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Original article

Clinical analysis of 54 cases of large area soft tissue avulsion in the lower limb

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ABSTRACT

Objective: To assess the clinical curative effect of different treatment methods for large area avulsion injury in the lower limb.

Methods: Between January 2010 and December 2013, 54 patients with large area avulsion injury in the lower limb were treated in the trauma center of our hospital, including 34 males and 20 females with a mean age of 35.7 years (range, 16–65 years). The injury mechanism was traffic accident in 44 cases, hitting by heavy objects in 8 cases, and fall from height in 2 cases, involving 31 thighs, 19 legs and 4 feet involved. The sizes of the avulsed wounds ranged from 10 cm × 15 cm to 50 cm × 30 cm. There were 16 cases combined with hemorrhagic shock, 5 with femoral fractures, and 7 with tibiofibula fractures. Averagely the patients were sent to our hospital within 3.5 h (range, 1.5–10 h) after injury. For the 54 patients, three different surgical strategies were performed based on the wound area and condition of the avulsed skin: in Group A, 24 patients were treated by debridement and preservation of subcutaneous vascular network + vertical mattress suture of full thickness skin flap + tube drainage; in Group B, 25 patients were treated by split-thickness skin flap meshing and grafting + vacuum sealing drainage (VSD); and in Group C, the other 5 patients were treated by debridement and VSD at stage I + reattachment of autologous reserved frozen split-thickness skin graft at stage II.

Results: All the 54 patients recovered and were discharged eventually, without any deaths or amputees. In each group, there were no statistical differences (all $p > 0.05$) among different injury sites in terms of survival rate and length of hospital stay, except for the infection rate, which was much higher ($p = 0.000$) at the leg area than that at the thigh (32.54% ± 2.97% vs. 2.32% ± 2.34% in Group A and 50.00% ± 0.00% vs. 0 in Group C) or the foot (50.00% ± 0.00% vs. 0 in Group C). Moreover comparison of the three surgical methods showed a significant different (all $p < 0.05$) between each other for all the three assessed parameters, i.e. flap survival rate, length of hospital stay, and infection rate.

Conclusion: Treatment choices for skin avulsion on the lower limb should be based on the viability of the avulsed skin flap and the location of the wound. Proper choice can not only reduce the economic burden caused by using VSD, but also shorten the long hospital stay due to repeated wound dressing change or second stage surgery.

Introduction

With the rapid development of transportation and industry, the incidence of large area skin avulsion injuries combined with severe shock or fractures increased greatly, often caused by traffic accidents, hit by heavy objects, fall from height, twist by large machines, etc. Clinical treatment of these injuries pose a great challenge[1,2] because the surgeons need to face serious complications such as shock, wound coverage and infection, and has to choose a right time to deal with the combined fractures and injuries of the blood vessels, nerves and tendons. Large area skin avulsion injuries, especially those caused by traffic accidents or machine injuries, often couple with secondary skin necrosis (80%–95%), uncovered wound, fracture malunion or nonunion, scar contracture deformity and disfunction, even amputation and death if handled inappropriately.[3–6]

In this study, we compared three different treatment strategies on 54 cases of large area skin avulsion of the lower limb to investigate their therapeutic effects: (1) debridement and preservation

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of subcutaneous vascular network + vertical mattress suture of full thickness skin flap + tube drainage; (2) split-thickness skin meshing and grafting + vacuum sealing drainage (VSD); and (3) debridement and VSD at stage I + autologous frozen split-thickness skin meshing and grafting at stage II.

Materials and methods

General data

Between January 2010 and December 2013, 54 patients with large area soft tissue avulsion of the lower limb were treated in our hospital, including 34 males and 20 females with an average age of 35.7 years (range, 16–65 years). There were 44 cases injured in traffic accidents, 8 hit by heavy objects, and 2 fell from a high place, involving 31 thighs, 19 legs, and 4 feet. The detailed injury locations and injury mechanisms are shown in Fig. 1. The size of the avulsed wound ranged from 10 cm × 15 cm to 50 cm × 30 cm. Comorbidities included hemorrhagic shock in 16 cases, femoral fractures in 5 cases, and tibiofibula fractures in 7 cases. Averagely the patients were sent to our hospital within 3.5 h (range, 1.5–10 h) after injury.

