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Research Article

# Negative Pressure Wound Therapy in Surgical Wounds - A Single Centre Experience

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## Abstract

**Background**: Negative pressure wound therapy (NPWT) is a therapeutic technique using suction pump to promote healing of wound. It can be used in a variety of surgical wounds. The aim of the study was to evaluate the outcome of NPWT in different types surgical wounds in a district general hospital (DGH)with a view to identify the complete healing rate of surgical wound and complication rate of using this technique.

**Method**: A retrospective review on prospectively-collected data of 102 patients was conducted from January 2018 to September 2019. Demographic data, diagnosis, comorbidities, indications for the application of NPWT, duration of therapy were recorded. Outcome included rate of complete healing

and complications. The exclusion criteria were patients from other non-general surgical specialties and patients with bed sores.

**Result**: 102 patients (M: F 40:62) with a median age of 61 (30-96) years were included in the study. Median Body Mass Index (BMI) of patients was 27(19.2-44). 26.4%, 63% and 11.8% had a BMI less than 25, between 25-35 and above 35 respectively. The NPWT application was mostly (71.5% n= 73) used for anterior abdominal. Wound dimensions revealed a median length of 8 cm (range 3-20) and median width of 5cm (range 1-31). 98(96.1%) patients had complete healing and four patients (3.9%) had recorded complications.

**Conclusion**: From our experience, the use of NPWT achieved excellent complete healing rate with a very low complication rate. We can conclude that NPWT is a very useful, safe and effective technique to manage surgical wounds.

**Keywords:** Negative pressure wound therapy; Skin and soft tissue Infection( SSI)

## Introduction

Wound infection is the most common postoperative complication that includes surgical site infections (SSIs), seroma or hematoma and wound dehiscence. This leads to prolonged healing time, increased cost and decrease in quality of life [1]. It can also lead to incisional hernia formation and delay the commencement of adjuvant chemotherapy or interventions [2]. The risk factors for wound infection includes emergency surgery especially in the setting of sepsis, obesity, poor nutritional status, a history of smoking, diabetes [3].

Application of Negative Pressure Wound Therapy (NPWT) is an effective way to manage both open and chronic wounds including large and deep clean wounds, open abdominal wounds, skin grafts, open fractures, pressure ulcers [4]. It involves the application of sub atmospheric pressure to a healing wound. Usually, 50mm Hg to 125mmHg pressure is used. There are several mechanisms postulated to the efficacy of NPWT. It decreases seroma formation in a wound and stimulates angiogenesis and granulation. It also generates a hypoxic environment in a wound, resulting in the upregulation of inflammatory cytokines, which stimulates wound healing [5].

NPWT was first introduced in 1997 [6]. There are several studies that showed its effectiveness in reducing the SSI rate and promoting wound healing [7-9]. Cochrane review showed that in comparison with wound dressing, NPWT reduces the healing time in case of diabetic foot [10]. It has been widely practiced in the NHS. NPWT is delivered by skilled and dedicated specialist tissue viability nurses in both in-patient settings and community settings. However, the actual clinical efficacy, financial burden and complexity of its use with introduction of newer devices and components have always been controversial because of lack of robust high quality clinical effectiveness trials [11,12]. The aim of the study was to evaluate the safety and effectiveness of NPWT on surgical wounds in a district general hospital (DGH).The primary end point was incidence of complete wound healing. Secondary end point was complication rate.

## Methodology

It was a retrospective review of prospectively collected data. There were 102 patients included in our study over a period of 21 months from January 2018 to September 2019. Data were collected from patients records and hospital electronic data base. Patient demographics including Body Mass Index (BMI), diagnosis, comorbidities, indications for the application of NPWT, duration of therapy and adverse events including those related and unrelated to the treatment process were collected. Other variables like wound characteristics such as anatomical site, dimensions, type and primary operation including etiology and NPWT related variables such as duration, pressure, type (continuous vs intermittent) were recorded. All adult patients with general surgical wounds not amenable for simple wound dressing were included in the study. The NPWT was performed by experienced doctors and trained nurses.

