Original Article

Efficacy of Negative Pressure Wound Therapy on Thoracic Wounds After Esophagectomy

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ABSTRACT

Objective: To evaluate the efficacy and effectiveness of NPWT in healing thoracic infections after esophagectomy in comparison with traditional open wound therapy.

Study Design: A retrospective study

Place and Duration of Study: This study was conducted at the Bakhtawar Amin Medical & Dental College & Hospital Multan from 10th July 2021 to Jan 10th 2022.

Materials and Methods: A total of 100 patients with oesophagal cancer were included in the study who underwent esophagectomy. Only 30 patients were selected for final analysis, among which 20 patients were treated with NPWT and 10 patients were administered open wound therapy. The NPWT device was operated by inserting a drainage tube in the wound. None of the patients reported any complaints about the procedure. The remaining 10 patients were administered traditional wound dressing. After the growth of granulation tissue and the infection was minimized, patients were discharged. The dressing change was done in the outpatient department.

Results: The rate of infection in our study was 30%. No patients showed any adverse reaction to the NPWT. All the patients treated with NPTW showed complete and successful wound healing. Patients experienced anastomotic leak and pneumonia as postoperative complications. The body temperature after the procedure and hospital stay did not differ significantly between both groups. However, the healing time of patients treated with NPTW was shorter I.e 12 days as compared to the other group i.e. 19 days.

Conclusion: Facilitated NPTW is a safe, inexpensive and effective method for the treatment of thoracic wounds in comparison with open wound therapy.

Key Words: Negative pressure wound therapy, open wound therapy, esophagectomy, and thoracic wounds.

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INTRODUCTION

Oesophagal cancer is one of the most prevalent and dangerous cancer in the world with significant morbidity and mortality cases. Esophagectomy is frequently used to treat this cancer, however, this procedure also poses the risk of postoperative morbidity mostly due to infection[1, 2]. This type of infection occurs as a result of an anastomotic leak and is a serious complication, at the same time surgical site infection also poses a great clinical risk. The prevalence of surgical site infection is increasing at an accelerated rate, causing discomfort and financial burden on the patient due to related risk of morbidity and mortality[3].

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Although Thoracoscopic esophagectomy is a less invasive and comparatively safe procedure leading to less frequent infection, oesophagal cancer is mostly treated with open surgery[4]. It is observed that the choice of method of treatment can prevent surgical site infections. Negative-pressure wound therapy (NPWT) is an effective technique to heal surgical wounds by applying negative pressure. It has been used in various studies and has yielded positive results[5, 6].

Negative pressure wound therapy contributes to wound healing by preventing infectious agents and removing interstitial fluid, decreasing oedema and promoting oxygen perfusion, formation of new blood vessels and formation of granulation tissue. NPWT is used frequently in both adults and neonates in various types of wounds. In addition to its use in other procedures, thoracic wounds are also healed by this technique as it treats infections and maintains chest wall integrity [7, 8]. Besides all the evidence, the working of NPWT in incision infection is still vivid. This study aims to evaluate the efficacy and effectiveness of NPWT in healing thoracic infections after esophagectomy in comparison with traditional open wound therapy.

MATERIALS AND METHODS

A retrospective study was conducted in the surgical thoracic department of Bakhtawar Amin Medical & Dental College & Hospital Multan from 10th July 2021 to 10th Jan 2022. A total of 100 patients with oesophagal cancer were included in the study who underwent esophagectomy. Only 30 patients were selected for final analysis, among which 20 patients were treated with NPTW and 10 patients were administered open wound therapy. An in-depth history of patients was noted including age, sex, smoking status, history of alcoholism, BMI, comorbid conditions, complications after surgery, hospital stay, intraoperative data, pathological history and duration of wound healing. All the patients provided their informed consent to become a part of the study. The ethical committee also approved the study design of the research.

30 patients were treated with NPWT after the operation. The NPWT device was operated by inserting a drainage tube in the wound. These tubes extended out with the transparent dressing surrounding the infection site. Negative pressure was maintained by connecting the drainage tube to a negative pressure suction ball. Both the suction ball and the tube were fixed at one position. After the infection was treated, the dressing was removed, revealing a healed wound. None of the patients reported any complaints about the procedure. The remaining 10 patients were administered traditional wound dressing. After the growth of granulation tissue and the infection was minimized, patients were discharged. The dressing change was done in the outpatient department. All the patients were prescribed prophylactic antibiotics postoperatively. The antibiotic use was continued until no infection was found by culturing and testing.

All the data were analyzed by SPSS version 20. Standard deviation was used to present parametric data and the results were compared by performing a t-test. Mann-Whitney test was used to analyze nonparametric data. Fisher's test was used to compare both groups. A p-value <0.05 was regarded as statistically significant.

RESULTS

The rate of infection in our study was 30%. All the tumors were squamous cell carcinomas and were confined to thoracic portion of oesophagus. Standard oesophagectomy procedures including lvor Lewis and Mckeown techniques were used via posterior mediastinal approach. The patients' characteristics and intraoperative data is illustrated in Table I and II respectively. Patients of both groups did not differ significantly with respect to clinical features.

All the infections were treated during the hospital stay or outpatient department visits. No patients showed any adverse reaction to the NPWT. All the patients treated with NPTW showed complete and successful wound healing.

