CLINICAL EXPLORATION OF VACUUM SEALING DRAINAGE IN WOUNDS OF SOFT TISSUE DEFECTS OF EXTREMITIES

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ABSTRACT

Objective: The application of vacuum sealing drainage (VSD) nursing technology in wounds of soft tissue defects of extremities is discussed from various aspects. It seeks a nursing method that can prevent and reduce tube blockage, restore skin tissue, increase patient comfort, reduce treatment costs, and shorten hospital stay, and provide more ideal conditions for subsequent surgical treatment.

Method: Patients were selected in Tangshan Gongren Hospital from June 2016 to June 2017 as subjects. Patients admitted to the hospital are randomly divided into four groups. Channel establishment and oxygen supply group (group 1): establish a negative pressure closed drainage channel and supply a local intermittent high concentration of oxygen; channel establishment group (group 2): establish a negative pressure closed drainage channel; oxygen supply group (group 3): supply negative pressure closed drainage intermittent high concentration oxygen; control group (group 4): routine care with simple negative pressure closed drainage. The differences and effects of each group in clogging the pipeline, restoring skin tissue, increasing patient comfort, reducing treatment costs, and shortening hospital stay are analyzed. Observe the response of the subjects after each experiment. That is, the number of cases of complications such as massive bleeding, post-debridement local infection, exposed bone and tendon degeneration, necrosis, and the number of cases in which no complications occurred during the treatment. The data of this experiment are statistically described and statistically inferred by SPSS17.0 software. The chi-square test is used to compare the count data, and the variance analysis test is used to compare the measurement data.

Results: by comparison, channel establishment and oxygen supply group are superior to other groups in preventing and reducing tube blockage, restoring skin tissue, increasing patient comfort, reducing treatment costs, and shortening hospital stay.

Conclusion: VSD care technology may be a new approach to the treatment of soft tissue defects of extremities. It has extensive clinical application value and promotion significance.

Keywords: VSD, soft tissue defects of extremities, clinical research.

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Introduction

VSD care technology¹ is a new treatment. It uses a medical sponge dressing containing a drainage tube to cover or fill the wound surface of the skin and soft tissue defect, and then close it with a biological semi-permeable membrane to make it a confined space, and finally it connects the drainage tube to the negative pressure source and promotes wound healing through a controlled negative pressure². The skin wounds and defects of the extremities³ are a common surgical acute injury, which easily causes the wound to be contaminated. In this case, it is not possible to treat by first skin grafting and flap repair. At this time, VSD nursing technology can be used for treatment, providing experimental treatment basis for subsequent surgical treatment⁴.

Reports on the treatment of refractory wounds by the negative pressure method appeared as early as the 1970s⁵. In 1992, Dr. Fleischman of ULM University of Germany pioneered VSD technology and applied it extensively in orthopedics⁶. China’s first-generation VSD treatment system developed traditional point and strip drainage into the whole wound surface and three-dimensional drainage, which significantly improved the drainage effect of the wound surface, realized zero accumulation of wound secretion, and the wound edema disappeared quickly⁷. The representative product is the German Braun drainage bottle⁸; the second-generation VSD treatment system developed simple
negative pressure drainage as the main purpose of increasing blood perfusion of wound tissue, increasing oxygen partial pressure of wound tissue, increasing tissue metabolism and proliferation, and improving the repair ability of severe wounds(9); on the basis of the second-generation VSD treatment system, the third-generation VSD treatment system has increased the monitoring and exclusion of intelligent wound/pipeline negative pressure, and organically integrated the closed drainage technique of wounds with the closed irrigation and perfusion treatment technology of wounds(10). Today, VSD technology has been widely used in a variety of acute and chronic skin tissue damage and difficult wounds(11).

Characteristics of VSD dressing: no fiber, excellent elasticity and toughness, strong tensile strength, no solid shedding, avoiding the fiber falling off of ordinary dressing during use(12); the porous and flexible Wesday dressing effectively conducts negative pressure as far as possible and causes negative pressure irritancy at any point on the wound surface. This is the effect that can’t be achieved by any other dressing, gauze, drainage sheet, and drainage tube(13); the broad absorption of VSD dressings can be used as a pharmaceutical carrier(14); VSD dressings are currently known materials that have the best compatibility with wound tissue and skin(15); VSD dressings are green materials that can be degraded into water and CO₂ in 1-2 years in nature(16).

