Electrical burn: case report, multidisciplinary treatment and effectiveness of treatment with recombinant epidermal growth factor.

Espitaleta Omaira¹, Montoya Mario², Barranco Luis³

¹Department of Plastic and Reconstructive Surgery, Clinica Cartagena del Mar S.A.S, school of medicine, Universidad del Sinú, Cartagena campus, Cartagena, Bolívar, Colombia.
²Department of Internal Medicine, Clinica Cartagena del Mar S.A.S, school of medicine, Universidad del Sinú, Cartagena campus, Cartagena, Bolívar, Colombia.
³Postgraduate student, Universidad del Sinú, Cartagena campus, Cartagena, Bolívar, Colombia.

Abstract

Burns caused by electricity are potentially catastrophic injuries. They can compromise large areas or even the entire body and cause high morbidity and mortality. They often occur in work places, on adults and have a wide clinical spectrum, ranging from an unpleasant sensation produced by brief, low intensity exposure to sudden death due to cardiac arrest secondary to electrocution. Furthermore, the number of post-burn complications that can compromise the patient’s life is also very wide, including metabolic disorders, water-electrolyte imbalances and super infections as the main causes, without minimizing the aesthetic impact and disability they generate on the patient. We report the case of a 47 years old male who was admitted to the emergency room after suffering a high voltage electrical burn during work. It was a second degree, type AB burn according to the Benaim classification, with a 60% extension. It was treated concurrently by internal medicine and plastic surgery services with initial management by critical medicine. He developed metabolic complications due to a super infection with Pseudomonas aeruginosa, and received supportive and antibiotic therapy in addition to treatment by plastic surgery with a tangential escharotomy, surgical scrub and debridement, thoracic fasciotomy and recombinant human epidermal growth factor administration to improve epithelialization with good results from a functional and aesthetic point of view. It is vital to highlight the effectiveness of the stated therapeutic interventions given the high mortality rate that similar cases present in global literature.

Keywords: Electrical Injury; Burn Wounds; Epidermal Growth Factor; P. aeruginosa; Electricity.

Introduction

Electrical burns cause a biochemical imbalance due to protein denaturation and hemodynamic alterations because of an increase in vascular permeability. The degree of the injury depends on the intensity and duration of exposure to the causing agent and may vary from a relatively minor and superficial injury to a serious and extensive loss of skin and all its structures [1].

Whilst we can classify burns in accordance to their depth, we must classify electrical burns as those caused by high voltage, when the current is greater than 1000 volts, and those caused by low voltages, less than 1000 volts.

Victims of electrical burns represent approximately 5% of admissions into the main burn centers. Traumas caused by high voltage currents (> 1,000 V) are generally associated with work accidents, in which the worker comes in direct contact with the source of energy or indirect contact through conductive materials or equipment and can lead to temporary dysrhythmia in survivors, be associated to severe blunt trauma and cause deep tissue destruction [2].

*Address for Correspondence: Dr. Luis Barranco and Dr. Omaira Espitaleta, address of investigation, Clinica Cartagena del Mar 4thFloor, Pie de La Popa, Calle 30 # 20 - 17, Cartagena, Bolivar, Colombia. Telephone Number: (57) (5) 672426, Colombia. E-mail: luisbarrancomd@gmail.com.

Received: November 09, 2018; Date Accepted: December 20, 2018; Date Published: December 21, 2018.
Growth factors such as the epithelial growth factor, are low molecular weight polypeptides that stimulate cellular multiplication acting on the effector cell’s DNA. They act on a specific membrane receptor under very special conditions, at a pH and temperature close to physiological levels. They also attract white blood cells, endothelial cells, fibroblasts and keratinocytes. Different functions have been demonstrated on burned skin, such as regulating cell migration, angiogenesis, stimulating the secretion of collagen and extra cellular proteins through the fibroblast and keratin through the keratinocytes. Production of growth factors begins in the platelets in the first minute after the burn and ends when the injury has healed completely. However, these growth factors may not be active if proteases produced by neutrophils and bacteria have occupied the membrane receptor of the effector cell(10, 11).

We present the case of a male with extensive electrical burns in a work environment. We highlight how the multidisciplinary treatment and the strategy adopted by the attending services positively impacted the patient’s evolution with excellent results demonstrated by the reduction of hospital stay and from metabolic, aesthetic and functional perspectives, as well as survival despite current literature data in which the poor prognosis of patients with similar injuries is revealed.

Clinical Case

A forty-seven years old male presented to the emergency room after becoming in direct contact with a high voltage cable while doing some masonry job. He received a high voltage electric shock (13,200Volts), with an approximate exposure of 1 to 2 seconds as described by witnesses, after that his state of consciousness partially deteriorated along with a reduction of his acquaintance with his surroundings and drowsiness without spasticity relaxation or unconsciousness. Witnesses took him to the institution where he was initially assessed by the emergency service and critical medicine. The patient was diagnosed with a second degree burn with an approximate 30% extension, of which three fourths corresponded to type AB in Benaim classification (face, neck, anterior and posterior thorax with greatest impact on the back-lumbar area, upper right limb, including shoulder and arm pit joint, right gluteal region, right trochanteric region and proximal third of right thigh) with a wound of approximately 5x6 centimeters in the right trochanteric area that compromised the skin, subcutaneous cellular tissue, muscle fascia, gluteus maximus muscle and round ligament (Fig.1). The patient was immediately transferred to the intensive care unit to begin reanimation with intravenous fluids based on the Parkland formula (Ringer’s Lactate Solution:4 ml X Patient weight in Kg X % of Burned Body Surface) and an early application of exposed curing with silver sulfadiazine. He was assessed by a plastic surgeon who began surgical scrubs 24 hours after the patient was admitted and covered him with tritticum electrolyte, coagulation, kidney and liver function test, and electrocardiographic parameters. Hematuria and proteinuria were evident in a urine analysis, which progressively decreased with the established hydration treatment (12, 13).

