The Combination Application of Space Filling and Closed Irrigation Suction in Reconstruction of Sacral Decubitus Ulcer

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Dead space and poor drainage are the main reasons for intractable sacral decubitus ulcers. The objective of this study was to investigate the effects of treatment for sacral decubitus ulcer using space filling through muscle flap and closed irrigation. A total of 22 patients with serious sacral decubitus ulcer were treated with space filling through muscle flap and closed irrigation. After debridement of the decubitus ulcer, the infected areas over the bony prominence and osseous prominences were debrided. We elevated biceps femoris long head or semitendinosus and semimembranosus muscle. Pedicled by proximal part of muscle, the muscle flap was elevated to cover the ischial tuberosity. Transfusion systems of inflow and outflow drainage were placed between the muscle flap and ischial tuberosity. Wound healing and complications were observed. One wound dehiscence healed after secondary suturing. One wound gradually healed by dressing change after 3 weeks. The other cases had good results. Space filling and closed irrigation were complementary. The use of these two methods simultaneously is useful for the management of sacral decubitus ulcers.

Key words: Sacral pressure ulcers – Closed irrigation – Muscle flap – Space filling

Sacral pressure ulcers, especially grades III and IV, rarely respond to conservative treatment.^{1,2} The thorough surgical debridement needed to remove necrotic tissues often leaves a large cavity, in addition to the already existing soft-tissue defect. A large cavity will lead to poor drainage, which will increase infection and lead to operation failure.^{3–5}

Closed irrigation combined with space filling can effectively obliterate the dead space and produce full drainage. However, there have been no reports concerning the use of these two methods simultaneously for 24 hours. This is a report of the clinical results of the combined method. Clinically, it is exceptionally effective, in a comparatively short

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Fig. 1 Severe decubitus ulcer at ischial tuberosity deep down to bone. Preoperatively, active infection and unhealthy granulation tissue are observed in the wound.

time, in wounds that are considered impossible to heal and wounds that are thought to require an extremely long time to heal.

Patients and Methods

From January 2010 to January 2013, 22 patients with sacral pressure ulcers, 18 of them paraplegic, 4 of them with congenital lower limb hypoplasia, were treated with this technique. Twelve patients were men and 10 were women, and their ages ranged from 14 to 70 years (mean, 42 years).

All patients had stage III or IV pressure ulcers extending to the bone. The diameter of the skin defect ranged from 4 cm to 7 cm, and the cavity ranged from 9 cm to 13 cm. The size of the defect ranged 2 to 6 cm long, 4 to 7 cm wide, deep 9 to 13 cm.

The course of disease was 2 to 15 years. At the time of admission, patients had much exudation on the wound bed and dirty gray granulation. The cavity was deep down to the ischial tuberosity (Fig. 1). Inflammation in 4 cases spread to the ipsilateral hip joint. Eight patients with chronic osteomyelitis of the ischial tuberosity had dead bone. Bacterial cultures of wound showed *Pseudomonas aeruginosa* in 8 cases and *Staphylococcus aureus* in 6 cases.

Preoperative Preparation

Patients received the wound dressing and nutritional support after admission. Dressing with ethacridine lactate gauze packing into each part of the cavity could ensure full drainage. Patients with urinary incontinence should have indwelling catheterization in case of urine contamination. Nutritional treatment included oral nutrition, iron

Fig. 2 Muscle flap pedicled by their starting point was completely elevated toward the muscle attachment points at the deep muscle gap. After hemostasis, the muscle flap was turned up to cover the ischial tuberosity surface. A drainage tube and an irrigation pipe were placed between ischial tuberosity surface and muscle flap. Another negative pressure drainage (connected with the negative pressure drainage device) was placed into wound cavity at the thigh. They went percutaneously out of the skin and were fixed to the skin by suture.

supplements, if necessary, intravenous infusion of amino acids, and milk fat. Patients with fecal incontinence should fast for 3 days before surgery and receive intravenous hyperalimentation. For severe decubitus ulcer patients with severe anemia and chronic disease, preoperative short-term anemia was very difficult to correct. Wound exudation and recurrent fever could also increase the difficulty of treatment. We usually close the wound through surgery as soon as possible, as long as there is no wound inflammation, no significant purulent secretions, fresh granulation, or fever. Preparation of blood, about 800 to 1200 mL, preoperatively was necessary according to the condition of patients.