The VSD postoperative nursing technique(17) is used to treat the soft tissue defects of the extremities(18). The application of closed negative pressure drainage technique in surgical wound repair and nursing measures are mainly discussed(19). It provides more ideal conditions for subsequent surgical treatment(20). This study is the first report of the practical role of VSD nursing technology in the clinical nursing treatment of soft tissue defects of the extremities, promoting wound healing, shortening the length of hospital stay, reducing hospitalization costs, reducing tube blockage, and increasing patient comfort. The role of VSD nursing technology in clinical nursing is discussed preliminarily. It reduces the work intensity of nursing staff and provides experimental basis for further application in clinical practice. At the same time, it can be effectively prospected in terms of increasing bed utilization and increasing departmental income.

**Materials and methods**

**Materials**

**Experimental reagent**

Medical distilled water preparation (China Otsuka Pharmaceutical Co., Ltd., Tianjin, China) and 0.9% physiological saline (The First Affiliated Hospital of Liaoning Medical College, Jinzhou, China).

**Laboratory apparatus**

VSD-B type material (VSD Co., Ltd., Wuhan, China), wall negative pressure drainage device (Cixi Huakang Oxygen-Supply Ying Equipment Co., Ltd., Cixi, China), wall oxygen supply unit (Cixi Huakang Oxygen-Supply Ying Equipment Co., Ltd., Cixi, China), Oxygen tube (TuoRen Co., Ltd., Xinxiang, China), infusion set and 20 ml syringe (WEGO Co., Ltd., Weihai, China).

**Test methods**

**Treatment method of negative pressure closed drainage technique**

**Debridement**

The foreign body and blood clot in the wound are removed, and the invasive tissue is removed (dark purple, no bleeding, no pain), and the wound edge is repaired as necessary to ensure smooth drainage and strive to transform fresh pollution into fresh surgery for the first phase of healing. There is a little necrotic tissue and exudate residue in the debridement material, sometimes it will emit odor through the semi-permeable membrane, and even the various colors of yellowish green, green pus, gray and dark stains appear on the material. It is recommended to use a full-face flushing of hydrogen peroxide to dredge the network to open the hole to ensure the best clinical efficacy. When a large amount of fresh blood is found to be aspirated, the attending doctor should be notified immediately to check for active bleeding in the wound and to make the appropriate correct treatment.

**Cleaning of the skin around the wound**

The wound skin is cleaned with 0.9% saline to remove the necrotic stratum corneum, and then the residual iodine disinfectant and skin dander are wiped off with 75% alcohol to facilitate the S&N semipermeable membrane.
Design and coverage of VSD dressings

According to the size of the wound, prepare a VSD-B dressing of the corresponding size and trim according to the shape of the wound. When a large wound requires the use of multiple dressings, the drainage tubes can be connected in series to reduce the number of tubes in the draft tube and facilitate sealing. The direction principle of the outlet of the drainage tube is to facilitate the sealing of the drainage tube. The designed Weiss’s dressing is covered on the wound surface and sutured with silk thread. The deeper wounds need to be filled with the Weiss’s dressing to the bottom of the deep cavity, and no dead space can appear.

Connection of negative pressure source

Combine all the drainage tubes into one outlet with the t-branch pipe and connect the negative pressure source as early as possible. When the negative pressure source is connected, the VSD dressing is pressed with the palm, so that the exudate is sucked as much as possible before the film is applied, so as to facilitate the sticking of the semi-permeable membrane.

Seal

Wipe the wound skin with 75% alcohol and saline and wipe off the residual liquid with dry gauze to ensure the dry and clean skin of the wound. The S&N semi-permeable membrane is taken out from the healthy skin without the drainage tube and layer by layer and pressed onto healthy skin. The flatness of the semi-permeable membrane must be ensured during the pasting process. Good sealing is the key to ensure the drainage effect. In order to better complete the sealing work, the dressing can be applied by the “stacking method”. After the paste is completed, the support film on the back of the film is removed, and the coverage of the semi-permeable film needs to include healthy skin of the wound edge of at least 2 cm, so as to ensure the sealing effect. If the negative pressure is constant, the seal is good and the negative pressure effect is satisfactory.

Postoperative observation and care

First, the wound should be protected and effective drainage should be guaranteed. The medical staff should observe the subject’s local skin, VSD dressing and drainage. The use of bio-permeable membranes for closed wounds should ensure the drying of the wound and local skin.

Scrub the surrounding skin 1-2 times a day with iodophor. If there is a poor drainage, report to the doctor promptly. Observe the negative pressure effect. If the polyvinyl alcohol film (PVA) under the transparent film collapses, the negative pressure is effective. If the original state is restored, the negative pressure is invalid.

