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Case Report and Review of the Literature: Human Amniotic Membrane in the Management of Burn Wounds

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Abstract

High-voltage electrical burns often have a deeper extent and cause more damage to surrounding soft tissue than injuries caused by fire burns or scalds. For the treatment of burn injuries there are dressings, dermal analogues, temporary skin substitutes; which favor the re-epithelialization of the wound bed, accelerating the healing process and some of them having specific properties.

We present a case of a 41-year-old man who suffered high-voltage electrical burns on the face, neck, thorax, abdomen, upper limbs, and lower limbs. He underwent surgical cleaning at the day of his hospital admission, 7 days later a second surgical cleaning was performed with placement of human amniotic membrane in thoracic and abdominal burns. 10 months after the burn, the patient presents complete recovery of his burn injuries, hyperchromic scars with no evidence of pathological healing. As neurological sequelae, he presented polyneuropathy secondary to electrocution.

We conclude that the amniotic membrane is an excellent substitute for temporary skin, useful for promoting the epithelialization of bloody areas from burns and reducing the local inflammatory response.

Conclusion: The comparison between robotic-assisted liver surgery and laparoscopic surgery shows that the average medical cost was higher in robotic surgery when compared to laparoscopic liver cancer.

Keywords: Electrical burn; Amniotic membrane; Reepithelization.

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Introduction

Burns can be classified according to the depth of the damage caused to the skin and underlying tissues.

Second degree burns heal by re-epithelialization, at the edges of the wound the basal cells begin to migrate towards the viable wound bed, they are stimulated by the loss of cell contact inhibition, by the release of local growth factors (factor growth factor, transforming growth factor alpha), and contact with proteins from the wound bed, among others. However, the migration limit from the edges of the wound is 1-2 cm. When the cutaneous appendages remain viable, keratinocytes can migrate from them to the wound, likewise keratinocytes migrate more quickly in a bed that is maintained with adequate moisture [1].

Another way to classify burns is according to their etiology: heat, electrical, and chemical. Electrical burns are rare, corresponding to less than 5% of all burns, they represent the most frequent cause of amputation in burn patient management units. They are classified as high voltage (>1,000 V) or low voltage (<1,000 V) injuries. Those with high voltage present more extensive damage, injuring deeper soft tissues, therefore they will require a greater number of surgical interventions [2]. An electric arc can reach temperatures of up to 2,000°C, causing thermal and electrical burns that can vary in depth and cause damage to internal organs [3]. The resistance of the tissues in ascending order is: nerves, blood vessels, muscle, skin, tendons, fat, bone. There are three mechanisms that cause electrical burns: a true electrical injury caused by the flow of current against the resistance of the involved tissues causing damage due to excessive heating of these, a direct thermal burn due to the heat of the arc that occurs when the high voltage current passes through the air, and lastly the thermal burn produced by the igniting clothing of the patient or ignited surroundings [4].

For the treatment of burn injuries there are dressings, dermal analogues, temporary skin substitutes; which favor the re-epithelialization of the wound bed, accelerating the healing process and some of them having specific properties.

The human amniotic membrane is a temporary skin substitute that has low antigenicity, high antimicrobial potential, has anti-inflammatory properties that reduce fibrosis, likewise isolates the injured bed from the external environment, reduces heat and fluid loss, and favors the epithelialization of lesions from previously excised 2nd and 3rd degree burn wounds. It is obtained from the delivery rooms and later undergoes a process of radio sterilization and cryopreservation in the tissue bank [5].

The fetal human amniotic membrane is composed of 2 parts: The chorion and the amnion. The chorion, which is the external layer providing a sac-like appearance, composed of trophoblastic and mesenchymal tissue and the amniotic membrane corresponding to the internal layer. The amnion is composed of 5 layers: epithelium, basement membrane and stromal matrix, the latter is divided into a compact, fibroblastic and spongy layer [6,7].

The epithelium performs 3 main functions: covering, secretory activity, intense intercellular and transcellular transport. It produces growth factors such as beta transforming growth factor, hepatocyte growth factor, platelet-derived growth factor, epidermal growth factor, keratinocyte growth factor, among others.

The basement membrane facilitates epithelial cell migration, promotes epithelial differentiation, prevents epithelial apoptosis and injury site expansion, and decreases pain [8].

The stromal matrix is avascular, producing growth factors such as epidermal growth factor, hepatocyte growth factor, and keratinocyte growth factor. Suppresses inflammatory cells by rapid stimulation of apoptosis, contains various forms of protease inhibitors; reducing granulation tissue and excessive angiogenesis, thus decreasing the formation of fibrosis, which would manifest as hypertrophic pathological scarring in the burned patient.

