

Efficacy of Negative Pressure Wound Therapy on Management of Surgical Site Infections: A Systematic Review of Randomized Clinical Trials

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Abstract

Surgical site infections (SSIs) are common postoperative complications that typically develop within 30 days of surgery. Negative Pressure Wound Therapy (NPWT) has gained prominence because of its potential to reduce dressing changes and enhance wound care outcomes. This systematic review evaluated the efficacy of NPWT in managing SSIs based on evidence from randomised controlled trials (RCTs).

A systematic review was conducted, adhering to Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines. Data were sourced from Google Scholar, PubMed, and PMC using specific search terms related to NPWT and SSIs. Articles were evaluated for quality using the Cochrane appraisal to ensure a comprehensive and bias-free review.

Our literature review provided us with 18,199 articles, and upon removing duplicates and irrelevant articles, 409 papers remained, which were then screened based on title, abstract, and full-length texts. Finally, 16 articles were considered; two were unavailable, four failed the critical appraisal, and two needed to meet the criteria for further evaluation. Consequently, eight studies, all of which were randomised controlled trials with a total of 1,196 patients, remained. This study involved adult males and females who underwent negative pressure wound therapy for various arthroplasties and diabetic foot ulcers. NPWT was compared to traditional dressings, and the outcomes measured were infections, epithelialisation time, hospital stay, blisters, seromas, wound complications, and amputations, with significance set at $p < 0.05$.

NPWT showed significant benefits over traditional dressings, including reduced SSIs and fewer dressing changes. This offers a promising approach to enhancing wound management. However, given the limited research available, further research is needed to provide conclusive evidence across all surgical types and patient populations.

Keywords

- Negative pressure wound therapy
- Vacuum-assisted wound therapy

- Vacuum-Assisted Closure (VAC)
- Wound care techniques
- Advanced wound care
- Postoperative Care

Introduction & Background

Surgical site infections (SSIs) are a significant concern in postoperative care, affecting approximately one to three percent of patients [1] and are linked to substantial perioperative morbidity, such as an increase in hospital stay duration, higher healthcare expenses, and increase in postoperative mortality risk [2]. Therefore, managing and preventing surgical site infections and wound care are essential areas of research.

Wound healing involves various biological and molecular processes, such as cell migration, proliferation, remodelling and storage of the extracellular matrix. However, because of underlying patient comorbidities, certain pathophysiological and metabolic factors often change this healing milieu, hindering or delaying recovery and increasing the risk of consequences [3].

Wound care has evolved significantly since Ambroise Paré's renowned statement, 'I dressed him, and God healed him,' with advancements in healing approaches and closure techniques [4,3]. Several techniques have been developed to treat SSIs, ranging from dressings, antibiotic therapy, and wound debridement [1] to more sophisticated wound dressings to stimulate the proliferative stage of wound healing, including hydrocolloids, topical application of autologous blood products, growth factors, cultured skin, and negative pressure wound therapy (NPWT) [3].

NPWT intervention was developed in the 1990s, and its uptake in developed countries' healthcare systems has been dramatic. The most recent introductions to the market are single-use or disposable negative-pressure products. These devices use simple wound dressings, such as gauze or transparent occlusive (non-permeable) dressings, with negative pressure generated in the hospital by vacuum suction pumps. They are now used in both secondary and primary (community) care [5].

NPWT dressings available include:

1. Prevena® is a wound management system that uses a continuous negative pressure of –125 mmHg and is secured by a stabilisation layer to ensure complete and airtight adhesion to the skin. The 0.019% ionic silver layer minimises bacterial growth. This single-use device can stay in place for up to seven days.
2. Pico systems are canister-free, with a pump generating an adequate negative pressure of –80mmHg, and each dressing has a silicon layer (reduce lateral tension), an airlock layer (even distribution of pressure), an absorbent layer (remove exudate) and a top film layer (acts as a physical barrier).
3. The SNAP therapy system is a single-use, mechanically powered, portable system with a pump and spring mechanism to generate negative pressure. It is suitable for wounds associated with 120 mL exudate per week.
4. The ActiVAC therapy system operates on the same principle as the SNAP, except that its power source is reusable. It can be used if the exudate volume exceeds 120 mL/week [4].

