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ORIGINAL ARTICLE

Negative Pressure Wound Therapy versus Traditional Dressing in Posterior Spinal Surgery: A 10-year Retrospective Study

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ABSTRACT

Introduction. Spine surgical site infections are serious complications with significant morbidity and economic burden. Negative pressure wound therapy has recently become popular in treating open wounds. This study aimed to compare the incidence of infections between patients treated with negative pressure wound therapy and traditional sterile dressing/closed suction drain after posterior spinal surgery.

Methodology. This was a retrospective study of patients in Chong Hua Hospital from May 2011 to May 2021. The patients treated from May 2011 to December 2016 received traditional dressing and those treated from January 2017 to May 2021 received NPWT. The rates of post-operative wound dehiscence, postoperative seroma, erythema, and pain were compared.

Results. A total of 324 patients were included with 194 patients under the traditional dressing group and 130 under negative pressure wound therapy group. Six patients in the traditional dressing group and two in the NPWT group developed SSIs. All six patients in the NPWT group had risk factors for infection such as multiple comorbidities and high BMI, whereas the two patients in the traditional dressing group had no documented risk factors. All patients from the NPWT group achieved clean closed post-operative sites after debridement and antibiotic treatment whereas one patient from the traditional dressing group underwent a revision surgery.

Conclusion. Results were comparable between the two groups. While NPWT showed promise in achieving a clean wound, these results should be interpreted with caution due the small sample size. Further research is needed.

Keywords. Negative Pressure Wound Therapy (NPWT), Surgical Site Infection (SSI), spine surgery, posterior spinal surgery, traditional dressing

INTRODUCTION

Spinal surgery, due to its complexity and the significant trauma involved, carries considerable risks. This includes the potential for surgical wound infections, complications, and the failure of internal fixation devices. These factors can cause severe pain, prolonged hospital stays, and increased healthcare costs. Postoperative infections in spinal surgery are particularly problematic because they can hinder healing, lead to complications like radiating pain, and necessitate longer recovery periods. This not only burdens the patient with physical and psychological stress but also places additional demands on healthcare resources.[1]

To address this, an alternative to the usual interventions is the use of negative pressure wound therapy (NPWT) immediately after surgery. Increasing NPWT usage for complex soft tissue injuries accelerates wound healing compared to traditional methods. Evidence shows it enhances wound healing by

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reducing edema, increasing the rate of granulation tissue formation, and stimulating circulation. Increased blood flow translates into a reduction in the bacterial load (removal of interstitial tissue) and delivery of infection-fighting leukocytes, thereby, possibly preventing wound complications in patients who underwent spine surgery.[2]

Lower rates of surgical site infection could lead to reductions in costs associated with length of hospital stay, diagnostic tests for microbiology, antibiotic use, and antimicrobial resistance.[3]

The meta-analysis conducted by Lu et al.[4] demonstrated that NPWT is beneficial for spinal surgery patients. NPWT significantly reduced the incidence of surgical wound infections and other postoperative complications. Furthermore, it was associated with a shorter hospitalization duration compared to traditional wound dressings. By enhancing wound healing and reducing the risk of infection and complications, NPWT helps achieve less pain, faster recovery, and a more efficient rehabilitation process. This ultimately leads to lower healthcare costs and an improved overall patient experience.[5]

METHODOLOGY

This is a retrospective chart review study of patients treated at Chong Hua Hospital from May 2011 to May 2021. The patient population was taken from a group of surgeons who followed a similar protocol: traditional dressing was used from 2011 to 2016, while NPWT was used from 2017 to 2021.

We included patients who underwent posterior spinal surgery (cervical, thoracic, lumbar), and who were treated with negative pressure wound therapy from January 2017 to May 2021 and with traditional sterile dressing/closed suction drain postoperatively from May 2011 to December 2016.

We excluded patients who underwent anterior cervical spinal surgery, removal of implants, epidural steroid injection, patients with cerebrospinal fluid leak, patients with metastatic/neoplastic tissue in the wound, and patients allergic to NPWT dressing materials.

Evaluation of two groups (Negative pressure wound therapy group vs. Traditional sterile dressing/closed suction drain group) were compared in terms of: wound dehiscence, postoperative seroma, and erythema or pain which would indicate a surgical site infection. Any repeat procedure or intervention for SSI was taken into account including the organisms isolated, antibiotics used and any revision surgery done afterwards. Demographic variables documented were patient's age, sex, BMI, and comorbidities.

All patients underwent primary closure of their postoperative site (Figure 1). Patients' wounds in the traditional dressing group were dressed with sterile pads, foam dressings, silver coated dressings, or other adhesive dressings (Figure 2), with or without a closed suction drain (JP drain, hemovac, or penrose).