Once the patient was hemodynamically stable, the plastic surgery service came into play by carrying out an early tangential escharotomy, surgical scrub band debridement, that the patient tolerated well (Fig. 2).

During his stay, the patient was subject to various interventions consisting of an escharotomy with fasciotomy, avulsive escharotomy greater than 20%, scrub band irrigation of general and specific areas, in addition to neurovascular island flaps to the wound described on the right hip with a Penrose drain (Fig.3). That wound behaved as a trochanteric eschar with posterior colonization by gram-negative bacteria. As of the eighth day of hospital stay, the patient developed predominantly nocturnal spiking fevers associated with leukocytosis with neutrophilia and hypokalemia. Intravenous potassium replacement was started and nutritional support was requested. By day 10, a burn and drain secretion culture confirmed Pseudomonas aeruginosa colonization(Fig.4) and antibiotic therapy was changed for piperacillin / tazobactam and clindamycin for 14 days with improvement in the clinical picture. On day 34, new signs of a systemic inflammatory response were evidenced by fever, tachycardia, leukocytosis, acute phase reactant elevation (C-reactive Protein:192 mg/ dl) and a new secretion culture grew Pseudomonas aeruginosa, for which a new antibiotic cycle with Aztreonam was administered with a good response.

Due to the initial scarring process with inelastic fibrous tissue in burned areas, the patient developed a compartmental thoracic syndrome, requiring a thoracic fasciotomy and fasciectomy. The areas

![Figure 1: Electrical second degree burn compromising 60% of total body surface: anterior and posterior thorax, upper left extremity, left side of neck (type AB in Benaim classification) And proximal third or external face of right thigh (type B).](image1)

![Figure 2: First surgical intervention. Trochanteric eschar can be observed, corresponding to the electrical discharge exit point (subsequently colonized by P. aeruginosa).](image2)
that donated grafts were the lower extremities, which epithelialized without complications in the week after the procedure.

The patient underwent a total of twelve surgical interventions. Due to the large extension of the burns, and reduced availability of donating areas, an intraleisonal and intradermic administration of human recombinant epithelial growth factor was begun (a total of 4 vials at a dose of 0.2 cc every 4 centimeters) to decrease the hospital stay and stimulate the immediate fixation of the grafts and flaps, which was delayed by the repeatedly described infectious processes. However, a significant improvement was evident in the formation of granulation tissue and reepithelization of affected areas. The grafts attached quickly, being able to reduce complications due to scar contractures (Fig.5). The patient developed satisfactorily, without fever episodes or alterations to other organs or systems, with a small decrease in the functionality of the mobility of the lower and upper right extremity. He was finally discharged with outpatient treatment and monitoring.

Discussion

The injuries that electrical burns cause are from the inside out, and for that reason severe skin injuries are generally not evident. In this case, there was direct contact with the source of electricity, the injured skin became a solution of continuity and an exudate could be observed. A significant amount of liquid and proteins that are essential for preserving blood volume and, therefore, for maintaining peripheral vascular resistance within normal parameters, were lost through that exudate in addition of being an ideal front door for opportunistic infections (14).

Prophylactic antibiotics reduce all causes of mortality of intensive care unit patients and patients with burns; when administered in the first two weeks, they reduce mortality by close to half. Unfortunately, the available information is insufficient and these measures cannot be generalized. Perioperative prophylaxis reduces infections in the burned areas, but not mortality, and topical antibiotics applied on the injuries reduce infection rates and bacterial colonization in some age groups. However, it is important to know the microbiological profile in different intensive care units, as well as the resistance profile of the germs that are most frequently implied in wound superinfections, since it varies significantly in different units and hospital environments (15).

Burn patients require a comprehensive wound care treatment. The main objective is obtaining adequate scarrring and epithelialization to avoid functional and aesthetic consequences. It is necessary to prevent infection and control inflammation. Infections prolong the inflammation phase and tissue hypoxia; therefore, using antimicrobial agent would improve the quality of scarring and reduce the total scarring time.

The observation that the viscera were not compromised by the high voltage, could be attributed to the limited contact time and could have played an important role in our patient’s prognosis, is interesting.

The use of epidermal growth factor or recombinant human epithelial growth factor stimulates the proliferation of various cel groups, and local application in complicated wounds has increased recently. However, experience with burns is scarce. The available scientific evidence added to the quick reepithelization and favorable evolution observed in our patient suggests that the administration of...
human recombinant epithelial growth factor could be a valuable therapeutic strategy that might improve the final aesthetic and functional outcomes in electrical burn victims (Fig. 6) (16).

References

1. Ricardo Ferrada - Juan Pablo Trochez - Javier Ayala i. Manejo del paciente quemado, TRAUMA, abordaje inicial en los servicios de urgencias, Salamanca P; 2013:290-302, Elsevier. [Crossref]


5. Ogilvie MP, Panthaki ZJ. Electrical burns of the upper extremity in the pediatric population. J Craniofac Surg. 2008; 19: 1040-1046. [Crossref]


7. Wasiak J, Cleland H, Campbell F and Spinks A. Dressings for superficial and partial thickness burns.Cochrane Database of Systematic Reviews 2013, Issue 3. Art. No.: CD002106. [Crossref]

8. Arthur P Sanford and David N Herndon. Current therapy of burns Shriners Burn Hospital, Galveston, Texas, USA, 2013. [Crossref]