In the process of negative pressure closed drainage, if the dryness of the Vickers dressing becomes hard in the first 48 hours, the Vickers dressing may be dealcoholized due to poor sealing. Once this happens, the saline can be slowly retrogradely injected from the drainage tube, and the Vickers dressing is soaked and softened again. Then turn on the negative pressure again, check the area where the seal is not tight, and re-seal the leaked area with the S&N semi-permeable membrane. If the Vickers dressing hardens 48 hours after the vacuum sealing drainage treatment, it indicates that there is no drainage in the drainage tube, and it can be left untreated. When the drainage tube is blocked, the irrigation port of the side tube of the drainage tube can be slowly infused with physiological saline to soak and rinse with a 20 ml syringe, and the negative pressure source is connected for suction, and the operation can be repeated many times, if still blocked, then the Vickers dressing needs to be replaced. The cases collected in this group can undergo skin grafting after 1-2 VSD operations.

Skin grafting

Before skin grafting, the wound surface is thoroughly expanded and the granulation is trimmed to make it flat. After the wound is enlarged, the wound is repeatedly washed with sterile saline (which may contain the corresponding antibiotic) hydrogen peroxide and iodophor. The wound completely stops bleeding. According to the condition of the wound, the skin covers the wound under appropriate tension, and sutures the edge of the skin and the wound edge. In view of the thin film, it is not suitable for suturing too much, so as not to cause the skin to tear.

Before bandaging, rinse the blood under the skin sheet with normal saline. The skin graft of the receiving area is covered with a sterile oil yarn, and the multi-layer mesh gauze is covered on the oil yarn, and the bandage is pressure-wrapped. Or when suturing the wound edge and the skin edge, retain the long line. After the suture is completed, the surface of the skin piece is covered with a lay-
er of sterile oil yarn. Place an appropriate amount of mesh gauze on the oil yarn, divide the reserved long lines into arrays, and then package them relative to each other.

If the wound is large and the infection exists, a stamp-like skin grafting method can be used. The keratinized layer of the skin sheet is attached to the oil gauze, and the size and the transplant density of the stamp-like skin piece are determined according to the amount of the skin supply. Bandaging method is the same as above. Dress the wound with a sterile dressing.

Detection methods
The growth of granulation tissue in the wounds of each group during the treatment, the degree of pain relief during the treatment, the complications, the treatment time required by the patients, the length of hospital stay and the hospitalization expenses are observed.

Investigate patient comfort
VAS pain score is used to evaluate the pain perception of patients during treatment. Divided into: 0 points to 10 points, 0 points: no pain; less than 3 points: slight pain, the patient can tolerate; 4 points to 6 points: the patient feel pain, affecting sleep, still tolerable; 7 points to 10 points: The patient has progressively strong pain and the pain is unbearable. The VAS scores of patients with preoperative and postoperative VSD are recorded, and the difference is calculated to determine the difference between each group.

The wound comfort questionnaire is issued to understand how the wound dressing of different groups of patients felt about the wound after nursing. The score is divided into 0 to 10 points, 0 points: very uncomfortable, dry and tight; 3 points or less: slightly uncomfortable, dry and tight feeling exists; 4 to 6 points: occasionally uncomfortable, no obvious dry tightness; 7 to 10 points: very comfortable, feels moist and cool, no dry and tight.

First skin graft survival rate
Observe and record whether the experimental group and the control group survive after skin grafting, whether a second skin graft operation is needed. Cases that do not require re-skin surgery are considered to be cases of first skin graft survival. The first skin graft survival rate of the two groups is calculated and compared.

Time of treatment and hospitalization before skin grafting
The time required from admission to debridement to skin grafting and the total hospitalization time of each group are recorded.

Total hospitalization expenses
The medical expenses of each experimental group and the control group from hospitalization to discharge from hospital, including drug costs, operating costs and inspection costs, are recorded separately.

Data processing methods
The data of this experiment is analyzed by SPSS17.0 software, the count data is compared by chi-square test, and the measurement data is compared by variance analysis. If P < 0.05, it means that there is a statistical difference.

Results
Table 1 gives a comparison of the general information of the channel establishment and oxygen supply group, the channel establishment group, the oxygen supply group, and the control group.

It can be concluded from Table 1 that there are no significant differences in gender, age, and wound area between the four groups (P>0.05).