The NPWT system included a black polyurethane soft foam which is cut to fit the entire post-surgical area (closed primarily). A transparent adhesive fluid- and gas-impermeable film sealed the wound and surrounding skin. A hole was then cut in the center, covered with a pre-cut adhesive which connected to the machine with a suction tube (Figure 3). A negative pressure of 125 mmHg was intermittently generated,

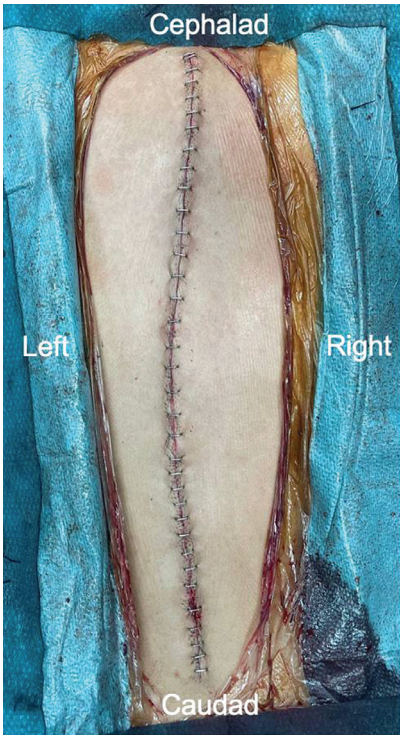

Figure 1. Post-operative site.

Figure 2. Wound dressing under negative pressure.

Figure 3. Traditional sterile dressing.

collapsing the foam, generating a uniform vacuum, evacuating the wound fluid into the container. The NPWT dressing was maintained for about 7 to 14 days, depending on the amount of fluid. For older patients with delicate skin, pressure was decreased to -105 intermittent pressure to avoid blisters or ulcer formation.

RESULTS

Between May 2011 to May 2021, 439 patients underwent spine surgery, 324 of whom underwent posterior spinal surgeries (Table 1).

Of the 324 patients, 194 patients were treated with traditional dressing postoperatively. Out of the 194 patients, six patients (Table 2) developed surgical site infections (incidence rate of 3.1%) (Tables 3 and 4). The mean age affected was 50 years old. There were four women and two men. Out of the 130 patients treated with NPWT dressing, two developed superficial infections (Table 5) suggesting an incidence rate of 1.5% with a mean affected age of 50 years old. Both patients were men (Tables 3 and 4).

All patients from the NPWT group achieved clean closed post-operative sites after undergoing debridement and appropriate antibiotic use. One patient from the traditional dressing group underwent a revision surgery after two years. None of the patients had a recurrence after the appropriate treatment.

DISCUSSION

There was no statistically significant difference in the baseline demographics, incidence of comorbidities, and infection rate between the two groups. The cause of the revision surgery in one patient from the traditional dressing group was implant loosening, attributed to infection after the first surgery (Table 5).

There was no significant difference between the two groups in terms of BMI and incidence of comorbidities. Of those who developed infections, two of the six patients in the traditional dressing group had normal BMI and no comorbidities, while both patients in the NPWT group had high BMI and multiple comorbidities (Tables 5 and 6).

The NPWT group achieved clean and closed postoperative sites, highlighting NPWT's potential benefits in wound management, particularly in lessening the number of

Table 1. The profile of the patients who underwent spine surgery, n = 324

Characteristics	Patients with:	
	Traditional dressing n = 194	NPWT dressing n = 130
Age, in years#	48.10 (20.10)	45.48 (22.08)
Sex+		
Male	88 (45.36)	63 (48.46)
Female	106 (54.64)	67 (51.54)

Note: Values in #mean (Standard Deviation) and in +frequency (Percentage).

Table 2. NPWT dressing

Patient	Age/ Sex	Diagnosis	Procedure/ Duration	Blood loss	BMI	Comorbidities	NPWT removed (Postop day)	Culture and sensitivity	Antibiotics	Treatment
1	15/M	Adolescent idiopathic scoliosis	Scoliosis surgery; 5 hours	600cc	25.5	None	7 days	*Pseudomonas stutzeri*	Clindamycin and Oxacillin	Debridement x 1 reapplication of NPWT – No recurrence; 3 days after detection
2	81/M	Lumbar spinal stenosis L3-L4, L4-L5	Lumbar laminotomy, PSF; 5 hours	600cc	26.5	Hypertensive, Diabetes Mellitus, Bronchial asthma, Chronic obstructive pulmonary disease	2 weeks	Methicillin-resistant *Staphylococcus aureus*	Ciprofloxacin and Linezolid	Debridement x1 reapplication of NPWT – No recurrence; 4 days after detection

Table 3. The incidence rate of infection of the patients who underwent spine surgery, n = 324

