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Comparison of negative pressure wound therapy versus conventional wound care in the treatment of mesh infection following incisional hernia repair

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Abstract

Postoperative incisional hernias are common complications following abdominal surgeries, necessitating timely repair to mitigate the risk of incarceration. Mesh repair has become standard practice, yet surgical site infections (SSIs) and subsequent mesh infections remain significant challenges. Negative Pressure Wound Therapy (NPWT) has emerged as a promising adjunctive treatment for enhancing wound healing and reducing infection rates. This Case Series Analysis compared the efficacy of Negative Pressure Wound Therapy and conventional treatment in managing surgical site and mesh infections in patients after incisional hernia repair. A total of 413 patients between October 2018 and October 2022 were included, with 37 developing surgical site infections. Seventeen patients received Negative Pressure Wound Therapy (Group 1), while twenty patients received conventional dressing and systemic antibiotics (Group 2). Patient demographics, comorbidities, treatment duration, and post-treatment outcomes were analyzed. Group 1 demonstrated a significantly higher healing rate (88.2%) compared to Group 2 (55%). Negative Pressure Wound Therapy was associated with a lower rate of mesh removal and secondary surgeries. However, treatment duration was longer in the Negative Pressure Wound Therapy group. Larger mesh areas were correlated with treatment failure. Negative Pressure Wound Therapy offers superior outcomes in managing surgical site infections and mesh infections following incisional hernia repair compared to conventional dressing. Despite longer treatment durations, Negative Pressure Wound Therapy reduces the need for mesh removal and mitigates complications associated with secondary surgeries. Prospective randomized clinical trials are warranted to validate these findings and assess long-term outcomes and cost-effectiveness.

Keywords: Incisional hernia, mesh infections, negative pressure wound therapy, mesh repair

Introduction

Postoperative incisional hernias are among the most common complications following abdominal surgery [1]. These hernias should be repaired as they carry the risk of incarceration. Repair of incisional hernias using mesh has become routine [2]. Using mesh allows for tension-free closure of the fascial defect, reducing the risk of recurrence. It has been reported that surgical site infections may develop in 10% to 30% of cases after hernia repair, with mesh infection occurring in 2% to 3% of these cases [3,4]. In patients with mesh infection, mesh removal followed by fascial defect suture closure is performed, but this method results in high recurrence rates [5]. Drainage of abscesses, antibiotic therapy, and local wound care result in low rates of mesh salvage, around 18% [6].

Negative Pressure Wound Therapy (NPWT) can be defined as the placement of a synthetic material over the wound cavity in a manner that does not allow air entry, followed by continuous aspiration. Initially used by Argenta and Morykwas, this method has become one of the fundamental elements of wound care as its effectiveness has been observed [7]. By inducing microdeformation, negative pressure promotes cell proliferation and migration [8]. It also removes wound exudate, thereby enhancing the removal of inhibitory mediators and matrix metalloproteinases, improving wound healing [9]. Studies have shown that NPWT can increase local blood perfusion, reduce edema, bring wound edges together, and significantly increase the growth of reparative granulation tissue, which is crucial in these types of wounds [10-12].

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Patients who develop wound infections are typically treated with traditional dressing methods twice daily, and antibiotics are administered based on wound culture and antibiogram results [13]. This can prolong hospital stay, increase patient dissatisfaction, lead to recurrent hospitalizations, and necessitate the use of surgical methods for drainage of developing abscesses and serial debridement. Moreover, resistant infections can result in mesh removal and further enlargement of the hernia defect. The use of NPWT directly over the mesh for mesh infections has been demonstrated in small patient groups in the literature [14,15].

This study compared NPWT using VAC® Therapy (KCI Licensing, Inc., San Antonio, TX) with conventional dressing in patients with such conditions. The aim was to evaluate the advantages of NPWT over classical treatment.

Material and Methods

Between October 2018 and October 2022, 413 patients who underwent surgery for incisional hernias at the Cumhuriyet University Faculty of Medicine Hospital were examined, of which 37 developed surgical site infections. Medical records of these 37 patients were retrospectively reviewed. Seventeen patients treated with negative pressure wound therapy were classified as Group 1. Twenty patients receiving daily wound care and systemic antibiotics were classified as Group 2. Patient data, including age, gender, comorbidities, area of mesh used for hernia repair, duration of treatment, and post-treatment outcomes, were recorded from patient files.

The study was approved by the Ethics Committee of Cumhuriyet University Faculty of Medicine on June 22, 2023 (Approval no: 23-06-38). Written informed consent of patients and volunteers was obtained following a detailed explanation of the procedures that they may undergo.