For over a decade, negative pressure wound therapy (NPWT), or dressings with active suction, to suture incisions has been suggested as a potential means of SSI prevention [6]. Currently, there is a lack of evidence of the benefits and potential harms of NPWT. Moreover, better-quality research is needed to determine the effectiveness of using NPWT in surgical wounds [5].

Methods

A systematic review was conducted and reported following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020.

Search Sources and Search Strategy

We conducted a thorough search and retrieval of relevant research papers using three important electronic databases in the field of research literature, as detailed in Table 1. We obtained data from Google Scholar, PubMed, and PubMed Central (PMC) using keywords such as "Negative pressure wound therapy/NPWT, Vacuum-assisted wound closure, Wound management, Surgical site infections/Surgical site complication. Boolean operators ("AND" and "OR") and the Medical Subject Headings (MeSH) were utilised to increase the search precision. Using the chosen keywords, we were able to locate relevant studies that provided evidence of the efficacy of NPWT in wound care and management.

Table 1 lists the details of the search strategy.

Database	Search Strategy
PubMed	negative pressure wound therapy OR NPWT OR vacuum-assisted wound closure AND wound closure techniques OR wound care OR wound management AND surgical site infections OR surgical site complications
PubMed Central (PMC)	"Negative pressure wound therapy/mortality"[MeSH Terms] AND "wound closure techniques/mortality"[MeSH Terms] OR "wound closure techniques/rehabilitation"[MeSH Terms] AND "surgical wound infection/mortality"[MeSH Terms] OR "surgical wound infection/prevention and control"[MeSH Terms] OR "surgical wound infection/surgery"[MeSH Terms]
Google Scholar	negative pressure wound therapy OR NPWT AND wound closure techniques OR wound care OR wound management AND surgical site infections OR surgical site complications

Study Selection and Eligibility Criteria

We carefully reviewed each article to ensure there were no duplicates and eliminated any irrelevant ones. To do this, we thoroughly examined each article's abstract, title, and subject headings. Table 2 lists the inclusion and exclusion criteria used to evaluate each study abstract and the full-text version for inclusion.

Table 2 Inclusion and Exclusion Criteria.

Inclusion Criteria	Exclusion Criteria
Application of NPWT for wound management.	Other wound management techniques.
Randomised controlled trials, both prospective and retrospective studies	Other study methods like systematic reviews and meta-analysis.
English language	Other languages.
Human subjects.	Animal studies or In vitro experiments.

Each selected paper was subjected to quality assessment using the PRISMA Checklist 2020. All articles were carefully reviewed to ensure they satisfied the selection criteria.

We strictly adhered to the PRISMA criteria to verify the study's comprehensiveness and methodological precision, as illustrated in Figure 1.

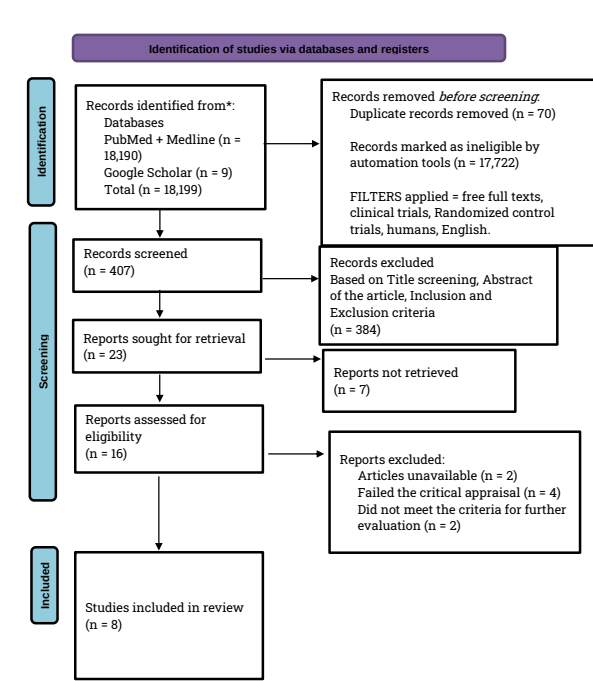


Figure 1: PRISMA flow chart of the literature review.