Incidence rate		Patients with:	
		Traditional dressing	NPWT dressing
Overall	Value	6 (3.09)	2 (1.54)
	n	194	130
According to Sex			
Male	Value	2 (2.27)	2 (3.17)
	n	88	63
Female	Value	4 (3.77)	0 (0.00)
	n	106	67

Note: Values in frequency (Incidence Rate in %)

Table 4. The comparative analysis of the incidence rate of infection of the patients who underwent spine surgery, n = 324

Incidence rate		Patients with:		Chi-squared (*P*-value)
		Traditional dressing	NPWT dressing	
Overall	Value	6 (3.09)	2 (1.54)	0.774 (0.379)
	n	194	130	
According to Sex				
Male	Value	2 (2.27)	2 (3.17)	0.115 (0.735)
	n	88	63	
Female	Value	4 (3.77)	0 (0.00)	2.571 (0.109)
	n	106	67	

Note: Values in frequency (Incidence Rate in %); *Significant at 0.05 using "N-1" Chi-squared test as recommended by Campbell[7] and Richardson.[8]

Table 5. Traditional dressing

Patient	Age/ Sex	Diagnosis	Procedure/ Duration	Blood loss	BMI	Comorbidities	Culture and sensitivity	Antibiotics	Treatment
1	62/M	Lumbar spinal stenosis L4-L5	Lumbar laminotomy, PSF; 5 hours	600cc	26.3	Hypertensive	*Pseudomonas aeruginosa*	Piperacillin-tazobactam	Debridement x1, 3 days after detection
2	68/M	Lumbar spinal stenosis L4-L5	Lumbar laminotomy, PSF; 4 hours	500cc	31.61	Hypertensive	Methicillin-resistant *Staphylococcus epidermidis*	Linezolid	Debridement x1, 4 days after detection
3	68/F	Lumbar spinal stenosis L4-L5	Lumbar laminotomy, PSF; 4 hours	400cc	23.4	Hypertensive	*Escherichia coli*	Metronidazole	Debridement x1, 4 days after detection
4	13/F	Adolescent idiopathic scoliosis	Scoliosis surgery; 4 hours	500cc	20.59	None	No growth	Cefuroxime	Debridement x1, 2 days after detection
5	57/F	Burst fracture sec to MVA	Thoracic laminectomy PSF; 4.5 hours	300cc	24.6	Diabetes Mellitus	*Mycobacterium tuberculosis*	Cefuroxime and HRZE	Debridement x1, 3 days after detection
6	13/F	Adolescent idiopathic scoliosis	Scoliosis surgery; 4 hours	500cc	18.87	None	*Klebsiella pneumoniae*	Cefuroxime	Debridement x2 – Revision of scoliosis surgery (2 years after)

Table 6. The demographic and medical profile of the patients with infection after the spine surgery, n = 8

Characteristics	Patients with:		Test statistic (*P*-value)
	Traditional dressing n = 6	NPWT dressing n = 2	
Age, in years*	59.50	48.00	-0.506 (0.613) [A]
Sex*			
Male	2 (33.33)	2 (100.00)	2.334 (0.1266) [B]
Female	4 (66.67)	0 (0.00)	2.334 (0.1266) [B]
Body Mass Index#	24.23 (4.51)	26.02 (0.69)	-0.531 (0.615) [C]
Comorbidities+			
Diabetes Mellitus	1 (16.67)	1 (50.00)	-(0.766) [D]
Hypertensive	3 (50.00)	1 (50.00)	
Bronchial Asthma	0 (0.00)	1 (50.00)	
Chronic Obstructive Pulmonary Disease	0 (0.00)	1 (50.00)	
None	2 (33.33)	1 (50.00)	

Note: Values in #mean (Standard Deviation), in +frequency (percentage), in *median; *Significant at 0.05 using [A]Mann-Whitney U Test, using [B]"N-1" Chi-squared test as recommended by Campbell[7] and Richardson[8], using [C]T-Test for two independent samples, and using [D]Fisher's Exact Test

dressing changes and reducing exposure to environmental contaminants. This suggests that NPWT provides a controlled healing environment, with benefits that extend beyond direct wound healing.[5]

NPWT is versatile and can be applied to clean, nonhealing, or infected wounds. This raises the question of whether its effectiveness is context-dependent; further research is needed to establish guidelines for its use in different types of wounds.

CONCLUSION

The study demonstrates comparable results between the two groups. While NPWT shows promise in managing clean, closed postoperative sites, its application, mechanisms of action, and comparative effectiveness in various contexts should be further explored. To minimize the risk of infection following posterior spinal surgery, patients should also be evaluated for risk factors that also impact wound healing and recovery. The results should be interpreted with caution due to the limited number of patients in the study. In the future, it is suggested that a prospective study is done with controlled variables to reduce bias and validate the efficacy of NPWT in spinal surgery.

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AUTHOR DISCLOSURE

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