

# Negative Pressure Wound Therapy in Infected and Complicated Wounds in Obstetrics and Gynecology: A Retrospective Comparative Study

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## Abstract

**Objective:** To compare clinical characteristics, microbiological findings, and wound management outcomes between negative pressure wound therapy (NPWT) and conventional wound care in patients with complicated postoperative obstetric and gynecologic wounds. **Materials and Methods:** This retrospective comparative study included 114 patients who developed postoperative wound infection, wound dehiscence, or other complicated surgical wounds following obstetric or gynecologic surgery between January 1, 2017 and December 31, 2019. Group 1 comprised 54 patients treated with NPWT, and Group 2 comprised 60 patients managed with conventional wound care. Demographic characteristics, surgical indications, inflammatory parameters, wound characteristics, microbiological findings, timing of wound complications, length of hospital stay, and wound closure strategies were compared between the groups. **Results:** Patients in Group 1 were significantly older than those in Group 2 ( $51.6 \pm 11.1$  vs.  $35.7 \pm 11.4$  years;  $p < 0.001$ ), whereas body mass index did not differ significantly ( $36.1 \pm 7.2$  vs.  $32.4 \pm 7.4$  kg/m<sup>2</sup>;  $p = 0.135$ ). The distribution of surgical indications differed significantly between the groups ( $p < 0.001$ ). The postoperative interval to wound dehiscence ( $7.3 \pm 3.4$  vs.  $10.2 \pm 7.5$  days;  $p = 0.153$ ), admission C-reactive protein levels ( $93.6 \pm 61.9$  vs.  $69.7 \pm 62.4$ ;  $p = 0.245$ ), and length of hospital stay ( $19.9 \pm 5.6$  vs.  $21.5 \pm 5.6$  days;  $p = 0.398$ ) were comparable. NPWT was initiated at a mean of  $8.4 \pm 3.6$  days after surgery. Positive wound cultures were less frequent in Group 1 than in Group 2 (55.6% vs. 75.0%;  $p = 0.029$ ), as was cellulitis (16.7% vs. 45.0%;  $p = 0.001$ ). Incision type also differed between groups ( $p = 0.008$ ), whereas wound depth did not ( $p = 0.293$ ). Closure information was incompletely reported and was therefore interpreted cautiously. **Conclusion:** In this retrospective comparative cohort, therapeutic NPWT was used in patients with complicated postoperative obstetric and gynecologic wounds without a significant difference in length of hospital stay compared with conventional wound care. Lower wound-culture positivity and cellulitis rates were observed in the NPWT group; however, because treatment allocation was non-randomized and the groups differed substantially in age, surgical indication, and incision type, these associations should not be interpreted as evidence of a causal antimicrobial or clinical benefit of NPWT. Prospective studies with larger and more homogeneous populations are warranted to further define the therapeutic role of NPWT in this clinical setting.

**Keywords:** Negative pressure wound therapy; vacuum-assisted closure; surgical site infection; wound dehiscence; gynecologic surgery; obstetric surgery.

## 1. Introduction

Surgical site infections (SSIs) and wound dehiscence are clinically important postoperative complications associated with increased morbidity, prolonged hospitalization, delayed recovery, and greater healthcare expenditure.<sup>1</sup> In obstetric and gynecologic surgery, several patient- and procedure-related factors have been associated with an increased risk of SSI, including obesity, malignant disease, prolonged operative time, and greater intraoperative blood loss.<sup>2</sup>

Negative pressure wound therapy (NPWT), also referred to as vacuum-assisted closure (VAC), applies controlled subatmospheric pressure to the wound through a sealed dressing system. Experimental studies establishing the biological basis of NPWT demonstrated increased local blood flow, enhanced granulation tissue formation, and reduced tissue edema.<sup>3</sup> Continuous removal of wound exudate and maintenance of a controlled wound environment have subsequently supported the use of NPWT in the management of complex acute, chronic, and contaminated wounds.<sup>3,4</sup>

Within obstetrics and gynecology, a substantial proportion of the available evidence has focused on the prophylactic application of NPWT to primarily closed surgical incisions. Large randomized trials have evaluated prophylactic NPWT after cesarean delivery in women with obesity and after laparotomy for gynecologic surgery.<sup>5,6</sup> These studies have primarily addressed the prevention of postoperative wound complications rather than the treatment of wounds in which infection, dehiscence, or other complications have already developed.<sup>5,6</sup>

Evidence regarding the therapeutic use of NPWT for established postoperative wound complications in obstetric and gynecologic practice is considerably more limited. Previous reports in gynecologic oncology have described NPWT in the management of complex wound failures and complicated vulvar or groin wounds, but the available literature largely consists of retrospective series involving relatively small numbers of patients.<sup>7,8</sup> Consequently, comparative data on therapeutic NPWT and conventional wound management in this clinical setting remain limited. The present study aimed to compare the clinical characteristics, microbiological findings, and wound management outcomes of patients with complicated postoperative obstetric and gynecologic wounds treated with NPWT (Group 1) and those managed with conventional wound care (Group 2).