Risk of Bias and Quality Assessment

Publication quality was evaluated independently using the Cochrane bias assessment tool for randomised controlled trials (RCTs), as shown in Table 3. Each publication was examined for seven different forms of bias: allocation concealment, random sequence generation, incomplete outcome data, selective reporting, blinding of participants, outcome assessment, and other biases. Bias was assessed as high risk, low risk, or unclear.

Table 3: Quality analysis of randomised controlled trials using Cochrane Risk of Bias (RoB) tool.

Table with 8 columns: Cochrane appraisal, Random Sequence Generation, Allocation Concealment, Blinding of Participant, Blinding of Outcome Assessment, Incomplete Outcome Data, Selective Reporting, Other Bias. Row 1: [7] Svensson-Björk et al., 2022. with various risk assessments.

Table with 8 columns for study IDs [8] through [14] and 8 rows for bias categories: Low risk, Low risk, Unclear, Unclear, Low risk, Low risk, Low risk, Low risk.

Results

After searching different online databases and libraries, we found 18,199 publications for our research evaluation. These publications were reviewed for duplicates, and 70 duplicate articles were excluded. Additionally, 17722 articles were excluded. The remaining 407 articles were screened based on strict title screening, article abstract, irrelevance to the inclusion and exclusion criteria, lack of full-text availability, and off-topic nature. After applying a rigorous filtering process, 16 articles were included in the study. Of these, two articles were unavailable, four failed the critical appraisal, and two did not meet the criteria for further evaluation. Consequently, only eight articles remained, all of which were randomised controlled trials that satisfied our predefined criteria. The findings are presented in Figure 1. The study involved both adult males and

females who underwent negative pressure wound therapy for wound care. Details of the study designs for each randomised controlled trial are outlined in Table 4.

Table 4: Detailed study design of each randomised controlled trial.

Reference	Study design	Type of surgical procedure	Number of patients	Type of interventions	Duration of treatment	Outcomes and P value
[7] Svensson-Björk et al., 2022.	Multicenter randomised controlled trial	Endovascular aneurysm repair (EVAR) in the groin	336 bilateral incisions + 41 unilateral incisions	NPWT Vs standard dressing	90 days postoperatively	Primary Outcome (SSI incidence): No significant difference in SSI rates between the NPWT and standard dressing groups for bilateral ($P = 0.49$) or unilateral incisions. Secondary Outcomes: Technical problems: Nine patients experienced issues with the NPWT device, mainly leakage, which led to discontinuation of treatment in some cases. Wound complications: No significant differences between the two groups in terms of postoperative complications like hematomas or wound dehiscence.
[8] Lee K et al., 2017.	Single-centre, prospective, randomised controlled trial	Lower extremity revascularization through groin incision	102 High risk (BMI >30)	NPWT (Prevena®) Vs standard sterile gauze dressing	Postoperative day 8 OR until discharge	Primary Outcome (Reduction in SSI rates): The NPWT group had a lower SSI rate than the standard dressing group, but the difference was not statistically significant ($P = 0.24$). Secondary Outcomes: Length of hospital stay: The NPWT group had a significantly shorter stay by 2.5 days. Wound dehiscence and revision surgery: No significant differences between the groups in terms of reoperation or readmission rates.
[9] Monsen C et al., 2014.	a prospective randomised controlled study	Vascular surgery of the femoral artery in the groin	20	Vacuum-assisted closure Vs alginate therapy	After surgical debridement to day 21	Primary Outcome (Time to epithelialization): The NPWT group had a significantly shorter time to full epithelialisation than the alginate group ($P = 0.026$). Secondary Outcomes: Bacterial contamination: Both groups showed a similar decrease in positive wound cultures over time. Recurrence of infection: No significant differences between groups. Wound healing time: Faster wound healing in the NPWT group.