All patients underwent abdominal wall defect repair using the onlay technique. After the fascia was closed with size 0 PDS suture, polypropylene mesh was placed on the fascia. The mesh was fixed to the fascia by suturing it with 2.0 prolene. A hemovac drain was placed over the mesh in all patients. The patients were discharged within twenty-four hours. They were instructed to come to the hospital every two days for a drainage check. When the amount of drain dropped below 20 cc/day, the drain was removed. Patients who came for control were evaluated. Local wound care was started in patients with signs of infection at the incision site. Patients diagnosed with mesh infection were hospitalized. The wound culture of the patients was taken and antibiotics were started according to the culture results. Negative pressure wound therapy was started on patients in Group 1 after surgical debridement. Negative pressure wound therapy was renewed every five days. Patients in Group 2 received daily active wound dressing. Healing was defined as resolution of the infection without the need for surgical removal of the mesh.

In Group 1, the skin sutures were completely opened after debridement, and the subcutaneous tissue was cleaned. The negative pressure wound therapy sponge was placed directly over the mesh to fill the wound cavity completely. It was covered with a drape, and negative pressure at 100 mmHg was applied. After benefiting fully from negative pressure wound therapy, skin closure was performed, leading to complete healing in 15 patients. In two patients, despite five sessions repeated every five days, due to mesh separation and persistent infectious discharge at the wound site, the patients underwent surgery for complete removal of the mesh. Debridement was performed, drains were placed in the area, and only skin sutures were applied.

In Group 2, after wound debridement, patients were treated with daily active wound dressing. They received intravenous antibiotic therapy. In eleven patients, when signs of infection disappeared, and discharge completely ceased, skin closure was performed, and complete healing was accepted. In the remaining nine patients, due to mesh separation or progression of infectious symptoms, the patients underwent surgery for mesh removal, followed by skin closure only.

Statistical analysis was performed using SPSS version 25.0 (IBM Corp., Armonk, NY, USA). Continuous variables (age, treatment duration, operation time, and mesh area) were presented as median (minimum–maximum) or mean ± standard deviation (SD). Comparisons between groups were conducted using the Mann-Whitney U test. A p-value less than 0.05 was considered statistically significant.

Result

In Group 1, there were seven men and ten women patients, while Group 2 comprised nine men and 11 women patients. There were no statistically significant differences between the groups in terms of gender distribution, mean age, area of mesh applied, or average operation duration median age (Group 1: 62.76 years, Group 2: 62.9 years , p=0.958), median area of mesh applied (Group 1: 100 cm² (range: 66–200), Group 2: 100 cm² (range: 66–250), p=0.964), or mean operation duration (Group 1: 64.53±9.79 min, Group 2: 67.75 ± 10.59 min, p=0.347) (Table 1).

The healing rates in Group 1 and Group 2 were determined to be 88.2% and 55%, respectively. The healing rate in the group treated with negative pressure wound therapy was statistically significantly better than the group treated with standard dressing. When comparing the median treatment durations between the groups, it was found that the treatment duration of patients in Group 1 was significantly longer [Group 1: 20 days (range: 10–25), Group 2: 14 days (range: 7–21), p=0.009] (Table 1).

When all patients were compared in terms of healing, it was observed that the treatment duration and operation duration were significantly longer in patients who did not heal. The size of the mesh applied was also statistically significantly larger. There was no statistically significant relationship between the healing rate and patient age (p>0.05), (Table 2). No mortalities were observed in either group.

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Additional comorbidities affecting wound healing, such as diabetes mellitus, obesity, chronic obstructive pulmonary disease, and chronic kidney disease, were also evaluated. It was determined that 10 out of 17 patients in Group 1 and 12 out of 20 in Group 2 had at least one of these comorbidities (Table 3). There was no statistically significant difference between the two groups regarding additional comorbidities.

Table 1. Comparison of groups according to Age, area of the mesh applied,treatment duration, operation time

	Group1	Group 2	P value
Age(year) mean±SD	62.76±8.20	62.9±7.40	0.958
Area of mesh applied(square centimeter) med(min-max)	100 (66-200)	100 (66-250)	0.964
Treatment duration (day) med(min-max)	20(10-25)	14(7-21)	0.009*
Operation time (minute) med SD	64.53 SD9.79	67.75 SD10.59	0.347

Med:medium, min:minimum, max:maximum, SD: standand deviation, *p<0.05

Table 2. Comparison of the treated patients and mesh removed patients

	Treated patients	Mesh removed patient	P value
Age (year) med (min-max)	65(40-76)	64(54-70)	0.714
Treatment duration (day) med (min-max)	15(7-18)	20(14-25)	0.018*
Operation time (minute) med (min-max)	63.50(45-90)	70(62-83)	0.015*
Area of mesh applied (square centimeter) med(min-max)	100(66-250)	150(66-200)	0.044*

Med:medium, min:minimum, max:maximum *p<0.05

Table 3. Comorbidity of the patients

Comorbidity	Group 1	Group 2	Total
Diabetus mellitus	2	4	6
Obesity	2	2	4
COPD*	2	3	5
Chronic renal failure	4	3	7

*Chronic obstructive pulmonary disease, Some patients havemore than one comorbidity

Discussion

First, this study observed that patients with ventral mesh treated with NPWT had significantly better healing outcomes. Associated with this, the rate of mesh removal with a second operation was lower in patients receiving NPWT treatment. However, it was found that the treatment durations were longer in patients receiving NPWT compared to those treated with conventional dressings. This may reflect the necessary time for NPWT to work on deeper, infected wounds where tissue regeneration is needed.

