A patient with extensive neck defects
Management of this unusual clinical situation

Ann. Ital. Chir., 2018 89, 4: 337-341
pii: S0003469X18028622

I.V. Reshetov*, K.A. Petrosyan*/**, P.A. Antonyan**, L.S. Khachatryan**

**Professor, Academician of the Russian Academy of Sciences. The Department of Plastic Reconstructive Surgery of the First Moscow State Medical University*
***The Department of Plastic Surgery YSMU after M. Heraci after I.M. Sechenov*

A patient with extensive neck defects. Management of this unusual clinical situation

Among all thermal burn injuries, electrical burns are the most unpredictable and are characterized by the damage of depressing and functionally important anatomical structures, as well as an extensive volume of tissue damage. The tactics of treating such post-burn defects require always an individual and non-standard approach. In this article, a clinical example of the plastic closure of a neck defect is presented, as a result of a high-voltage electric burn received, with counter skin-muscular flaps based on m. platysma. Considering the major role of the lymphatic system in microcirculation, in the pathogenesis of inflammatory processes and the immune response of the body, during the planning of the operation anatomical features of the lymphatic vessels of the anterior surface of the neck were studied. The result of the operation was a primary, full-fledged closure of the defect with two opposing cutaneous muscle flaps with unilateral lymph node preservation as well as a full functional restoration of the neck motion.

KEY WORDS: Electrical burns, Flaps lymph flow, Lymphatic system, Lymph nodes, Neck defect, Nonstandard clinical situations, Reconstruction

Introduction

The damaging effect of electric current on a person is manifested in biological, electrochemical, thermal and mechanical effects. Electrical trauma is relatively rare and amounts to 2.5% to 8% of all thermal damage, according to various authors. In developed countries, the frequency of electric shock injuries is 2-3 cases per 100.000 population, but among the total percentage of thermal burn injuries they are the most formidable and unpredictable. A rare outcome of an electric injury is the disability of the victims, in some cases with a fatal outcome, whose frequency is 10%. From electric trauma most often suffer people of young and working age, men die almost 4 times more often than women [1,2]. Two types of electric burns are distinguished by current strength: the first group is burns received by current up to 1000 volts - low-voltage and high-voltage - more than 1000 volts. Especially dangerous are high-voltage lesions, which are characterized by a deep level of damage to tissue structures and in parallel with emerging systemic abnormalities (cardiovascular system, central nervous system, etc.) [3,4]. It is known that the electric energy passing through the tissues of the organism meets on its way the resistance and passes, according to Joule's law, into the thermal, forming burn surfaces of different localization and depth at the points of entry and exit of the current. Electrochemical changes caused by current cause aggregation of platelets and leukocytes, movement

Pervenuto in Redazione Marzo 2018. Accwettato per la pubblicazione Maggio 2018
Correspondence to: K.A. Petrosyan, Department of Plastic Reconstruction Surgery of the First Moscow State Medical University, Moscow, Russia (e-mail: info@vak24.ru)

inside and extracellular ions, protein polarization, formation of gas and vapor, giving the tissues a cellular appearance, coagulating and destroying them [1,5]. The biological effect is manifested by violations of the conduction of the heart, the work of the nervous system, the reduction of skeletal muscles, etc.

As is known, the lymphatic system plays an important role in the microcirculation and pathogenesis of inflammatory processes, the immune response of the body, and the lymphatic vessels - tiny transparent channels concentrated near the surface parts of the skin, collect and transport the interstitial fluid containing various toxins and microorganisms into the lymphatic nodes (LN), where an immune response is initiated to control foreign agents [6,7]. Damage to the lymphatic system can lead to disruption of the hemostasis, immune response and microcirculation, in certain cases, to the appearance of lymphadema, which is a progressive condition and can be both congenital and due to damage to LV with iatrogenic interventions (radiation therapy, biopsy of signal nodes, surgical damage) [8]. With lymphedema there is a buildup of fluid in the interstitial tissue with a high protein content, cellular proliferation and inflammation, which leads to thickening and fibrosis of lymphatic vessels and surrounding tissues [9] ansplantation of lymphatic tissue, and this is probably due to the immune effect of transplanted lymph nodes. There are reports of a decrease of incidence of infections episodes in soft tissue after autotransplantation.