<table>
<thead>
<tr>
<th>General Information</th>
<th>Channel establishment and oxygen supply group</th>
<th>Channel establishment group</th>
<th>Oxygen supply group</th>
<th>Control group</th>
<th>F/X2</th>
<th>P</th>
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<td>9</td>
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<tr>
<td>Age</td>
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<td>45.03±17.50</td>
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<td>Wound area (cm²)</td>
<td>121.94±54.58</td>
<td>104.67±38.01</td>
<td>117.28±44.88</td>
<td>104.03±26.66</td>
<td>1.496</td>
<td>0.219</td>
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</tbody>
</table>

Table. 1: Comparison of general information of four groups of subjects.

Figure 1 shows the comparison results of the number of catheter blockages in the channel establishment and oxygen supply group, channel establishment group, oxygen supply group, and control group.

As can be seen from Figure 1, there is a statistical difference between the groups (where F = 109.257, P = 0.000). The results showed that there is no significant difference in the number of catheter blockages between the channel establishment...
and oxygen supply group and the channel establishment group (P=0.292); the number of catheter blockages in the oxygen supply group is higher than that in the channel-established plus oxygen group, and there is a statistical difference between the two groups (P=0.000); the number of catheter occlusions in the control group is higher than that in the channel-established plus oxygen group, and there is a statistical difference between the two groups (P=0.000).

The number of catheter blockages in the oxygen supply group is higher than that in the channel establishment group, and there is a statistical difference between the two groups (P=0.000); the number of catheter occlusions in the control group is higher than that in the oxygen supply group, and there is a statistical difference between the two groups (P=0.000). The number of catheter occlusions in the control group is higher than that in the oxygen supply group, and there is a statistical difference between the two groups (P=0.02).

In summary, the number of blocked plugs in the oxygen supply group is the highest, and the number of blockages in the channel establishment and oxygen supply group and the channel establishment group is the lowest, and the control group is at the intermediate level. Therefore, the channel establishment and oxygen supply group and channel establishment group should be preferred by comparing the relationship between the number of pipe blockages.

Figure 2 shows the comparison results of the first skin graft survival rate in the channel establishment and oxygen supply group, channel establishment group, oxygen supply group and control group.

Overall analysis showed statistical differences between the groups (F=24.603, P=0.000), the above figure shows that the skin graft survival rate of the channel establishment group is lower than that of the channel establishment and oxygen supply group, and there is statistical difference between the two groups (P=0.000); there is no significant difference in skin graft survival rate between the channel establishment and oxygen supply group and the oxygen supply group (P=0.187); the skin graft survival rate of the control group is lower than that of the channel establishment and oxygen supply group, and there is a statistical difference between the two groups (P=0.000). The survival rate of skin grafting in the oxygen supply group is higher than that in the channel establishment group, and there is a statistical difference between the two groups (P=0.000); the survival rate of skin grafting in the channel establishment group is not significantly different from that in the control group (P=0.276). The survival rate of the skin graft in the control group is lower than that in the oxygen supply group, and there is a statistical difference between the two groups (P=0.001).

In summary, the first skin graft survival rate is the lowest in the control group and the channel establishment group, and the first skin graft survival rate is the highest in the channel establishment and oxygen supply group and the oxygen supply group. Therefore, by comparing the size relationship between the first skin graft survival rates, channel establishment plus oxygen and oxygen supply groups should be preferred.

Figure 2 shows the comparison of the comfort of the wound in the channel establishment and oxygen supply group, channel establishment group, oxygen supply group and control group.
It can be concluded from the above table, in the treatment of wound comfort, there is no statistical difference between the channel establishment group and the channel establishment and oxygen supply group (P=0.524); the comfort of the treated wound in the oxygen supply group is lower than that in the channel-established plus oxygen group, and there is a statistical difference between the two groups (P=0.000); the comfort of the wound in the channel establishment and oxygen supply group is greater than that in the control group, and there is a statistical difference between the two groups (P=0.000). The comfort of the treated wound in the oxygen supply group is lower than that in the channel establishment group, and there is a statistical difference between the two groups (P=0.000). The treated wound comfort of the control group is lower than that of the channel establishment group, and there is a statistical difference between the two groups (P=0.002). The comfort of the treated wounds in the control group is higher than that in the oxygen supply group, and there is a statistical difference between the two groups (P=0.000).

In summary, the comfort of the oxygen supply group is the lowest, the channel establishment plus the oxygen supply group and the channel establishment group are most comfortable, and the control group is at the intermediate level. Therefore, by comparing the magnitude relationship between wound comfort, the channel establishment and oxygen supply group and channel establishment group should be preferred.