Treatment

Preoperative treatment

For the 16 shock patients, active anti-shock treatment was conducted after admission. Infusion of equilibrium liquid & blood and broad-spectrum antimicrobials to prevent infection was done simultaneously. Patients without shock were infused routine liquid. When patient's blood pressure turned stable, bacterial infection of the wound area was assessed. Patients without infection were prepared for operation.

Anesthesia

All the surgeries were performed under general anesthesia after observation of stable hemodynamics. For patients with active bleeding, tourniquet was used to avoid further ischemia of the avulsed soft tissue. Intraoperatively the temperature was particularly noted, e.g. use of blower to keep the patient warm and heating of flushing liquid to avoid vasospasm due to low temperature.

Surgery

After satisfactory anesthesia, the wound was firstly washed with a large amount of physiological saline. Then the wound edge and surrounding areas were brushed with soap solution, followed by three times of physiological saline washing, during which the wound area was particularly noted to keep away from the washing fluid. Secondly another three times of washing using physiological saline, hydrogen peroxide and Eric was performed to clean the wound area and covert space like cavities and bags. After thorough debridement of the devitalized fascia, muscles, fat, and skin tissue, the broken blood vessels and nerves were repaired. Patients with fractures were fixed with external fixators in advance. According to the observational result of the viability of the skin and soft tissue after debridement, as well as the damage degrees of the subcutaneous vascular network, three different surgical treatments were selected as follows:

(1) Group A (n = 24): preservation of subcutaneous vascular network + vertical mattress suture of full thickness skin flap + tube drainage. The avulsed skin tissue from the back of the thigh/leg was thick and had rich vascular network and perforating branches. When the skin proved to have a good vascular network after capillary test, the subcutaneous soft tissue and vascular network should be reserved directly without thinning. The flap can be directly secured to its original anatomical site with multi-point vertical mattress suture. Thereafter several tubes need to be placed at different directions of the wound area for negative pressure drainage. Finally pressure dressing of the wound was done (Fig. 2).

(2) Group B (n = 25): Split-thickness skin meshing and grafting + VSD. The skin and subcutaneous tissue in the front leg and foot were very thin. If the vascular network of the avulsed skin was damaged seriously, but the wound base had a good blood supply after debridement, this technique can be used. The avulsed skin flap was thinned and subdermal vascular was retained. Thinning must be stopped at 2 cm away from the skin pedicle. Thorough hemostasis was mandatory. By every 2–3 cm, a 1 cm-long hole was punctured on the flap using a small sharp knife. After then, the mesh split-thickness flap was reattached and covered with VSD for drainage.

(3) Group C (n = 5): debridement and VSD in stage I + reattachment of autologous frozen split-thickness mesh graft in stage II. If the wound base, usually the front leg and foot, had a poor blood supply, serious contamination after debridement, or even with partial bone and tendon exposure, the wound should be covered with VSD in stage I. Split-thickness skin flap can be first reserved and frozen, which will be later retransplanted to the wound area in about a week (Fig. 3).

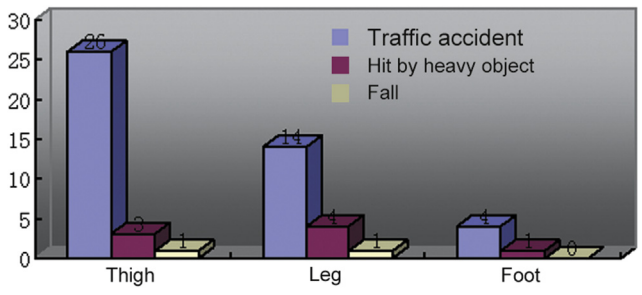

Fig. 1. Distribution of injury locations and causes.

Postoperative treatment

VSD treatment should be dynamically monitored: the pressure should be controlled at 125–450 mmHg and continuous negative pressure aspiration should be guaranteed. Bulge of VSD dressing indicates that negative pressure sucking is invalid and tubes should be checked to see whether there is any blocking or rupture leakage. The sucked liquid should be assessed to rule out bloody drainage or abnormal color. At 5–7 days, surgeons need to remove the VSD to examine the growth of the graft. If the graft did not grow well, re-cutting of the necrotic tissue or even re-debridement should be done.

Statistical analysis

The data of skin survival rate (postoperative survived skin area/avulsed area × 100%), wound infection rate and the average length of hospital stay were collected and analyzed by SPSS 18.0 software. Data were expressed as mean ± standard deviation and ratios. Intra-group comparison of different wound locations was conducted by using single factor variance analysis and inter-group