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Discussion on the Application Effect of Simplified Vacuum Sealing Drainage (VSD) in the Treatment of Chronic Refractory Wounds

Xiaohong Rong*, Jing Deng, Qingrong Du, Xiaoli Zheng, Xiaoying Zhang

Guangyuan Central Hospital, Guangyuan 628000, Sichuan Province, China

Corresponding author: Xiaohong Rong, 15082820908@163.com

Abstract: *Objective:* To analyze the effect of simplified vacuum sealing drainage (VSD) in the treatment of chronic refractory wounds. *Methods:* A total of 90 patients with chronic refractory wounds treated from May 2022 to May 2023 were randomly divided into groups. The simplified VSD treatment was employed in group A, and conventional treatment was employed in group B, and the wound healing of both groups were compared. *Results:* Group A showed better wound healing compared to group B , $P < 0.05$; the wound healing rate, wound healing duration, visual analog scale (VAS) score, wound dressing times and other indicators in group A were better than those in group B, $P < 0.05$. The SF-36 score of group A was higher than that of group B, $P < 0.05$; the complication rate of chronic refractory wounds in group A was no different from that in group B, $P > 0.05$. *Conclusion:* Simplified VSD treatment is effective in treating patients with chronic refractory wounds, and it reduces the number of wound dressing changes and promote wound healing.

Keywords: Chronic refractory wound; Simplified VSD; Curative effect

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1. Introduction

Wounds that remain unhealed after one month of treatment, or those with less than a 50% reduction in wound area during the same period, are classified as chronic refractory wounds. These wounds, characterized by delayed or poor healing, can extend the treatment duration, impose financial burdens on patients and their families, and adversely affect the physical and mental well-being of individuals. These wounds can be caused by car accident injuries, falling injuries from heights, and bed rest due to chronic diseases The prevalence of patients with these types of wounds remains substantial, and effectively promoting the healing of chronic refractory wounds continues to be a focal point of research for medical professionals. Consequently, determining the most effective approach for facilitating wound healing remains a prominent area of investigation in clinical research [2]. Vacuum sealing drainage (VSD) is a safe and efficient method that is often used in the clinical treatment of difficult wounds. However, the materials used in this treatment are expensive. Therefore, the effect

of simplified VSD treatment was studied using 90 patients with chronic refractory wounds admitted from May 2022 to May 2023.

2. Materials and methods

2.1. General information

Ninety patients with chronic refractory wounds admitted from May 2022 to May 2023 were randomly divided into groups: group A and group B. The baseline data of patients with refractory wounds of both groups were similar ($P > 0.05$), as shown in **Table 1**.

Table 1. Data analysis of patients with chronic refractory wounds

Group	*n*	Gender		Age (years)		Wound area (cm^2)	
		Male	Female	Range	Average	Range	Average
Group A	45	25 (55.56)	20 (44.44)	51–96	77.42 ± 2.41	1.2–150	86.36 ± 2.47
Group B	45	26 (57.78)	19 (42.22)	51–97	77.39 ± 2.36	1.3–148	86.21 ± 2.49
x^2/t	-	0.0452		0.0412		0.0647	
P	-	0.8315		0.9673		0.9486	

2.2. Inclusion and exclusion standards

Inclusion criteria: (i) Patients with refractory wounds according to the "Guidelines for Diagnosis and Treatment of Wounds" [3], (ii) patients whose wound area has not reduced by more than 50% after one month of debridement and dressing changes, (iii) patients who have provided informed consent, (iv) patients with good blood circulation in the wound area.

Exclusion criteria: (i) Patients with mental retardation, (ii) patients with mental abnormalities, (iii) patients with cardiovascular or cerebrovascular diseases, (iv) patients with color Doppler ultrasound showing arterial occlusion, (v) patients with abnormal blood indicators.