## 2. Materials and Methods

### 2.1. Study Design and Ethical Approval

This retrospective comparative study was conducted at a tertiary referral center in the Department of Obstetrics and Gynecology. The study protocol was approved by the Clinical Research Ethics Committee of Kahramanmaraş Sütçü İmam University Faculty of Medicine (date: July 31, 2019; session no: 2019/14; decision no: 241).

Medical records of patients who underwent obstetric or gynecologic surgery at our clinic between January 1, 2017 and December 31, 2019 and subsequently developed postoperative wound infection, wound dehiscence, or other complicated surgical wounds were retrospectively reviewed.

### 2.2. Study Population and Groups

A total of 114 patients were included in the study. Patients treated with negative pressure wound therapy (NPWT) constituted Group 1 (study group; n=54), whereas patients managed with conventional wound care constituted Group 2 (control group; n=60).

Demographic and clinical variables included age, body mass index, surgical indication, postoperative laboratory parameters, wound characteristics, microbiological culture results, timing of wound complications, length of hospital stay, and wound closure strategy.

### 2.3. Wound Management

#### 2.3.1. Negative Pressure Wound Therapy

In Group 1, the wound bed was prepared before initiation of NPWT by surgical debridement when required, followed by irrigation with sterile normal saline. NPWT was applied using a Comfort negative pressure wound therapy system in continuous mode. Negative pressure was generally maintained between  $-90$  and  $-140$  mmHg according to wound characteristics and clinical assessment. Dressing changes were generally performed at 48-hour intervals for the first three applications. NPWT was continued until adequate granulation tissue formation and satisfactory wound-bed preparation were achieved, based on the attending physician's clinical assessment. The mean duration of NPWT was approximately 10 days. Following adequate wound-bed preparation, delayed resuturing was performed when considered clinically appropriate.

#### 2.3.2. Conventional Wound Care

In Group 2, wounds were cleansed with povidone-iodine when clinical signs of wound infection were present and with sterile normal saline when no overt infection was observed. Necrotic tissue was debrided as clinically indicated. Dressing changes were generally performed at 48-hour intervals for the first three applications and subsequently at 72-hour intervals. Antibiotic therapy was selected or modified according to wound culture results when available. Following adequate wound-bed preparation and clinical improvement, secondary suturing was performed when considered appropriate by the attending physician.

### 2.4. Statistical Analysis

Continuous variables were summarized as mean  $\pm$  standard deviation or median with interquartile range, as appropriate. Between-group comparisons of continuous variables were performed using the independent-samples Student's *t*-test or Mann-Whitney *U* test according to the distributional characteristics of the variables. Categorical variables were presented as numbers and percentages. Pearson's chi-square test was used when expected cell counts were adequate; Fisher's exact test was used for  $2 \times 2$  tables when appropriate, and the Fisher-Freeman-Halton exact test was used for sparse  $2 \times 3$  tables. All statistical tests were two-sided, and a *p* value  $<0.05$  was considered statistically significant. Statistical analyses were performed using IBM SPSS Statistics for Windows, version 25.0 (IBM Corp., Armonk, NY, USA).

## 3. Results

Patients in Group 1 were significantly older than those in Group 2 ( $51.6 \pm 11.1$  vs.  $35.7 \pm 11.4$  years, respectively;  $p < 0.001$ ). Although the mean body mass index was numerically higher in Group 1 than in Group 2 ( $36.1 \pm 7.2$  vs.  $32.4 \pm 7.4$  kg/m<sup>2</sup>), this difference was not statistically significant ( $p = 0.135$ ). The distribution of surgical indications differed significantly between the groups ( $p < 0.001$ ). Cesarean delivery accounted for 27.8% of cases in Group 1 and 65.0% in Group 2, whereas benign gynecologic indications accounted for 44.4% and 25.0%, respectively. Oncologic procedures constituted 27.8% of cases in Group 1 compared with 10.0% in Group 2.

The mean postoperative interval to wound dehiscence was  $7.3 \pm 3.4$  days in Group 1 and  $10.2 \pm 7.5$  days in Group 2, with no statistically significant difference between the groups ( $p = 0.153$ ). In Group 1, NPWT was initiated at a mean of  $8.4 \pm 3.6$  days after surgery. Admission C-reactive protein levels were also comparable between the groups ( $93.6 \pm 61.9$  vs.  $69.7 \pm 62.4$ , respectively;  $p = 0.245$ ). Similarly, the mean length of hospital stay did not differ significantly between Group 1 and Group 2 ( $19.9 \pm 5.6$  vs.  $21.5 \pm 5.6$  days;  $p = 0.398$ ) (Table 1).