The amnionic membrane does not integrate with the lesion bed and does not vascularize, but it favors angiogenesis and induces the formation of granulation tissue (both in a controlled manner) and epithelialization due to the presence of multiple growth factors: Epidermal Growth Factor (EGF), Transforming Factor Alpha (TGF-α), Transforming Factor Beta 1 (TGF-β1), Keratinocyte Epidermal Growth Factor Receptor (KGFR), Hepatocyte Epidermal Growth Factor Receptor (HGFR) [9].

It has a very low risk of rejection, due to its low antigenicity and lack of HLA-A, HLA-B, HLA-C and HLA-DR. It decreases the local inflammatory response at its site of application by inducing inflammatory cell apoptosis, and the phenotypic change of macrophages from a pro-inflammatory M1 type to an anti-inflammatory/regulatory M2 phenotype.

It also has the property of acting as an insulator, since it protects and preserves a clean excised wound, it has also been observed to decrease local pain [10].

Case presentation

A 41-year-old male patient who suffered a high-voltage electrical burn. His condition began when he was working, the truck in which he was traveling was trapped between high-voltage cables, when maneuvering to try to free the vehicle, he presented an electric shock from the high-voltage cable and was ejected from the vehicle at a distance of approximately 3 meters. He is assisted by paramedical personnel and transferred by ambulance helicopter to ISSEMyM Toluca Medical Center, our center being the 3rd level reference hospital in the State of México.

During his admission to the shock area of the emergency department, he presented mixed superficial and deep 2nd degree burns, 3rd degree of 19% of the total body surface burned: face 1%, neck 1%, thorax and anterior abdomen 9%, right upper limb 1%, left upper limb 1%, abdomen 2%, right lower limb 0.5%, circumferential left lower limb 3.5%. Burned vibrissae, peri-oral and palate burns were observed, these being signs indicative of airway burn, for which orotracheal intubation was decided (Figure 1).

He underwent 15 days of hospital stay in charge of the Reconstructive Surgery service, requiring 9 days of management in the of which 6 days he underwent invasive mechanical ventilation. On the day of his admission, wound washing was performed in the intensive care unit bed because the patient was hemodynamically unstable. 1 day after his admission, a forearm and right hand fasciotomy was performed, 2 days later fasciotomy closure was performed; 7 days after his admission, surgical cleaning and amnion placement were performed on burns in the thorax and anterior abdomen, without being removed (Figure 2); with clinical improvement: without presenting data of local or systemic infection, notable decrease in pain and adequate adherence to the affected area and presence of underlying granulation tissue.

Currently, 10 months after the electrical burn, the patient presents complete recovery from the burns, hyperchromic scars, no skin retraction, no raised edges, and no hypertrophic scarring (Figure 3). Presents neurological sequelae consisting of polyneuropathy secondary to electrocution, which are managed by the neurology service. It is also found in rehabilitation therapies to improve the gait pattern, increase strength, and improve ranges of motion in the upper and lower extremities.

Figure 1: Initial image after electrical burn and admission to the UTI.

Discussion

Regarding our clinical case presented, the human amniotic membrane is used as a temporary skin substitute in the treatment of patients with extensive burn injuries in general. To mention some of the main advantages of amniotic membrane in the management of burns: it shortens the patient's recovery time, it prevents fluid and electrolyte disturbances, it decreases the intensity of pain, it is almost completely transparent, which allows us to observe the underlying wounds, it is very flexible and adapts to the irregularities of the body surface (including joints), it is not necessary to remove it [11,12]. It can also be used in a complementary way on a meshed skin autograft, to favor the healing of the burned bed and improve the quality of healing [13].

It is easily accessible, the cost is minor, currently due to its bactericidal qualities and tissue bank protocols, the prevalence of infections has decreased.

Figure 2: Placement of human amniotic membrane in our patient.

Figure 3: Final result 10 months after the electrical burn.

Likewise, the results observed in the healing characteristics have been favorable with respect to the almost null presence of pathological scars, this is mainly due to the fact that the TGF-β1 released by the amniotic membrane inhibits the differentiation of myofibroblasts into fibroblasts [14]. As we can see in our patient, who despite having presented second and third degree burns, did not present hypertrophic scarring, the final result of the healing is adequate, he only presented a slight hyperpigmentation of the scars, being a favorable cosmetic result.

Conclusion

The human amniotic membrane is a very useful skin substitute with great advantages in the management of patients with burns, reducing their hospital stay by shortening the re-epithelialization time of burned areas and preventing bed infection, reducing patient pain. Since it does not have to be removed, the need to use skin grafts decreases, thus reducing morbidity since skin donor areas will not be required.

Likewise, the results observed in the healing characteristics have been favorable with respect to the almost null presence of pathological scars, with hypertrophic scarring secondary to second and third degree burns being frequent.

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