Surgery Methods

The vital signs of paraplegia patients were monitored. General anesthesia or epidural anesthesia was used with other patients according to their condition. Skin incision was marked 0.5 to 1.0 cm away from the wound edges. An adrenalin solution (1:200,000) was infiltrated to the incision lines and intradermal tissues. Scar tissue in the cavity was completely removed by electric knife, until the ischial tuberosity surface was exposed. Bony prominences and dead bone were resected after removing soft tissue at the ischial tuberosity surface. The

Fig. 3 Irrigation fluid consisted of 240,000 U gentamicin dissolved in 3000 mL physiological saline. After surgery, one tube is connected to a bag of irrigation fluid, and the other is connected to a continuous drainage bag. The bag of physiologic saline solution should be placed higher than the wound to maintain a pressure gradient between the bag and the wound. Then, continuous suction through the other tube is started. This ensures that the physiologic saline solution continuously irrigates the wound. A total of 6000 to 9000 mL/day of irrigation liquid should be used at first, depending on the degree of wound contamination.

hemostasia with electric coagulation under vision and wound immersion with iodine were important for primary healing. Biceps femoris long head was exposed and elevated through additional incision in

the back of the thigh. Semimembranosus and semitendinosus muscles were also exposed when the biceps femoris was obviously atrophied. We also protected the sciatic nerve. The muscle flap approximately 8 to 10 cm long was elevated, respectively pedicled by the proximal part of the muscle through an incision at the muscle belly. The muscle flap was completely elevated toward the muscle attachment points at the deep muscle gap. After hemostasis, the muscle flap was turned over to cover the ischial tuberosity surface. A drainage tube and a rinsing pipe were placed between the ischial tuberosity surface and muscle flap. They went percutaneously out of the skin and were fixed to the skin by suture. The skin flap was rotated upward and advanced to cover the wound. Another negative pressure drainage (connected with the negative pressure drainage device) was placed into the wound cavity at the thigh (Fig. 2).

An irrigation pipe connected with the saltwater bag and a drainage tube joined with a drainage bag were inserted postoperatively (Fig. 3).

Postoperative Nursing

Irrigation liquid consisted of 240,000 U gentamicin dissolved in 3000 mL physiological saline. After connecting the irrigation bottle with the lavage tube, we hung the device about 1.5 m above the bed surface. We adjusted the drip rate according to the wound condition. The daily rinse volume was determined by the size of the cavity, from the initial daily rinsing with 6000 mL to 9000 mL to daily rinsing of 3000 mL later on. The drainage bag can be hung at the bedside, but below the wound, to prevent reverse flow of the drainage liquid. Fixing the drainage tube properly was necessary to keep the drainage unblocked. Recording the volume of fluid rinsing on time could keep the liquid intake and output balance. The color and character of the fluid should be closely observed. Irrigation fluid replacement should be timely and follow aseptic techniques. In order to rinse fully, we proceed as follows: regularly close drainage tube, open irrigation tube only, then open drainage tube; repeat 2 to 3 times a day. Generally, until the drainage fluid became clear, we could stop the irrigation and change to negative pressure drainage until the irrigation fluid was clear. The drainage tube could be removed after 1 to 2 days. Intravenous hyperalimentation, sensible antibiotic, and strenuous nursing care for the prevention of complications were

Fig. 4 Closed irrigation suction in combination with muscle flap repaired severe decubitus ulcer at ischial tuberosity well, 2 months after surgery.

necessary. Suture removal was 10 to 12 days postoperatively.