[10] Pachowsky M et al., 2011.	Prospective randomised study	Total hip arthroplasty	19	NPWT (Prevena®) Vs standard dressing	Five days, including the day of surgery	Primary Outcome (Wound dehiscence): The NPWT group showed a lower rate of wound dehiscence, though statistical significance wasn't specifically highlighted. Secondary Outcomes: Postoperative pain: No significant differences in postoperative pain levels were reported between the NPWT and standard dressing groups. Dressing changes: The NPWT group required fewer dressing changes. Infection rates: A trend towards fewer infections in the NPWT group, though not statistically significant.
[11] Mody GN et al., 2008.	Randomised control trial	Revision arthroplasty of hip and knee	36	Low-pressure single-use INPWT Vs standard dressing	Till six weeks postoperative	Primary Outcome: Wound complications: There were fewer wound complications in the INPWT group (1 patient) compared to the standard dressing group (3 patients). However, the difference was not statistically significant ($p = 0.14$). Secondary Outcomes: Risk factors (BMI > 30, smoking, diabetes): 9 patients in the standard dressing group and 10 patients in the INPWT group had these risk factors. Dressing-related complications: None were reported in either group.
[12] Chau WW et al., 2023.	RCT	Knee arthroplasty	255	NPWT (PICO) Vs standard dressing	Six weeks from joint replacement	Primary Outcome (Reduction in blister formation): The NPWT group experienced significantly fewer blisters than the conventional dressing group. Secondary Outcomes: Patient satisfaction: Patients generally preferred NPWT for comfort and ease of care, though specific satisfaction metrics weren't provided. Wound healing time: Faster healing was observed in NPWT patients, though the exact figures weren't given. Postoperative complications: The NPWT group had fewer complications, such as dehiscence and infection, but the results were not statistically significant.
[13] Karlakki	Non-blinded	Primary hip and knee	220	INPWT (PICO) Vs	-	Primary Outcome: Post-

SL et al., 2016.	randomised control trial	arthroplasties		conventional dressing		operative wound complications: There was a four-fold reduction in wound complications in the INPWT group, although this reduction only showed a trend toward significance ($p = 0.06$). Secondary Outcomes: Wound exudate: There was a significant reduction in peak post-surgical wound exudate in the INPWT group ($p = 0.007$). Length of stay (LOS): There was no significant reduction in overall LOS ($p = 0.07$), but a significant reduction was observed in patients with extreme LOS values in the INPWT group ($p = 0.003$). Dressing changes: There were significantly fewer dressing changes in the INPWT group ($p = 0.002$).
[14] Blume PA et al., 2007.	Multicenter prospective randomised control trial	Diabetic foot ulcers	335	NPWT Vs advanced moist wound therapy	Day 112 OR till the closure of the ulcer	Primary Outcome (Ulcer closure): A significantly greater proportion of foot ulcers achieved complete closure in the NPWT group than in the AMWT group ($P = 0.007$). Secondary Outcomes: Time to healing: The median time to 100% ulcer closure was significantly shorter in the NPWT group (96 days) than in the AMWT group (not determinable) ($P = 0.001$). Secondary amputations: Fewer secondary amputations occurred in the NPWT group ($P = 0.035$).

Three articles on vascular surgeries in the groin, one on knee arthroplasty, one on hip arthroplasty, one containing both hip and knee arthroplasties, one on revision arthroplasty of hip and knee, and one on diabetic foot ulcer cases were seen. NPWT was used in different cases and compared with a control group of traditional dressings. The desired outcomes were the incidence of surgical site infections, time of full skin epithelialisation, duration of hospital stay, blister and seroma formation, wound complications, and amputations. A p-value of <0.05 were considered significant.

Discussion

The findings from these RCTs consistently demonstrate the advantages of NPWT over traditional dressings. NPWT's mechanisms—enhancing blood flow, reducing oedema, and promoting granulation tissue formation—contribute to its efficacy in lowering SSIs and other complications. The ability of the therapy to maintain a

moist wound environment and remove exudates also plays a crucial role in improving healing outcomes.

Key Mechanisms of Actions of NPWT

Enhanced Blood Flow: NPWT increases microvascular blood flow and delivers more oxygen and nutrients to the wound site, essential for healing. This improved perfusion aids in faster wound closure and reduces the risk of infections.

Oedema Reduction: By removing excess fluid from the wound site, NPWT reduces oedema, decreasing pressure on the surrounding tissues and improving overall perfusion. This mechanism is particularly beneficial for managing wounds with significant exudate.