Figure 3 shows the comparison results of the treatment costs of the channel establishment and oxygen supply group, the channel establishment group, the oxygen supply group, and the control group. Overall analysis showed statistical differences between the groups (F = 5.344, P = 0.002). The results in the above table indicate that the treatment cost of the channel establishment group is higher than that of the channel establishment and oxygen supply group, and there is a statistical difference between the two groups (P=0.004); in terms of treatment costs, there is no statistical difference between the channel establishment and oxygen supply group and the oxygen supply group (P=0.588); the treatment cost of the control group is higher than that of the channel establishment and oxygen supply group, and there is a statistical difference between the two groups (P=0.002). The treatment cost of the oxygen supply group is higher than that of the channel establishment group, and there is a statistical difference between the two groups (P=0.017); in terms of treatment costs, there is no significant difference between the channel establishment group and the control group (P=0.831); the treatment cost of the control group is higher than that of the oxygen group, and there is a statistical difference between the two groups (P=0.010).

In the comparison of prevention and reduction of the number of tube blockages, the channel establishment and oxygen supply group and channel establishment group are lower than the oxygen supply group and the control group (P<0.05). There is no difference between the channel establishment and oxygen supply group and the channel establishment group (P>0.05), and the pipeline blockage of the oxygen supply group is the most serious. In terms of the survival rate of the skin graft, the channel establishment and oxygen supply group and the oxygen supply group are high-
er than the channel establishment group and the control group (P<0.05). There is no difference between the channel establishment and oxygen supply group and the oxygen supply group (P>0.05). There is also no difference between the channel establishment group and the control group (P>0.05). In terms of patient comfort, the channel establishment and oxygen supply group and channel establishment group are higher than the oxygen group and the control group (P>0.05). There is no difference between the established group and the oxygen supply group and the channel establishment and oxygen supply group and oxygen supply group are lower than the channel establishment group and the control group (P<0.05). There is no difference between the established group and the control group (P>0.05). There is also no difference between the established group and the control group (P>0.05). There is also no difference between the established group and the control group (P>0.05). For hospitalization days, the channel establishment and oxygen supply group and oxygen supply group are lower than the channel establishment group and the control group (P<0.05). There is no difference between the established group and the oxygen supply group and the oxygen supply group (P>0.05), and the oxygen supply group feels the most uncomfortable. In terms of hospitalization days, the channel establishment and oxygen supply group and oxygen supply group are lower than the channel establishment group and the control group (P<0.05). There is no difference between the channel establishment and oxygen supply group and the oxygen supply group (P>0.05), and there is also no difference between the established group and the control group (P>0.05). In terms of treatment cost, the channel establishment and oxygen supply group and oxygen supply group are less than the channel establishment group and the control group (P<0.05). There is no difference between the channel establishment and oxygen supply group and the oxygen supply group (P>0.05), and there is also no difference between the established group and the control group (P>0.05). 

Discussion

Niu et al.’s investigation and analysis concluded that patients who used VSD technology had faster wound healing than those who used the original dressing method, and greatly reduced the incidence of complications. Zielinski et al. observed that patients treated with VSD showed that the technique can improve the skin graft survival rate and effectively restore the defect of the tissue wound. It also proves that this technology can improve the local conditions of damaged wounds and accelerate the doubling of granulation tissue. At present, the simple negative pressure closed drainage technique is a new method and new technology for treating skin defects similar to soft tissue of the extremities, but its technical concept and technical methods have been improved in the past ten years to reach maturity.

VSD negative pressure drainage is a new method for dealing with superficial wounds and deep drainage. It can completely remove the secretions and necrotic tissue of the cavity or wound and has a good therapeutic effect on diseases that are difficult to treat such as osteomyelitis. It is an innovation in surgical treatment technology. It can control negative pressure, promote blood flow growth and protein synthesis, promote granulation growth, accelerate wound healing, and provide power for a full range of active drainage. It also seals the bio-permeable membrane and isolates the infection from contact between the wound and the external environment. It can perform a full range of drainage, turning traditional point or local drainage into a planar drainage, ensuring that necrotic tissue and exudate can be aspirated at any point in the wound at any time.

The treatment cost of the channel establishment group and the control group is the highest, and the treatment cost of the channel establishment and oxygen supply group and the oxygen supply group is the lowest. Therefore, channel establishment and oxygen supply group and oxygen supply group should be preferred. In summary, in the application of VSD nursing technology, the channel establishment and oxygen supply group have an advantage in preventing the clogging of the pipeline, the recovery of skin tissue, increasing the comfort, reducing the cost, shortening the hospitalization time, etc., and it may be a new type of nursing treatment for soft tissue defects of extremities.

References


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