Discussion

Sacral is the main body bearing parts with high risk of decubitus ulcer, especially for paraplegia patients. Deep pressure ulcers usually occurs in this area. Such a deep ulcer is easy to form a flask-like dead space with a small mouth and big bottom^{6,7} and often leads to poor drainage. Poor drainage and dead space are major causes of repeated infection, even to osteomyelitis. And more deep infection is always the main reason for ulcer recurrence and operation failure.

Frequent washing away of pus (necrotic tissue and emanating fluids) from the wound with liquids such as physiologic saline solution cleans the wound and decreases the number of bacteria. For this reason, it is the most important step taken for infected wounds.⁸ A closed irrigation technique was first used to treat osteomyelitis and later was applied to surgery, including plastic surgery.¹⁰⁻¹² Moore suggests that wound cleansing is considered an important component of pressure ulcer care.⁹

We applied closed irrigation suction to control infection through cleaning the wound fully. In our clinical practice, closed irrigation suction with the use of antibiotic saline to rinse dead space consisted of 24 hours of irrigation and interrupted drainage. In order to rinse fully, we proceed as follows: regularly close drainage tube, open irrigation tube only, then open drainage tube; repeat 2 to 3 times a day. In addition, the method is different from irrigation suction reported by Kiyokawa.¹³ We applied the siphon principle through placing the irrigation bag about 1.5 m above the bed surface, without application of negative pressure suction simultaneously. This ensured the irrigation fluid

containing antibiotics could remain in the wound for a certain time and could not be quickly washed away. Effective control of wound inflammation is performed. It is also probable that this effectiveness is behind the healing without recurrence of infection (Fig. 4).

Closed irrigation alone is not enough, because the dead space promotes the proliferation of bacteria and weakens the effect of closed irrigation. Sufficient obliteration of dead space will make closed irrigation more effective. Space filling also enabled healing of adhering tissue. The treatment of decubitus ulcer requires reconstruction with thick tissue to provide padding of bony prominences and obliterate dead space.¹⁴ There are many methods to close the cavity. However, muscle flap with good blood supply, strong anti-infection capability, filling the dead space entirely and preserving the structure integrity was usually a better option for repairing a decubitus ulcer.¹⁵⁻¹⁷ Decubitus cavities at the ischial tuberosity of the bedsore wound are often bigger, most already invading the gluteus maximus under the gap, and even invading the hip joint. At this time, repair of the ischial tuberosity decubitus through transferring the gluteus maximus flap may influence repair effect. So the choice of neighboring tissue flap was the most appropriate.

Biceps femoris long head flap was pushed up to fill the cavity through cutting the starting point of unit two biceps domestic. But the pressure ulcers at ischial tuberosity often have already invaded the starting point of the biceps femoris, semimembranosus, and semitendinosus muscles. This part of these muscles at their starting points always became tendinous structures. When we cut these muscles at their attachment point and push them up to close the wound, the repair effect may be bad because of poor revascularization, limited advance distance, and bigger suture tension.¹⁸⁻²⁰ But we can receive a good repair effect through cutting above muscle at the muscle belly and turning it over to fill the cavity pedicled by the proximal part of above muscle. The main advantages of the method suggested are the reduction of suture-line tension and obliteration of dead space.²¹

Filling dead space through muscle flap enables suturing of an infected wound that is then managed as a closed wound. Moreover, the transfer of muscle flap can reduce the wound area and simplify repair of the skin defect. So we do not need transfer complex myocutaneous flap. We applied direct suture to close the wound, reducing the damage and risk produced by cutting the flap.

Another advantage of this system is that the number of dressing changes is reduced dramatically. Hospital costs for patients and discomfort with dressing changes are also reduced. We applied this system in repairing 22 cases with severe decubitus at tubera ischiadicum and obtained satisfactory effect.

Conclusions

Although wound etiologies vary and there are a number of factors that affect wound healing, dead space and bacteria colonization of wounds are the chief concerns among them. Closed irrigation technique can effectively control wound infection through realizing full drainage. Muscle flap can fill the dead space. Space filling and closed irrigation suction are complementary. This simultaneous and continuous method could have both an additive and a synergistic effect on wound healing of sacral decubitus ulcer.

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