Granulation Tissue Formation: Sub-atmospheric pressure stimulates granulation tissue formation, which is crucial for wound closure. This process accelerates the healing of both acute and chronic wounds.

Moist Wound Environment: NPWT maintains an optimal moist environment, accelerating wound healing and reducing the risk of infection. The therapy also helps manage wound exudate effectively, preventing maceration of the surrounding skin.

Enhanced blood flow and oedema reduction are the fundamental mechanisms consistently reported in all studies. Svensson-Björk et al. and Lee et al. noted improved wound healing, attributable to better microvascular perfusion and reduced tissue oedema [7, 8]. These mechanisms are crucial for acute surgical wounds and chronic conditions, supporting faster recovery and reducing the risk of infection. At the same time, Monsen et al. and Pachowsky et al. highlighted NPWT's role in promoting granulation tissue formation and maintaining a moist wound environment [9, 10]. These mechanisms facilitate faster epithelialisation and wound closure, essential for effective healing in patients undergoing vascular surgery and those undergoing orthopaedic procedures. Managing exudate while keeping the wound moist is particularly beneficial in high-exudate wounds, underscoring the versatility of NPWT.

Comparison of Study Populations and Settings

Across the studies, there is variation in the patient populations being treated with NPWT. Patrick Murphy's trial focused on high-risk vascular surgery patients with hypertension and diabetes [8]. In contrast, Wai-Wang Chau and Milena Pachowsky concentrated on orthopaedic patients undergoing joint replacements and hip surgeries [12]. This diverse range of surgical interventions demonstrates the versatility of NPWT across different surgical fields. While the NPWT group generally showed favourable outcomes regarding infection rates and wound healing across studies, the populations' risk profiles (e.g., BMI, diabetes, vascular disease) directly impacted the outcomes.

Murphy et al. targeted vascular surgeries with high-risk patients. Although statistical significance in SSI reduction wasn't achieved, a trend toward lower infection rates and shorter hospital stays was observed [8]. Chau et al. focused on orthopaedic patients and found significant reductions in blister formation, a common complication in joint surgeries, which suggests that NPWT may be especially beneficial in procedures with high risks of superficial wound complications [12]. Pachowsky's trial in hip arthroplasty patients highlighted the reduction of postoperative seromas with NPWT, suggesting that NPWT can have a more profound impact in soft tissue management cases [10]. These findings suggest that the success of NPWT may vary depending on the type of surgery and the patient's risk factors.

Impact on Surgical Site Infections (SSI)

The effect of NPWT on SSIs is a common theme across the studies, though with varying results. Patrick Murphy's study did not show a statistically significant reduction in SSIs but did demonstrate trends favouring NPWT [8]. In contrast, Christina Monsen observed faster wound healing with VAC therapy in deep infections, although infection clearance rates between VAC and alginate therapy were comparable [9]. Robert Svensson-Björk's multicenter trial found no significant difference in SSI incidence between NPWT and standard dressings for closed inguinal incisions, likely due to this cohort's low baseline risk of SSIs [7]. However, these results contrast Blume's study on diabetic foot ulcers, where NPWT led to a statistically significant reduction in secondary amputations and improved ulcer closure [14]. This disparity in findings may be attributed to differences in surgical site location, baseline infection risk, and patient comorbidities (e.g., diabetes), as well as the mechanical challenges posed by each type of surgery. For example, SSI rates increase because of the proximity of wounds to the perineum and genitalia, use of prosthetic materials, and disruption of lymphatic vessels during groin incisions; most are attributable to infection by skin flora or direct bacterial spread at the time of the initial operation [15] and infections in vascular surgeries may result more from contamination during the procedure. In contrast, orthopaedic surgeries may suffer from complications like seromas or dehiscence that NPWT more directly mitigates.