French lymphologist Corinne Becker (2002) believes that the lymphatic tissue in the transplanted fat flap can be involved in the mechanism of combating local infection, and also play a role in the reduction of edema due to changes in the composition of proteins in the edematous fluid [10]. In this article, we want to share our experience of closing the post-burn combined neck defect with two opposing flaps of the superficial muscle and the fascia of the neck, which took into account the features of the anatomy of the lymphatic system for further improvement in lymph drainage. Preservation of the lymphatic nodule in the complex provides certain advantages, providing adequate blood supply and lymph drainage [11,12]. Unlike the musculocutaneous flaps of the large pectoral muscle, these flaps are less bulky, mobile, and the color identical with the skin of the neck and the ability to prevent a larger secondary defect of the donor zone makes this flap the optimal choice for reconstructing neck and face defects [13].

Given the main and secondary sources of blood supply to the m.platysma, the flap can be formed on the upper, lower or posterior legs of the feed [14].

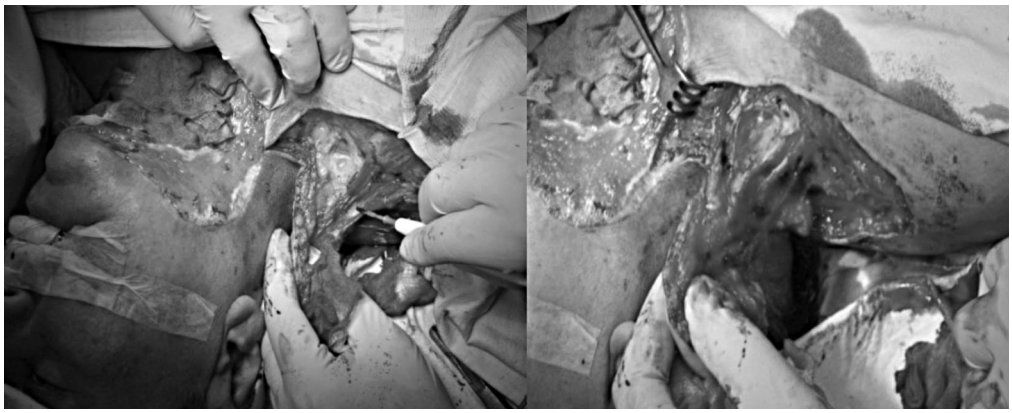
The flap on the basis of the upper leg is supplied from the facial and submental arteries, the flaps on the hind legs receive their blood supply, mainly from the occipital and posterior ear arteries, the flaps on the lower legs are fed from the transverse cervical arteries. There are data on the successful collection of flaps on the back and upper legs of food. [15]

Clinical observation

The patient S. 68 years old, entered the clinic in the planned order 3 weeks after the severe electrical burn injury suffered by the voltaic arc of high voltage. A combined high-voltage electric trauma (2000 volts), an electric burn on the front surface of the neck IIIb0, right foot IV 0, the left one - II 0. The entrance gates of the electrocurrent were lower extremities, the exit site was the anterior surface of the neck (Figs. 1, 2, 3).

Before admission to the clinic, the patient received conservative and surgical treatment (anti-shock and anti-burn measures, stage necrosectomy) in another medical institution. When entering the front surface of the neck,

Figs. 1, 2, 3: Patient C. 68 years old, the condition after the transferred electric injury after 3 weeks (2000 V). (1)he location of the output of electric current. (2) defect of the integumentary tissues of the neck after the performed necrectomy. (3) the location of the electric current input.



Figs. 4, 5,: Cutting out 2 sheets of musculocutaneous flap on the basis of m.platysma.

Figs. 6, 7: Movement and rotation of the opposing musculoskeletal flapsat 160-170 ° with full closure of the defect without tensio.

Figs. 8, 9: Appearance of the patient after 3 and 12 months (from the left to the right, respectively).

an extensive defect of 35.0×25.0 cm, capturing the skin, subcutaneous fat, m.platysma, cervical fascia and medial portions of m. sternocleidomastoideus, m. omohyoideus, m. sternohyoideus, the bottom of the wound was represented by exposed thyroid and cricoid cartilage. In order to close the defect, it was decided to use the opposite musculocutaneous flaps (m. Platysma) from two supraclavicular areas, on the lower feeding legs. In the pre-operative period, the drag was visualized using the usual ultrasound method to identify and mark regional LV in order to involve the latter in planned flaps [16]. In the postoperative period, examination of the lymphatic system of the supraclavicular area was carried out with the help of lymphoscintigraphy, which is by far the most widely used and low-invasive method of visualization of the lymphatic system. The principle of the method consists in the introduction of radioactive indicators, the absorption of which occurs by the surface lymphatic network, with further accumulation in the lymph nodes, to which the lymph current flows from the site of the injection and detected by the external radiation detectors [17]. The contrast is displayed on a flat methacrylate screen,impregnated with 99mTc-sodium pertechnetate (Russia), located behind the patient. In the course of the operation, the design of the flaps made it possible to draw one node from the left side, to the right - 2 knots. After scraping and mobilization (Figs. 4, 5) of skin muscular flaps on segmental feeding legs, they are moved

