly decreased. A good consequence for the usage of ciNPWT is shown by the mean decrease in length of hospital stay that ciNPWT caused. [25] There was minimal stated heterogeneity among the trials .

In breast surgery, complicated wounds have been treated with ciNPWT. In 2018, 200 patients receiving bilateral reduction mammoplasty in the several countries reported wound problems from a multicenter, randomised trial. [6] To allow for within-patient comparison, patients were randomly assigned to receive standard wound care dressings or the single-use ciNPWT system, with the treatment assigned to either the right or left breast for up to 14 days. Up to 21 days following surgery, follow-up evaluations were carried out to compare the variations in incision healing issues. Breasts treated with ciNPWT experienced considerably fewer healing issues than breasts treated with normal care ($p=0.004$), with 113 (56.8%) against 123 (61.8%). [6] Additionally, CiNPWT showed a 38% relative reduction in the incidence of dehiscence by day 21 (32 patients, 16.2% versus 52 patients, 26.4%) ($p<0.001$). [6] However, those with a history of breast radiation were not eligible, as this was not an oncological surgery. Furthermore, the average age was 35.7 years, which would differ significantly from individuals receiving cancer therapy.

In a related prospective randomized research, postsurgical incision for patients undergoing bilateral breast reduction mammoplasty was performed with ciNPWT (n=32 patients). Once more acting as their own controls, the patients received fixation strips for one breast and ciNPWT for the other. [26] The number of wound complications for the ciNPWT-treated sites was considerably lower ($p<0.004$) than for the fixation strips at up to 21 days of follow-up. The visual analogue scale (VAS) and the Patient and Observer Scar Assessment Scale (POSAS) were used to assess the aesthetic appearance and scar quality. Results at 42, 90, and 180 days showed a noticeably ($p<0.05$) higher-quality scarring in the breasts treated with ciNPWT as opposed to normal care, which involved the use of fixation strips. [26] Again, individuals with prior radiotherapy and breast cancer were excluded. In a retrospective investigation, patients with ciNPWT after instant expander-based breast reconstruction had a lower incidence of

mastectomy flap necrosis than patients with traditional dressing. [27] They found that the ciNPWT group had lower rates of major mastectomy flap necrosis (2.2% versus 13.7%, respectively, p=0.031) compared to the conventional dressing group, as well as lower rates of overall necrosis (11.1% versus 27.9%, respectively, p=0.019); major mastectomy flap necrosis (8.9% versus 23.5%, respectively, p=0.019); minor necrosis, infection, seroma and hemorrhatoma formation, and expander explantation did not differ. In fact, this could imply that people would benefit from a shorter period of time before receiving adjuvant oncologic therapy if ciNPWT results in less significant flap necrosis. However, this study had two limitations: first, it was retrospective in nature; second, there was a significant sample size difference (45 versus 183 persons, respectively) between the ciNPWT and traditional dressing groups. As a result, the results should be regarded with caution .

NPWT in breast cancer oncoplasties

Skin necrosis after oncoplastic treatments is not uncommon, although outside of single case reports or series, there is little information available on NPWT in oncoplastic settings. It was reported that the case of a 54-year-old female who had a BRCA-1 mutation. [28] T The patient underwent an immediate implant-based reconstruction after a risk-reducing, nipple-saving mastectomy. However, the patient thereafter displayed indications of cutaneous necrosis. Following the implant's removal, NPWT was used in conjunction with numerous surgical washouts and antibiotic therapy. As a result, the infection was treated and the skin envelope recovered, making it possible to place a new implant .

Furthermore, a case series (n=5) was provided that showed the 45:15 minute cycles of saline irrigation therapy in conjunction with NPWT to be effective in the short term. [29] The first patient had a delayed implant-based reconstruction after a bilateral nipple-sparing mastectomy with expanders. The patient had seroma, wound dehiscence, abscesses, and septicemia when they first arrived. Similar abscesses developed around the implant in the second patient as a result of postponed implant-based repair. After undergoing a bilateral nipple sparing mastectomy with expanders, the third patient developed cellulitis and wound dehiscence after two months. The fourth patient underwent a bilateral mastectomy with nipple sparing and the insertion of subpectoral expanders. After an expander slipped, skin pressure necrosis appeared at one month. Two years after the fifth patient's expander-assisted left skin sparing mastectomy, an implant took its place. The patient first showed signs of wound dehiscence a year later. For implant removal and washout, all cases were returned to the operating room prior to the deployment of the irrigation/aspiration system. [29] All patients had their grafts reinserted after a week, but they did not provide additional outcome data, so it is unknown what the long-term effects might be .

In a study, 24 patients underwent either a therapeutic mammoplasty with contralateral symmetrizing breast reduction or a skin sparing mastectomy with prompt reconstruction. [30] The contralateral breast was symmetrized and allowed to recover with standard care while the therapeutic breast received ciNPWT. On the therapeutic side, the overall wound breakdown rates were 1/24 and on the symmetrizing side, 4/24. The authors discovered that the mean time to wound healing was 10 after eliminating one patient who had fat necrosis following a mammoplasty. [9] 16.1 days on the symmetrizing side and days on the therapeutic side. [31] It appears possible and possibly advantageous to use ciNPWT in oncological settings, despite the small numbers observed in these studies. ciNPWT was compared with conventional post-surgical dressings in a case series conducted in 2018 over a one-year follow-up period. The patients had mastectomies and other oncoplastic surgeries performed in addition to breast conserving procedures. [30] The post-surgery complications were found to be lower in ciNPWT patients than in conventional dressings patients. Furthermore, compared to those who received traditional dressings, those got ciNPWT exhibited noticeably more risk factors. Nevertheless, due to the limited sample size of this case series, it likely underpowers the research, especially when considering adequate risk stratification, and the absence of randomization. However, it indicates that ciNPWT has potential utility in a range of oncoplastic processes .

Conclusions

It becomes evident that, as of this writing, there is little evidence supporting the use of NPWT in OBC, with the majority of usage reports pertaining to complicated wounds. There's also little data to support prophylactic usage of ciNPWT. NPWT, however, has been demonstrated to be safe and maybe beneficial when used with VAC. To evaluate the effectiveness of ciNPWT in OBC, more randomized trials that concentrate on wound morbidity, cosmesis, and recovery time are required.

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