Length of Hospital Stay

Several studies found that NPWT could reduce hospital stays, but this outcome is nuanced: Murphy et al. demonstrated a 2.5-day reduction in hospital stay for NPWT patients [8]. Conversely, Chau et al. found a longer hospital stay in NPWT-treated patients, likely because those patients were undergoing more complex or bilateral surgeries [12]. The difference in outcomes may highlight that while NPWT reduces complications like infections and blisters, the complexity of the surgery or underlying health conditions might require longer hospital observation despite the use of

NPWT. Additionally, extended stays might be more related to the surgery than the dressing used in cases involving complex bilateral procedures.

Wound Healing Mechanisms and Wound Closure

NPWT mechanisms, including the micro-deformation of the wound bed, removal of interstitial fluid, and creation of a moist healing environment, seem to have universal benefits across different wound types. Christina Monsen's finding of faster epithelialisation in the VAC group compared to the alginate group emphasises NPWT's efficacy in accelerating wound healing through mechanical mechanisms [9]. In the case of Blume's diabetic foot ulcer trial, the faster closure rates in NPWT-treated ulcers suggest that NPWT might be especially effective in managing wounds with impaired healing processes, such as those associated with diabetes [14]. On the other hand, Milena Pachowsky's study, focusing on seroma reduction, shows how NPWT can help avoid complications related to fluid accumulation in orthopaedic procedures [10]. These studies collectively support that NPWT's benefit is most evident when dealing with wounds at high risk for delayed healing or those involving extensive fluid management challenges.

Comparison of NPWT Systems

Various NPWT systems, including Prevena, Pico, and ActiVAC, were tested, each with differing pressures and technological features. Studies like those by Chau comparing portable versus standard NPWT systems highlighted how newer, portable systems might offer comparable outcomes while being more convenient for patients despite some technical challenges such as leakage and suction problems, as noted by Svensson-Björk [7, 12]. The fact that different NPWT devices performed similarly in terms of wound healing outcomes across these trials suggests that the choice of device may be based on patient-specific factors, such as the volume of exudate expected and the need for mobility, rather than on significant performance differences.

Clinical Benefits of NPWT

Several studies have explored the clinical benefits of NPWT. One of the most compelling advantages is the potential reduction in surgical site infections (SSIs). By maintaining a sterile wound environment, reducing lateral wound tension, and minimising seroma formation, NPWT has been shown to lower SSI rates in high-risk surgeries. For example, Patrick Murphy's trial on 102 patients undergoing lower extremity revascularisation showed a trend towards lower SSI rates in the NPWT group compared to those receiving standard dressings. However, statistical significance was not reached [8]. However, the NPWT group had a significantly shorter hospital stay, indicating potential cost savings and faster recovery. Similarly, NPWT has been effective in other high-risk surgical wounds, such as groin incisions following

vascular surgery. A study by Christina Monsen demonstrated that NPWT significantly reduced the time to full skin epithelialisation compared to alginate therapy [9]. The wound cultures showed a similar decrease in bacterial presence in both groups, but the faster healing in the NPWT group highlighted its efficacy in managing deep perivascular infections.

NPWT in Orthopedic and Joint Surgery

NPWT has also found applications in orthopaedic and joint surgeries, particularly in reducing complications like blistering and wound dehiscence. Wai-Wang Chau's study on 255 patients undergoing joint replacement showed that those treated with NPWT had significantly fewer blisters and required fewer dressing changes [12]. Interestingly, while NPWT patients had a longer hospital stay, this was attributed to the group's higher number of bilateral surgeries.

Another study by Milena Pachowsky on patients undergoing total hip arthroplasty (THA) found that NPWT significantly reduced postoperative seroma formation, a common complication in hip surgeries [10]. On the fifth and tenth postoperative days, ultrasound examinations revealed that the NPWT group had significantly smaller seromas than the standard dressing group. This finding suggests that NPWT could improve wound healing and reduce the risk of fluid accumulation post-surgery.

NPWT in High-Risk Patients and Chronic Wounds

NPWT has shown promise in managing chronic wounds, particularly in high-risk patients with comorbidities like diabetes, obesity, and peripheral vascular disease. Patients with diabetic foot ulcers (DFUs), in particular, have benefited from NPWT. In a multicenter trial by Peter A. Blume, NPWT was compared to advanced moist wound therapy (AMWT) in 342 patients with diabetic foot ulcers [14]. The results demonstrated a significantly higher rate of ulcer closure in the NPWT group, along with fewer secondary amputations. The use of NPWT in such cases enhances wound bed preparation and enables faster healing, potentially preventing the need for more invasive interventions like amputations.