**Table 1. Demographic, clinical, and treatment characteristics of the study groups**

| Variable                              | NPWT          | Conventional wound care | p value |
|---------------------------------------|---------------|-------------------------|---------|
| Age (years)                           | 51.6 ± 11.1   | 35.7 ± 11.4             | <0.001  |
| BMI (kg/m <sup>2</sup> )              | 36.1 ± 7.2    | 32.4 ± 7.4              | 0.135   |
| <b>Surgical indication</b>            |               |                         | <0.001  |
| Cesarean section                      | 27.8% (15/54) | 65.0% (39/60)           |         |
| Benign gynecologic indications        | 44.4% (24/54) | 25.0% (15/60)           |         |
| Oncologic cases                       | 27.8% (15/54) | 10.0% (6/60)            |         |
| Postoperative day of wound dehiscence | 7.3 ± 3.4     | 10.2 ± 7.5              | 0.153   |
| CRP at admission                      | 93.6 ± 61.9   | 69.7 ± 62.4             | 0.245   |
| Length of hospital stay (days)        | 19.9 ± 5.6    | 21.5 ± 5.6              | 0.398   |
| Postoperative day of NPWT initiation  | 8.4 ± 3.6     | —                       | —       |

Incision type differed significantly between the groups (Fisher-Freeman-Halton exact  $p=0.008$ ). Pfannenstiel incisions were present in 61.1% of patients in Group 1 and 80.0% of patients in Group 2. In Group 1, 11.1% of patients had a GAM incision and 27.8% had a combined GAM plus Pfannenstiel incision, compared with 0% and 20.0%, respectively, in Group 2. Wound depth was similar between the groups ( $p=0.293$ ). Fascial involvement was observed in 16.7% of Group 1 and 10.0% of Group 2, whereas subcutaneous involvement was present in 83.3% and 90.0%, respectively.

Positive bacterial growth in wound cultures was identified in 55.6% of patients in Group 1 and 75.0% of patients in Group 2, a statistically significant difference ( $p=0.029$ ). Cellulitis was detected in 16.7% of patients in Group 1 and 45.0% of patients in Group 2, also a statistically significant difference ( $p=0.001$ ). These unadjusted between-group differences should be interpreted in light of the non-randomized design and baseline imbalances.

Wound closure information was incompletely reported. All evaluated patients in Group 1 were described as undergoing delayed resuturing following NPWT, whereas in Group 2, 10 patients underwent resuturing and 10 underwent primary closure. Because complete group-level closure denominators and categories were not presented, a valid between-group statistical comparison of closure strategy could not be independently verified from the reported data.

**Table 2. Wound characteristics of the study groups**

| Variable                                   | NPWT          | Conventional wound care | p value |
|--------------------------------------------|---------------|-------------------------|---------|
| <b>Incision type</b>                       |               |                         | 0.008   |
| Pfannenstiel                               | 61.1% (33/54) | 80.0% (48/60)           |         |
| GAM                                        | 11.1% (6/54)  | 0% (0/60)               |         |
| GAM + Pfannenstiel                         | 27.8% (15/54) | 20.0% (12/60)           |         |
| Positive bacterial growth in wound culture | 55.6% (30/54) | 75.0% (45/60)           | 0.029   |
| Cellulitis of the wound                    | 16.7% (9/54)  | 45.0% (27/60)           | 0.001   |
| <b>Wound depth</b>                         |               |                         | 0.293   |
| Fascia                                     | 16.7% (9/54)  | 10.0% (6/60)            |         |
| Subcutaneous tissue                        | 83.3% (45/54) | 90.0% (54/60)           |         |

For categorical comparisons, Pearson chi-square tests were used when expected cell counts were adequate; the Fisher-Freeman-Halton exact test was used for incision type because of sparse cells.

#### 4. Discussion

The present study compared therapeutic NPWT with conventional wound care in patients with complicated postoperative obstetric and gynecologic wounds. Patients in Group 1 were significantly older than those in Group 2, whereas body mass index was comparable between the groups. Surgical indication and incision type also differed significantly between the groups. Positive wound cultures and cellulitis were less frequent in Group 1 on unadjusted analysis, while length of hospital stay was similar between groups. Because patient- and procedure-related characteristics may influence postoperative wound complications, these findings should be interpreted in the context of the substantial baseline differences between the groups.<sup>2</sup>

NPWT applies controlled subatmospheric pressure to the wound bed, promoting removal of wound exudate, reduction of tissue edema, increased local perfusion, and granulation tissue formation.<sup>3,4</sup> These mechanisms provide a biological rationale for its use in complex and difficult-to-heal wounds. However, the biological effects of NPWT should not be interpreted as evidence of superior clinical outcomes in every wound type or patient population.

