

CASE REPORT

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Treatment of Recalcitrant Electrical Burn Ulcer with Application of Topical Trichloroacetic Acid and Autologous Cultured Fibroblast

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Abstract: In this case report, we present a case of deep, partial-thickness, recalcitrant electrical burn ulcer that was healed completely using tissue debridement with topical 50% TCA (Trichloroacetic acid) and application of autologous fibroblasts. To the best of our knowledge, this is the first time that the application of topical TCA along with autologous fibroblasts have been used for the treatment of an electrical burn ulcer with a satisfactory result.

Keywords: treatment, burn, fibroblast, culture, TCA

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Case Presentation

Our patient was 38-years old man who was working in an electric company. Following electrical burn, he developed a relatively large ulcer on his right plantar area along with small superficial burn on his right palmar area. These burn ulcers were treated with topical Silver Sulfadiazine ointment along with Vaseline gauze dressing. The ulcer on palmar area was completely healed during a few days, however the plantar ulcer did not show any sign of improvement up to day 18 post-injury.

He was referred to us on day 18 for treatment of his recalcitrant plantar ulcer. In physical examination, an ulcer with diameters of 3×4 cm and depth of 6 mm was observed on the plantar area. The margin of ulcer was very hyperkeratotic. There was no sign of infection in the ulcer. Regarding non-improvement of the ulcer during this time, he was considered to be treated with autologous fibroblasts. Informed consent was taken from the patient.

To destroy the surrounding hyperkeratotic tissue, topical 50% TCA solution was applied to the hyperkeratotic margin of the ulcer using cotton applicator until whitening of the tissue was occurred. We used 50% TCA peeling for debridement of hyperkeratotic tissue (instead of surgical blade debridement) to decrease the risk of infection, bleeding and other side effects attributable to the latter method. TCA peeling of the hyperkeratotic tissue seems to be less invasive as compared with traditional surgical blade debridement.

7 days later, ulcer showed relatively diminished surrounding hyperkeratotic tissue with no significant change in ulcer size. He was treated again with topical 50% TCA application. Routine wound care was continued during this period of time.

On the same day (day 18), a 4-mm punch biopsy was performed from retroauricular area and was sent for Rooyan Institute (Isfahan, Iran) where culture of fibroblasts was performed. The biopsy tissue was minced into small pieces and placed onto culture dishes containing DMEM F12+10% AHS (autologous human serum) and 100 µg/ml streptomycin, 100 IU/ml penicillin and 2 mM L-Glutamine at 37 °C and 5% CO₂ and 95% humidity. Upon culture the fibroblasts expanded out of the explants and reach confluency. Finally 20 million cells were isolated and prepared for transplantation. Cells viability was assessed by trypan blue staining.

On day 41 post-injury, a mixture of 20 millions fibroblasts in 1 cc of serum was ready. In addition to the remaining surrounding hyperkeratotic tissue, the base of ulcer was abraded cautiously using 15 scalpel surgical blade until pinpoint bleeding was occurred (Fig. 1). A thin layer of fibroblast suspension was applied to the ulcer using sterile syringe and the wound was covered with Vaseline gauze and protected using 3 M Tegaderm Dressing and a crepe bandage.

The patient was given Cephalexin, 500 mg QID as a prophylaxis for 7 days and was instructed not to change the dressing during this time. On day 48 (7 days after fibroblast application), the dressing was removed showing complete filling of the ulcer with granulation tissue (Fig. 2). The patient was instructed to change the dressing on daily basis. 3 weeks after fibroblast application, the ulcer was completely healed and reepithelized with minimal scar formation (Fig. 3).

Discussion

The risk of hypertrophic scarring is minimal when epithelialisation is achieved in less than 10 days. When wound healing is delayed, the risk of hypertrophic scarring escalates.¹ It is important that the clinician recognizes the signs of delayed healing and implement appropriate strategies that encourage epithelialisation. In addition to the cosmetic and functional improvements, faster healing reduces patient discomfort and may reduce health service costs.

In the current case, we encountered with an electrical burn ulcer that showed no sign of healing despite conventional burn ulcer care. The margins of the ulcer were very hyperkeratotic and it was



Figure 1. The burn ulcer immediately before fibroblast application.



Figure 2. The ulcer 7 days after fibroblast application showing complete filling of the ulcer with granulation tissue.

classified as deep, partial-thickness burn. We planned to remove the hyperkeratotic tissue using topical 50% TCA application and to facilitate burn ulcer healing using autologous fibroblasts.

Fibroblasts are mesenchymal cells that can be readily cultured in the laboratory and play a significant role in epithelial-mesenchymal interactions, secreting various growth factors and cytokines that have a direct effect on epidermal proliferation, differentiation and formation of extracellular matrix. They have been incorporated into various tissue-engineered products such as Dermagraft (Advanced BioHealing, La Jolla, CA, U.S.A.) and Apligraf (Novartis, Basel, Switzerland) and used for a variety of clinical applications, including the treatment of burns, chronic



Figure 3. Complete healing of the ulcer 3 weeks after fibroblast application.

venous ulcers and several other clinical applications in dermatology and plastic surgery.²

Both allogeneic or autologous fibroblasts may be used in tissue engineering. In contrast to allogeneic cells, autologous fibroblasts carry no risk of rejection or risk of cross-infection. In addition, for permanent engraftment, autologous fibroblasts are necessary. However, there is often a delay in culturing autologous cells in order to obtain sufficient cell numbers.^{3,4} Allogeneic fibroblasts have been used as a biological dressing or for preconditioning of the wound bed prior to application of a permanent graft, especially when wounds are very large. Using autologous fibroblasts in dermal substitutes, on the other hand, has led to better restoration of dermal skin and minimal scar formation compared with allogeneic dermal substitutes.⁵⁻⁶

In the current case report, we did not perform biopsy to confirm fibroblast attachment. Fibroblast suspension application, however, appeared to significantly enhance wound healing. In fact, despite routine burn care including moist dressing and debridement, no sign of improvement was evident before application of fibroblast suspension (day 41). However, 7 days after fibroblast suspension, the ulcer was completely filled with granulation tissue and 3 weeks after application the ulcer was completely healed. This enhanced healing may contribute to an improved outcome for the patients in terms of reduced complications such as infection, but may also reduce hospitals costs arising with increased length of stay and increased treatment requirements both in the hospital and during the ongoing scar management process. However, the risk of hypertrophic scar development seems to be an issue that must be studied in the other studies.

To our best knowledge, it is the first experience of using autologous fibroblasts for treatment of electrical burn injury. In addition, in this case we used topical 50% TCA solution as a non-invasive method to destroy the surrounding hyperkeratotic tissue that usually delays wound healing.

Disclosures

This manuscript has been read and approved by all authors. This paper is unique and is not under consideration by any other publication and has not been published elsewhere. The authors report no conflicts of interest.



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