Ventral hernia repair is one of the most commonly performed procedures in general surgery. These hernias occur in 10-25% of abdominal surgeries [16] and are treated mainly by placing polypropylene mesh. One of the most significant challenges in their treatment is infections, which occur in 1-2% of cases [17,18]. Significantly as the size of the hernia increases, the area of mesh placement on the abdominal wall enlarges. This area can only be achieved through extensive tissue dissection and separation of tissues from the fascia. The more comprehensive this dissection, the higher the risk of postoperative tissue exudation and infection. When all patients included in this study were compared, it was found that the mesh areas of those who failed in treatment methods were significantly larger. (table 2)

Our findings are consistent with the existing literature supporting the efficacy of Negative Pressure Wound Therapy (NPWT) in treating mesh infections. Bueno-Lledó et al. , in their systematic review involving 230 patients, reported an 85.2% success rate in preserving infected meshes using NPWT [19]. This success rate closely aligns with the 88.2% success rate observed in our study. Both studies emphasize the high efficacy of NPWT in cases utilizing polypropylene mesh. Similarly, Li et al. demonstrated in their systematic review that NPWT effectively controls infection without mesh removal, reinforcing our findings regarding improved mesh salvage rates through NPWT [20]. On the other hand, the study by Kercher et al. demonstrated the successful application of NPWT in treating infections associated with polytetrafluoroethylene (PTFE) mesh, suggesting its potential effectiveness across different mesh types [21]. Our study

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differs by exclusively using polypropylene mesh; however, our results also support the applicability of NPWT principles across various mesh types. Therefore, further research investigating the effectiveness of NPWT across different mesh materials would be beneficial.

The development of infection in the mesh area requires the mesh to be removed with a second surgery [22]. In these secondary interventions, the abdominal wall will sustain more damage, leading to further enlargement of the hernia area. Additionally, there is a risk of injury to intra-abdominal organs during dissection due to potential adhesions, which could lead to new complications. Therefore, initial treatment should aim to be as effective as possible in patients where infection develops and aimed at preserving the mesh.

Extensive debridement should be performed when mesh infection is detected as soon as possible, and efforts should be made to sterilized the mesh surface [23]. The main goal in such wounds is to treat the infection to prevent mesh loss and to avoid a second operation and potential complications. One treatment applied for this purpose is providing wound care with frequent traditional dressings after debridement, and another option is the application of negative pressure wound therapy [24-26].

The global guidelines of the World Health Organization (WHO) report that NPWT-like dressings have beneficial effects in reducing overall postoperative infection rates [27]. The findings align with previous research showing NPWT's benefits, such as increased perfusion, reduced edema, and stimulation of granulation tissue formation [7,10-12]. These physiological effects, induced by negative pressure, contribute to better infection control, which is particularly relevant for wounds with mesh where bacterial colonization is common. NPWT's ability to create a controlled environment for wound healing—reducing wound exudate and removing harmful mediators—supports a conducive setting for faster recovery without necessitating mesh removal. In a meta-analysis, which evaluated seven articles on this subject, it was stated that in all studies, surgical site infections were significantly lower in prophylactic NPWT treatment [28]. Similar results have also been published in a study, supporting these findings [29,30]. Additionally, a study emphasized that the use of NPWT in infected abdominal wounds could be an alternative treatment to mesh removal, similar to our study [31].

Importantly, no significant differences were observed between the two groups regarding patient demographics, mesh size, or comorbidities, suggesting that the improved outcomes with NPWT were likely due to the treatment method itself rather than differences in patient profiles (table 1,3). Comorbidities such as diabetes, obesity, and chronic diseases are known to impair wound healing, but their presence did not seem to affect the relative efficacy of NPWT compared to conventional methods. This finding is crucial as it implies that NPWT can offer benefits across a diverse patient population, including those with risk factors that traditionally complicate wound healing.

Conclusion

This study found that patients with mesh repair significantly benefited from Negative Pressure Wound Therapy, but their wound healing times were longer. The most significant limitation of this study is its retrospective nature; furthermore, a cost-benefit analysis could not be performed. Although similar studies are in the literature, we believe that there is a need for larger-sample prospective randomized clinical trials.

Conflict of Interests
The authors declare that there is no conflict of interest in the study.

Financial Disclosure
The authors declare that they have received no financial support for the study.

Ethical Approval
The study was approved by the Ethics Committee of Cumhuriyet University Faculty of Medicine on June 22, 2023 (Approval no: 23-06-38).

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