Table No. I: Demographic data of both groups

Variable	NPWT group (n=20)	Open wound therapy group (n=10)	p
Age	62.2±6.0	62.1±5.0	0.745
Sex			0.349
Male	15 (75%)	9 (90%)	
Female	5 (25%)	1 (10%)	
History of alcoholism	1 (5%)	-	0.335
Smoking	13 (65%)	5 (50%)	0.365
High blood pressure	12 (60%)	4 (40%)	0.174
Diabetes	3 (15%)	1 (10%)	0.919
Body mass index	21.9±2.1	21±2.9	0.743
Tumour location 0.199			
Upper thoracic	2 (10%)	1 (10%)	
Middle thoracic	12 (60%)	5 (50%)	
Lower thoracic	4 (20%)	4 (40%)	
Pathological stage 0.172			
I	1 (5%)	1 (10%)	
II	12 (60%)	6 (60%)	
III	6 (30%)	2 (20%)	
IV	1 (5%)	-	

Table No.2: Intraoperative data of both groups

Variable	**NPTW group**	**Open wound therapy group**	**p**
Surgical procedure 0.655			
Ivor-Lewis esophagectomy	15	7	
McKeown esophagectomy	5	3	
Anastomotic site			
Above aortic arches	12	8	
Below aortic arches	8	2	
Operative time (minutes)	220± 50.9	217.1±55	0.672
Intraoperative blood loss (mL)	425.6±214.2	395.4± 233	0.630

As shown in Table 3, patients experienced anastomotic leak and pneumonia as postoperative complications. The body temperature after the procedure and hospital stay did not differ significantly between both groups. However, the healing time of patients treated with NPTW was shorter i.e. 12 days as compared to the other group i.e. 19 days.

2 patients from the NPTW group and 1 from the wound therapy wound showed Enterococcus faecalis in the wound fluid and were prescribed macrolides antibiotics. The treatment cost of wound therapy was twice that of the NPTW procedure.

Table No.3: Postoperative details of surgery patients

Variables	NPTW group	Open wound therapy group	p
Anastomotic leak	3 (15%)	2 (20%)	0.717
Pneumonia	13 (65%)	6 (60%)	0.825
Postoperative maximum temperature (℃)	37.1±0.75	37.1±0.70	0.895
Postoperative maximum WBC (×109 /L)	12±3.0	14.5±5.5	0.124
Postoperative stay (days) 0.088			
Median	23	18	
Range	13-200	13-100	
Wound healing time (days) 0.003			
Median	12	19	
Range	6-35	8-32	

DISCUSSION

The rate of infection in our study was 30%. The average rate of infection after open surgery is 1.89-18.92%[9]. The difference in the rate of infection can be explained by the small sample size. Traditionally, open wound therapy is used to treat the wounds after the operation, however, this procedure is lengthy, costly, painful and requires daily dressing changes. On the other hand, we suggested a far safer and more convenient method to treat surgical site infections.

Negative pressure wound therapy was developed in 1993 by Fleischmann[10]. Firstly, it was used to treat patients with open fractures which lead to successful results. Now, this therapy is used for healing different wounds including postoperative wounds [11-13]. This procedure involves applying negative pressure on the wound bed to facilitate the formation of granulation tissue by preventing the lacuna formation and increasing blood circulation[14]. The transparent dressing keeps the wound covered and also allows observing it without changing the dressing repeatedly. This not only lessens the patients' discomfort and doctors' labour.

The working of NPTW in wound healing is not clear. It can be due to the fact that it keeps the wound covered and maintains a stressed and hypoxic environment which leads to the activation of mechanoreceptor and hypoxia-mediated signalling pathways[15, 16]. This in turn results in angiogenesis, formation of granulation tissue and reconstruction of extracellular matrix, contributing to the healing process.[17]

A lot of complications including postoperative infections have been reported after thoracic surgery. NPTW has proved to be effective in curing these infections. However, surgical site infections pose less risk than thoracic infections so they are not paid much attention, although their rate is increasing and they also pose the risk of morbidity and mortality. Currently, open wound therapy is used for these infections until none is left. But it requires daily dressing changes which slow the healing process. This NPTW should be preferred instead to treat infection way more quickly as evident from our results[18, 19].

The results of our study are in agreement with Sharp[20] who administered PICO and traditional vacuum-assisted closure devices to adult patients. The method led to issues like difficulties in the use of the device, patient transportation, pain, lack of staff training and site and size difficulties. Therefore, the author used NPWT which showed much better results. Not only did the wounds heal but the pain score was lower and the patients were comfortable with this device. The hospital time was also less than in the use of the traditional unit.

The traditional device is hard to use and the medical staff is not trained for it, although it is more effective than traditional wound therapy. An expert can only operate such as device and its maintenance is also a difficult task. On the other, the use of facilitated NPTW as in our study eliminates all such issues and makes the patients and practitioners comfortable.

CONCLUSION

Facilitated NPTW is a safe, inexpensive and effective method for the treatment of thoracic wounds in comparison with open wound therapy.

Author's Contribution:

Concept & Design of Study:	Javed Mirdad Tarar
Drafting:	Kashif Nadeem
Data Analysis:	Amjad Ali
Revisiting Critically:	Javed Mirdad Tarar, Kashif Nadeem
Final Approval of version:	Javed Mirdad Tarar

Conflict of Interest: The study has no conflict of interest to declare by any author.

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