Positive wound cultures were detected in 55.6% of patients in Group 1 compared with 75.0% in Group 2 ( $p=0.029$ ), and cellulitis was detected in 16.7% versus 45.0%, respectively ( $p=0.001$ ). These are statistically significant unadjusted associations, but they should not be interpreted as evidence of a direct antimicrobial effect of NPWT because treatment was not randomized and the groups differed in important baseline characteristics. Previous studies have not demonstrated a consistent reduction in bacterial burden during NPWT. Weed et al. reported no consistent bacterial clearance during treatment, whereas Mouës et al. found that overall quantitative bacterial load remained relatively stable despite changes in bacterial species.<sup>9,10</sup> Therefore, the lower culture positivity and cellulitis rates observed in the present study are hypothesis-generating rather than proof of a causal treatment effect. Although a systematic review and meta-analysis suggested potential clinical benefits of NPWT in the treatment of surgical site infections, the included evidence was predominantly observational, highlighting the need for cautious interpretation.<sup>11</sup>

Wound closure strategy could not be fully compared from the reported data because complete closure categories and denominators were not provided for both groups. The manuscript reports delayed resuturing after NPWT in Group 1 and both resuturing and primary closure among the documented Group 2 cases. Previous reports have described therapeutic NPWT in complex postoperative gynecologic oncology wounds and complicated vulvar or groin wounds.<sup>7,8</sup> Outside gynecologic practice, prospective and randomized studies have also evaluated NPWT as part of a treatment pathway preceding delayed primary closure in contaminated abdominal wounds.<sup>12,13</sup> Nevertheless, because treatment allocation and the timing of definitive wound closure in the present study were based on clinical judgment, it cannot be concluded that NPWT itself increased the probability of successful resuturing.

Length of hospital stay did not differ significantly between Group 1 and Group 2. Evidence regarding the influence of therapeutic NPWT on hospitalization and wound-healing outcomes remains heterogeneous. An earlier Cochrane review found insufficient rigorous randomized evidence to establish the effectiveness of NPWT for surgical wounds healing by secondary intention.<sup>14</sup> More recently, the SWHSI-2 randomized trial found no significant reduction in time to wound healing with NPWT compared with usual care in surgical wounds healing by secondary intention.<sup>15</sup> Although the patient population and wound characteristics in that trial differ substantially from those in obstetric and gynecologic practice, these findings reinforce the need to avoid attributing shorter or longer hospitalization directly to NPWT in observational studies.

An important aspect of the present study is that NPWT was used therapeutically after wound complications had developed. In contrast, much of the higher-level obstetric and gynecologic evidence has focused on prophylactic NPWT applied to primarily closed incisions after cesarean delivery or gynecologic laparotomy.<sup>5,6</sup> Evidence specifically addressing therapeutic NPWT for infected, dehiscent, or otherwise complicated gynecologic wounds remains comparatively limited and is largely based on retrospective studies and small clinical series.<sup>7,8,16</sup> Therefore, the present comparative cohort contributes additional real-world data regarding an indication for which direct evidence remains limited.

Several limitations should be acknowledged. The retrospective and non-randomized design introduces the possibility of selection bias and residual confounding. The groups were not homogeneous in important baseline characteristics, particularly age, surgical indication, and incision type, and treatment selection reflected clinical decision-making rather than random allocation. Therefore, the observed differences in wound-culture positivity and cellulitis are unadjusted associations and may be partly explained by confounding. In addition, complete wound-closure data were not presented, preventing independent verification of the reported closure comparison. Some NPWT-related treatment parameters could not be uniformly standardized because of the retrospective design. Consequently, causal conclusions regarding the effectiveness of NPWT cannot be drawn. Nevertheless, the present study provides comparative real-world data on the therapeutic use of NPWT in complicated postoperative obstetric and gynecologic wounds.

## 5. Conclusion

In this retrospective comparative study, patients in Group 1 were significantly older than those in Group 2, and the groups also differed in surgical indication and incision type. Positive wound-culture rates (55.6% vs. 75.0%;  $p=0.029$ ) and cellulitis (16.7% vs. 45.0%;  $p=0.001$ ) were lower in Group 1 on unadjusted analysis, whereas length of hospital stay was comparable between the groups. Because treatment allocation was non-randomized and substantial baseline differences were present, these findings should be interpreted as associations rather than evidence of a causal benefit of NPWT. Closure-strategy comparisons could not be independently verified because complete group-level closure data were not reported. Prospective studies with larger, more homogeneous populations and adjusted analyses are needed to clarify the therapeutic role of NPWT in complicated postoperative obstetric and gynecologic wounds.

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