Challenges of NPWT

Despite its many benefits, NPWT is not without limitations. Some potential risks include wound maceration, dressing retention, and infection. NPWT devices can also be cumbersome, limiting patient mobility and sometimes causing discomfort due to noise during operation. Additionally, NPWT is contraindicated in wounds near joints, cancerous tissues, areas with low blood flow, and in patients with fragile skin.

As reported in some clinical trials, there have also been technical challenges associated with NPWT devices, such as leakage and inadequate suction. For instance, in Robert Svensson-Björk's study on NPWT for inguinal incisions after endovascular aneurysm repair (EVAR), there were technical problems in nine patients, with

leakage being the most common issue [7]. Moreover, the trial showed no significant difference in SSI rates between NPWT and standard dressings, highlighting the need for further research to determine its effectiveness in low-risk incisions.

Limitations of the study

The number of patients in each trial varied from 20 to 335. The duration of treatment and follow-up ranged from five days postoperatively to 90 days postoperatively or 112 days in case of ulcer closure. Therefore, the long-term effects are not entirely known because of the absence of data. Only a few RCTs were available for ethical reasons, thus limiting the review. In this review, we included only articles written in English. However, this approach may have caused us to overlook valuable studies in other languages, which could have enhanced the strength of our review. Data on the expense of treatment were not available, making it difficult to compare cost-effectiveness among different approaches. As a result, determining the most optimal treatment in terms of both clinical outcomes and economic feasibility was not possible in this study.

Future Research Directions

While current evidence supports the use of NPWT, further research is needed to:

Evaluate Long-term Outcomes: Long-term follow-up studies are essential to understand the sustained benefits and potential late complications of NPWT. Such studies will help establish the long-term efficacy and safety of NPWT in various surgical contexts.

Identify Optimal Patient Populations: Research should focus on identifying specific patient groups that benefit most from NPWT, considering factors such as age, comorbidities, and wound characteristics. This will enable personalized treatment approaches and improve patient outcomes.

Cost-effectiveness Analyses: Comprehensive cost-effectiveness analyses will help understand the economic benefits of NPWT in different healthcare settings. Such analyses are crucial for healthcare providers and policymakers to make informed decisions about adopting NPWT.

Comparative Studies: Further comparative studies are needed to evaluate NPWT against other advanced wound care modalities to establish the best practices in wound management. These studies should focus on comparing NPWT with alternative therapies regarding its efficacy, safety, and cost-effectiveness.

Conclusions

In conclusion, this review, which included only RCTs, provides the effectiveness of NPWT and its impact on wound care. NPWT has shown significant improvements compared to traditional standard dressings in terms of

decreased surgical site infections, postoperative complications, length of hospital stay, amputations, seromas, exudate formation, and reduced number of dressing changes. Given the limited research available, large-scale clinical trials are needed to understand its long-term benefits and cost-effectiveness.

Author Contributions

Reshmitha Kantamneni made a major contribution to the article, such as the conception of the work and collection of data for the work, correction, tables, and figures editing, and drafted the manuscript from introduction to conclusion. Tirath Patel contributes to collecting data, double-checking for possible errors, and drafting the introduction and method section. Arnesh Shukla participates in selecting data, checking for duplicated data and possible errors, and drafting method sections and tables. Ayesha Salma participates in checking for data collection references and drafting the result section and discussion. Dev Patel participates in drafting discussions, data collection, checking for possible errors, and providing suggestions. Jabez David John contributes to abstract drafting, discussion editing, data collection, and checking for possible errors. Sarath Chandra Ponnada participates in editing the abstract and providing it. Suggestions, data collection, figure editing, and title modification. Ketan Kantamneni participates in data collection, checks for any possible errors, and drafts conclusions. Tuheen Sankar Nath participates in data collection and abstract editing, ensuring all guidelines are met, generating ideas, providing suggestions, title modification, corrections, revising the manuscript, and drafting the introduction, method, and conclusion. All authors read and approved the final manuscript.

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