## Results

A total of 102 patients were included in the study. The Male to female ratio in the study was 40:62. The median age of patients was 61 (30-96) years (Table 1).

The majority (61.7%, n=63) of the patients were overweight or obese with BMI in the range of 25-35 and 11.8% (n=12) with a BMI above 35. This was followed by 26.4%(n=27) with a normal BMI. However, there was no direct correlation between BMI and requirement or complication related to NPWT.

ASA score was recorded in relation to the patient comorbidities and showed that the majority (81.3%) were either ASA II (33.3%, n= 34) or III (48%, n= 49).

Etiology of NPWT was postoperative abdominal surgery in the majority of the sample (n=73) with wound located over anterior abdominal wall making up 71.5% of the study population. Of these, majority were surgical site infection (n=68) and five patients received NPWT as a method of temporary abdominal closure (n=5). Other etiologies included post examination under anesthesia of anorectum with abscess drainage (n=17), pilonidal sinus surgery (n=10), one perineal abscess (n=1) and an extensive perineal debridement for Fournier's gangrene (n=1).

The wound size revealed a median length of 8 cm (range 3-20) and median width of 5 cm (range 1-31). Application of NPWT was initially done either in theatre following an operation (36.2% n=37) or later on in ward (63.7% n=65)

The total duration of NPWT varied between patients with a median value of 21.5 days (range 2-120).

The majority (96.1%, n= 98) of the wounds healed completely as expected requiring no further intervention. Complete healing was defined as 100% skin epithelialization without the need for further drainage or dressing However, there were only four documented complications which mandated abandoning NPWT. Three patient had a minor complication of skin irritation/ contact dermatitis due to the dressing material which and was treated conservatively and NPWT discontinued while another patient who had a background of crohn's disease developed an intestinal fistula following the application of NPWT. However, it wasn't determined if the fistula was already present or the NPWT was the cause of it, but NPWT was discontinued, the patient was managed conservatively and the fistulae healed

consequently. One patient had an extensive perineal debridement for Fournier's gangrene. The patient was subsequently transferred to a plastic team for skin grafting. He had initial NPWT prior to grafting and had a good outcome (Figure 1,2 &3).

None of our patients developed infection and sepsis, foam retention in the wound, tissue adherence, bleeding or severe pain.

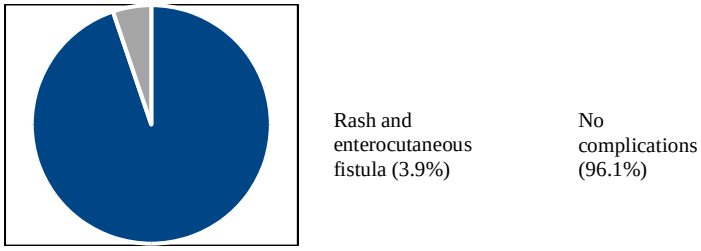


**Figure 1:** Pie chart showing complications.

**Figure 2:** Patient presented with severe sepsis and hyperglycaemia and on catheterization, it was noted that the scrotal skin was erythematous and that the scrotum had doubled, in size within a 24-hour period. Urgent CT which confirmed Fournier's gangrene as was suspected. Radical debridement of scrotum and perineum following Fournier's gangrene with formation of a sigmoid colostomy was done [13].

**Figure 3:** NPWT with drains in situ and pressure of about 125mmhg [13].

**Figure 4:** Post vac dressing and skin grafting outcome. A total of 43 days treatment with good wound healing [13].

| Variables | Values |
|---|---|
| Total Number of Patients | 102 |
| **Patient Characteristics** | |
| Male | 40 |
| Female | 62 |
| Median Age in years | 61 (30-96) |
| BMI | |
| <25 | 27(26.4%) |
| 25-35 | 63(61.7%) |
| >35 | 12(11.8%) |
| ASA grade | |
| ASA-I | 19(18.6%) |
| ASA –II | 34(33.3%) |
| ASA-III | 49(48%) |
| Surgery | |
| Laparotomy (abdominal wound) | 73 |
| Pilonidal Sinus Surgery | 10 |
| Perineal abscess and extensive perineal debridement | 2 |
| Post Examination under anesthesia and Incision and Drainage of Abscess (Perianal Region.) | 17 |
| **Wound Characteristics** | |
| Median Length in cm | 8 (3-20) |
| Median Width | 5 cm (1-31) |
| **VAC Therapy** | |

| | |
|---|---|
| Continuous | 102 |
| Complications | 4 (3.9%) |
| Median Duration | 21.5 days (range 2-120). |

