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Use of porcine acellular dermal matrix following early dermabrasion reduces length of stay in extensive deep dermal burns

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ARTICLE INFO

Article history:
Accepted 19 October 2015

Keywords:
Deep dermal burns
Dermabrasion
Acellular dermal matrix

ABSTRACT

Objective: Extensive deep partial-thickness burns still seriously challenge the surgeon's abilities. This study aimed to assess the impact of early dermabrasion combined with porcine acellular dermal matrix (ADM) in extensive deep dermal burns.

Methods: From September 2009 to September 2013, a total of 60 adult patients sustained greater than 50% total body surface area (TBSA) burn by hot water or gas explosion were divided into three groups based on dermabrasion: group A (early dermabrasion and porcine ADM), group B (early dermabrasion and nano-silver dressings), and group C (conservative group). The wound healing time and length of hospital stay were analyzed. Scar assessment was performed at 3 and 12 months after the injury with a modified Vancouver Scar Scale linked with TBSA (mVSS-TBSA).

Results: No significant difference was found in mean burn size, burn depth, age, male-to-female ratio, or incidence of inhalation injury between the patients in the three groups ($p > 0.05$). Compared with groups B and C, the patients that received early dermabrasion combined with porcine ADM had a shorter wound healing time ($p < 0.01$). The burn patients treated with early dermabrasion and porcine ADM coverage had a mean length of hospital stay of 28.3 days (±7.2), which was significantly shorter than that of groups B and C ($p < 0.05$–0.01). The mVSS-TBSA of patients in group A was significantly improved in comparison with groups B and C at 3 and 12 months after the injury. There was no significant difference in the mortality rate between the three groups ($p > 0.05$).

Conclusion: Early dermabrasion combined with porcine ADM coverage facilitates wound healing, reduces the length of hospital stay, and improves esthetic and functional results in extensive deep dermal burns with burn size over 50% TBSA.

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http://dx.doi.org/10.1016/j.burns.2015.10.018
0305-4179/

1. Introduction

Early tangential excision of nonviable burn tissue with a roller axle graft knife, followed by immediate skin grafting, has become widely practiced as a treatment for deep dermal burns [1]. However, this procedure is always difficult in plane level control [2]. It depends on the physician's own experience which has certain disadvantages: the sacrifice of remaining viable healthy tissue, the need for larger donor site areas, and bleeding [2,3]. Even in regard to a sharp tangential excision using a dermatome, only 5.4% of a single tangentially excised layer of eschar contained all of the necrotic tissue without removing viable tissue [4]. Deep partial-thickness burns still seriously challenge the surgeon's abilities [5].

To reduce the undesirable effects of tangential excisions, a modified excision method called dermabrasion was introduced by Deloyers [6] and Lorthioir [7]. This technique, using sandpaper, motor-driven cylinders or steel, has been well studied by several authors [5,8–10]. Compared with classic tangential excision, dermabrasion has been demonstrated by the studies of De Souza and Esposito to have several advantages in terms of ease of manipulation, less injury to patients, lower infection rate, fewer complications, and quicker burn wound healing [10,11]. Moreover, skin autografting was not necessary in most cases [10,11].

Porcine acellular dermal matrix (ADM), a porcine-derived engineered skin tissue, is a dermal biomaterial in which all of the cellular elements have been removed [12]. It was widely used in the deep second degree burn wounds in China [2,13–16]. Within the past two decades, porcine ADM, as a wound regimen, has been found to preserve maximally residual dermal tissue and epithelium, protect interecological organizations, help accelerate the regeneration of epithelial and stem cells, promote the growth of granulation tissues [17], thus shorten the healing time, remodel the skin structure, and consequently has the effect of controlling hypertrophic scar at inception in the treatment of deep dermal burns [13]. Recently, porcine ADM has been demonstrated to bear a strong similar histological structure and biocompatibility to human ADM [18], and was utilized to cover large areas of severely damaged wounds [19], repair the abdominal wall defect [20], reconstruct the breast [21], and so on.

From September 2009 to September 2013, early dermabrasion combined with porcine ADM coverage was used to treat extensive deep second degree burns in 20 patients. A retrospective survey was made on these burn cases to document the efficacy of this approach with respect to the improvement of healing and decrease of length of stay.

2. Materials and methods

2.1. Patients

Most of the extensive burn wounds caused by hot water or gas explosion are deep dermal burns. The charts of hot water and gas explosion burns with greater than 50% total body surface area (TBSA) at our burn center between September 2009 and September 2013 were reviewed retrospectively. The patients older than 65 years, those admitted three or more days following the injury, and those with concomitant musculoskeletal or visceral injuries were excluded from this study. A total of 60 adult burned patients were identified.

The patients were divided into three groups based on dermabrasion: group A (early dermabrasion and porcine ADM), group B (early dermabrasion and nano-silver dressings), and group C (conservative treatment group).

2.2. Treatment

Group A: After effective resuscitation and the signs of shock eliminated, the wound was treated 2–3 days after injury. Under general anesthesia, the deep dermal wound was scraped with a steel dermabrader (Fig. 1, from Changsha Hairun Biological Technology Co., Ltd, Hunan, China) until punctate capillary bleeding occurred and viable tissues were observed. After dermabrasion, the wound was irrigated with copious amounts of normal saline to remove the necrotic tissue. Porcine ADM, which was prepared by using physical and chemical methods to remove the skin that causes cellular components of immune response and to retain the dermal frame (from Qidong Medical Institute Co., Ltd, Jiangshu, China), was laid directly on the debrided site, followed by povidine-iodine ointment and gauze. The outer coating dressings were renewed every two days and the porcine ADM was left on until it exfoliated spontaneously from the healed second degree burn area.

Group B: Dermabrasion was the same as the treatment of group A. After dermabrasion, the wound was covered with nano-silver antimicrobial dressings (Ai Ke Xin®, Shenzhen AGT Pharm Co., Ltd, Guangdong, China). The dressings were changed at an interval of 2–3 days.

Group C: Patients in the conservative group received debridement of the burn wound with providone-iodine and the wound was dressed with nano-silver antimicrobial dressings, which was applied every two days. The wounds on the head, face, and perineum received nano-silver antimicrobial dressings one time per day.

Patients in the above three groups were otherwise treated by similar metabolic and physiologic support protocols. Systemic antimicrobial agents were given perioperatively and when clinical signs of sepsis were present. Clinical complete wound healing time was analyzed. All patients wore a pressure garment when the wound healed, meanwhile, Contractubex (Merz+, Germany) and silicone gel were properly applied to the scarring surface area.

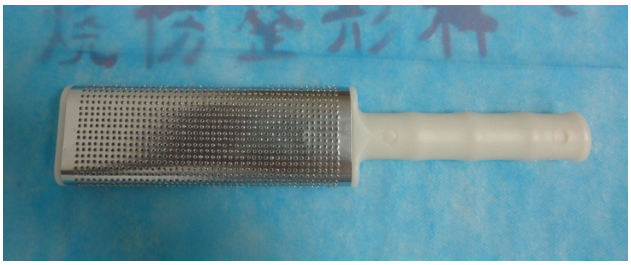

Fig. 1 – A steel dermabrader.