2.3. Treatment methods

Group A (simplified VSD treatment): (i) VSD education: the patients were informed of the process of the treatment, the expected effect, and the relevant precautions. (ii) Timeline of VSD treatment: About 10–14 days after wound debridement, if new granulation has formed locally, and there was no large area of necrosis, simplified VSD was initiated. (iii) The negative pressure source was carefully selected. In this study, an outpatient center-type negative pressure device was chosen for its portability. Then, the negative pressure suction tube was connected to the drainage bottle, and the urinary catheter was selected based on the wound's depth and area. If the length was insufficient, a specialized connecting tube was used to ensure the pipeline length was appropriate. Next, side holes were created in the area where the urinary catheter connected to the wound. It was recommended to have 3–4 holes to establish a drainage system with multiple side holes. Finally, the drain area was wrapped with an "Atrauman Ag" dressing. If cavities were found in the wound area, multiple drainage tubes were prepared and connected with a three-way tube. Additionally, transparent film dressings were folded into the shape of "dumplings." Non-adhesive foam dressing was used to cover the wound, and 3M transparent film dressing was chosen to seal the area. After completing the above treatment, drainage tubes with multiple side holes were placed in the wound area to ensure that each cavity was covered by a drainage tube. A small piece of foam dressing was used to adhere to the skin where the drainage tube made contact. Attention

was paid to cutting the dressing according to the size of the wound to completely seal it. Additionally, the foam dressing extended about 5cm beyond the film to maximize wound sealing. For areas where the skin fold could not be fully sealed, local folded skin was stretched with fingers to keep it flat before applying the dressing. Following these procedures, the negative pressure value was adjusted to -115 to -153 mmHg, based on the actual wound condition. Patient drainage was closely monitored. If a significant amount of bright red liquid was observed or if the patient experienced severe pain, the negative pressure value could be reduced, and if necessary, negative pressure could be discontinued. Dressings were changed every 7 days.

Group B (conventional treatment): The wound area was cleansed with normal saline, and necrotic tissue and foreign matter were removed. Evaluation for active bleeding was performed, and the adjacent skin was pat dried. Then, moist dressings were applied, and wound dressings were changed regularly.

2.4. Observation indicators

(i) Efficacy: When new granulation formation was evident, the wound fully healed, and the skin completely covered it, the treatment was considered markedly effective. If there was an increase in new granulation, expanded skin coverage, and a notable reduction in local exudate, the treatment was categorized as effective. However, if no new granulation was observed after the treatment, it was deemed ineffective.

(ii) Wound recovery indicators: rate and duration of wound healing, VAS score (0–10 points), and the number of wound dressing changes.

(iii) Quality of life: SF-36 scale was used to evaluate the quality of life of patients, ranging from 0 to 100 points.

(iv) Complications: bleeding, infection, high fever, etc.

2.5. Statistical research

The patients' data were statistically analyzed using SPSS 21.0. The count data were analyzed with the Chi-squared test (%), while measurement data were expressed as mean ± standard deviation and analyzed using the *t*-test. Statistical significance was considered at $P < 0.05$.

3. Results

3.1. Efficacy

The efficacy of the treatment received in group A was higher than that in group B ($P < 0.05$), as shown in **Table 2**.

Table 2. Comparison of curative effects in patients of both groups (*n* [%])

Group	Very effective	Effective	Ineffective	Efficacy
Group A (*n* = 45)	36 (80.00)	8 (17.78)	1 (2.22)	97.78
Group B (*n* = 45)	29 (64.44)	10 (22.22)	6 (13.33)	86.67
x^2	-	-	-	3.8726
P	-	-	-	0.0491

3.2. Wound recovery indicators

All wound recovery indexes of patients in group A were better than those in group B ($P < 0.05$), as shown in **Table 3**.

Table 3. Comparison of wound recovery indexes in patients of both groups (*n*, mean ± standard deviation)

Group	Wound healing rate (%)	Wound healing time (%)	VAS score (points)	Times of wound dressing changes (times)
Group A (*n* = 45)	44 (97.78)	20.48 ± 2.41	2.15 ± 0.23	3.48 ± 0.84
Group B (*n* = 45)	38 (84.44)	37.11 ± 3.26	4.26 ± 0.32	11.59 ± 1.25
x^2/t	4.9390	27.5172	35.9172	36.1240
P	0.0263	0.0000	0.0000	0.0000

3.3. Quality of life

After treatment, the SF-36 scores of patients in group A were lower than those in group B ($P < 0.05$), as shown in **Table 4**.