**Table 1:** Following table summarizes the different variables considered in the study.

## Discussion

Negative pressure wound therapy is safe and it accelerates wound healing. There is sufficient evidence to justify its use in the treatment of diabetes-associated chronic leg wounds [14]. Its efficacy has been proven for acute as well as chronic wounds, including those of vascular and diabetic origin [15]. We also know from the data that, NPWT in critically ill patients with open abdomen improves outcome [16].

The way NPWT works is complex and not all of its aspects are yet completely understood. It is postulated that there are four primary effects and several secondary effects. Primary mechanism of action includes macrodeformation, microdeformation, fluid removal and environmental control of the wound. In macrodeformation, the suction draws the wound edges together depending on the mobility of the surrounding tissue [17]. Microdeformation streches the cells, which inturn facilitates division and proliferation [18]. It also creates an insulated warm and moist environment and remove fluid from surrounding oedematous tissue [19]. There are also secondary effects that helps in wound heling by NPWT. These include granulation tissue formation, cell proliferation, modulation of inflammation , upregulating neurotransmitter and bacterial levels [20].

Thre is cochrane review of 45 studies to assess the benefit of NPWT in comparision to standard wound therapy for wounds healing by primary intention [21].

The review concluded that, there is slight increase in benefit of NPWT in comparision with standard wound therapy in wounds healing by primary intention. There is no additional benefit in terms of outcome like mortality, total rate of complication, length of hospital stay, pain and health related quality of life.

With regards to wound healing by secondary intention, there is also cochrane review [22] which assessed the effects of negative pressure wound therapy (NPWT) on the healing of surgical wounds healing by secondary intention in any care setting. Only two studies with 69 participants were included in this review. The authors concluded that there is currently no stringent RCT evidence available regarding the clinical effectiveness of NPWT in the treatment of surgical wounds healing by secondary intention. It remain largely uncertain whether NPWT gives any potential benefit in case of wound healing by secondary intention.

Our data showed that NPWT is very effective in healing wound by secondary intention. >96% of our cases healed completely.

Previous report [23] showed that, although NPWT promotes excellent wound healing, several complications can occur with its use like bleeding, pain and infection. Its long term use may be associated with decrease life quality, increase anxiety, and malnutrition. In our study, only four patients (3.9%) developed complications. Three patient had a minor complication of skin irritation due to the dressing material. All of them were treated conservatively and NPWT discontinued. One patient, who had a background of crohn's disease developed an intestinal fistula following the application of NPWT. The therapy was discontinued and the fistula healed by its own.

Our study has limitations. It is retrospective, observational study with single centre experience. There was no comparision with other modalities of wound therapy to conclude its significant benefit. There was no long term follow up data to comment on patient reported outcome like cosmesis, cost analysis or quality of life.

To overcome the potential bias, we need large, multicentre RCTs with a long term follow up.

## Conclusion

Our study showed the use of NPWT gives satisfactory results in laparotomy and perianal wound. It also accelerates healing of wound related with pilonidal disease operation. Its advantages include accelerated wound healing times, reduce risk of infection, reduce the number of dressing changes while increase blood flow to the wound area with simultaneously drawing out excess fluids. There was low complication rate recorded in our study. NPWT therapy can also be used easily in the community with set up of good community support network.

It is clear that NPWT is very helpful in many different clinical situations. It is a versatile treatment method that has provided effective treatment for different wounds. As wounds are heterogeneous in nature, using NPWT for their treatment is not a simple and straightforward process. Each patient will have different needs and this will have to be taken into account when planning on the treatment.

With more research into NPWT, new and innovative ways may be discovered in which they can be used, and the effectiveness of current treatments will undoubtedly increase.

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## Conflict of interest

The Author(s) have no conflict of interest to disclose.

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