Table 4. SF-36 score analysis of patients of both groups (mean ± standard deviation)

Group	Mental health (points)		Physical health (points)		Physiological functions (points)		Social functions (points)	
	Before treatment	After treatment	Before treatment	After treatment	Before treatment	After treatment	Before treatment	After treatment
Group A (*n* = 45)	62.21 ± 2.15	82.43 ± 3.26	63.11 ± 2.11	83.05 ± 3.41	61.85 ± 2.11	82.39 ± 3.21	63.14 ± 2.08	83.15 ± 3.19
Group B (*n* = 45)	62.33 ± 2.17	76.15 ± 2.98	63.13 ± 2.13	75.36 ± 3.19	61.83 ± 2.13	74.36 ±3.11	63.17 ± 2.09	75.11 ± 2.43
t	0.2635	9.5380	0.0447	11.0475	0.0447	12.0522	0.0683	13.4495
P	0.7928	0.0000	0.9644	0.0000	0.9644	0.0000	0.9457	0.0000

3.4. Rate of complications

There was no difference in the rate of complication between group A and group B ($P > 0.05$), as shown in **Table 5**.

Table 5. Comparison of complication rates in patients with chronic refractory wounds (*n* [%])

Group	Bleeding	Infection	High fever	Incidence rate
Group A (*n* = 45)	0 (0.00)	0 (0.00)	1 (2.22)	2.22
Group B (*n* = 45)	1 (2.22)	1 (2.22)	1 (2.22)	6.67
x^2	-	-	-	1.0465
P	-	-	-	0.3063

4. Discussion

Refractory wounds refer to delayed healing or non-healing wounds caused by external and internal factors, often accompanied by pathological inflammatory lesions [4]. Patients with chronic refractory wounds, need long-term hospitalization, debridement, and dressing changes, but some patients still have poor wound healing and even require amputation [5]. A commonly employed treatment method is Vacuum Sealing Drainage (VSD) technology. This technique utilizes a semi-permeable membrane to seal the wound and maintains continuous negative pressure suction, thereby effectively eliminating local fluid and secretions. The benefits of this approach include the prevention of wound bacterial growth and infection, reduction of tissue edema, stimulation of cell growth factor expression, and acceleration of wound healing, ultimately leading to shortened recovery times [6]. In addition, VSD technology is suitable for the treatment of deep refractory wounds. However,

this treatment method is expensive and some patients cannot afford it. In recent years, simplified VSD has gradually been used in clinical treatment, which is also effective in treating chronic refractory wounds. This study employed central negative pressure as the source of negative pressure and utilized materials such as drainage tubes and urinary catheters. The wound dressing of choice was "Atrauman Ag" dressing, which contains silver, exhibiting the capability to curb local inflammation, reduce edema, and avoid wound adhesion without causing harm. The urinary catheter, made from polyvinyl chloride, offers high safety, a soft texture, and economic advantages, with professional connectors and adjustable length, making it suitable for medical drainage. Additionally, the drainage tube with multiple side holes was fashioned from the urinary catheter to conserve medical materials. The selection of 3M transparent dressing for wound sealing brings benefits of waterproofing, breathability, and firm adhesion. Polyurethane foam dressing was chosen as the wound dressing, ensuring continuous and uniform negative pressure drainage, alleviating local skin and wound pressure, and facilitating the wound healing process [7,8]. The analysis of the data in this paper revealed that the efficacy of modified simple VSD treatment in patients with chronic refractory wounds (group A) surpassed that of conventional treatment (group B), with statistical significance indicated by $P < 0.05$. Additionally, the wound recovery parameters of group A patients were better than those of group B patients ($P < 0.05$). This underscores the effectiveness of modified VSD treatment. The effectiveness of this approach can be attributed to the use of non-adhesive foam dressing, followed by wound sealing with 3M transparent dressing and subsequent connection to the negative pressure suction device. This comprehensive method effectively evacuates wound cavities, inhibits bacterial growth, prevents airborne bacterial contamination, and accelerates wound healing. According to relevant literature, VSD treatment for chronic refractory wounds over 5–7 days can enhance blood vessel density, stimulate macrophage expression, and induce local angiogenesis [9]. Moreover, patients in group A exhibited lower SF-36 scores than those in group B, with statistical significance ($P < 0.05$), suggesting that the simplified VSD treatment does not compromise safety. This outcome can be attributed to the treatment's direct contact with the infected wound, which enables thorough drainage, reduces postoperative infection risks, minimizes the likelihood of local scarring, and facilitates skin closure that matches the thickness and color of adjacent healthy skin [10].

5. Conclusion

In summary, simplified VSD treatment can shorten the wound healing time and improve the quality of life of patients with chronic refractory wounds, which has the value of promotion.

Disclosure statement

The authors declare no conflict of interest.

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