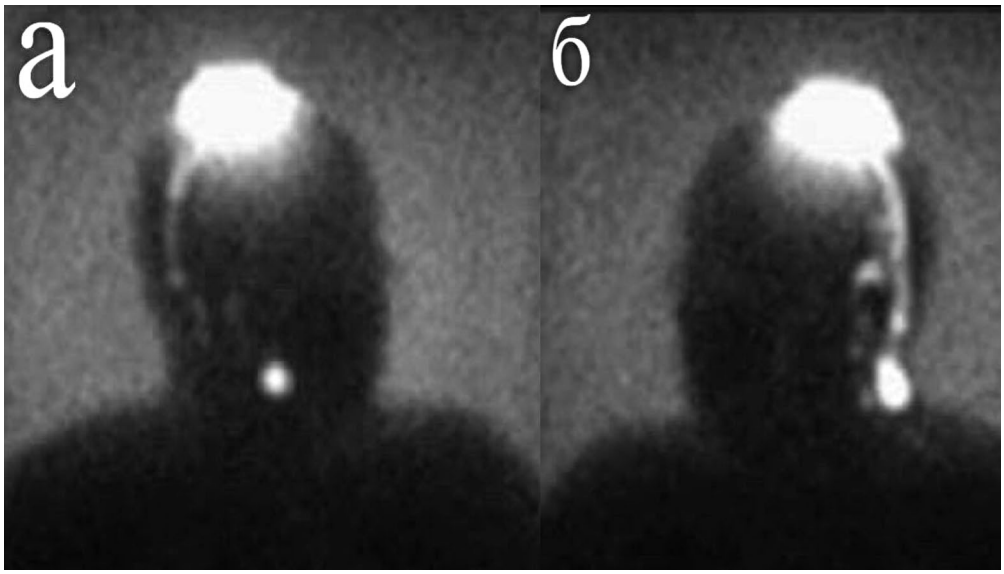


Fig. 10: (A) on the right - the outflow and accumulation of the marker in the area of the transplanted graft; (B) on the left - there is no accumulation of a marker in the region of the flap.

and rotated by 170 °, with complete closure of the defect without tension (Figs. 6, 7).
Simultaneously, the right foot was amputated at the level of the lower third of the skin. The nearest operational period proceeded smoothly, cutaneous sutures were removed on the 10th -12th day after the operation, the flaps became accustomed to 100%. The long-term result at 3 and 12 months after the operation was completely restored, a full-fledged, multicomponent cover in the area of the defect (Figs. 8, 9).

Results

A year after the operation, with the patient's consent, the lymphatic system of the head and neck was examined by lymphoscintigraphy.In the parietal region, two injections of 0.2 ml were subcutaneously, preliminary, along the midline. marker 99m-technetium (99Tc) (Tehnefit, OOO Diamed, Russia) with the total activity of the injected drug at 74 MBq. 120 minutes after the injection, the patient was placed in a gamma camera (E-Cam, Siemens Healthcare), where the outflow of lymph from the injection site was recorded and its further accumulation in the regional lymph nodes of the neck on the right side (Fig. 10A), to the left - the lymph current to the cervical region was absent and glow was observed only in the occipital lymph nodes (Fig. 10B).

Discussion

The obtained data of lymphoscintigraphy can indirectly indicate the probability of survival of transplanted grafts and were used in subsequent scientific research. With the purpose of preserving the lymph nodes and further restoration of the lymphatic drain, local skin muscular flaps allow preserving the structures of the lymphatic system and are most suitable for closing the defects of the anterior surface of the neck, since the dermal lymph nodes are located deeper than the superficial fascia, and their main ducts above it [18]. With dissection in more surface layers, not only local lymphatic ducts and nodes may be damaged, but regional nodes may also be outside the transplanted tissue block, thereby reducing the likelihood of earlier recovery of lymph outflow and engraftment of flaps.

Conclusion

Electrical injury leads to life-threatening consequences. In the case of rescuing the patient in the first day further delayed complications arise, which require the use of plastic surgery technologies to eliminate them. Particular difficulty is represented by defects in the tissues of the head and neck due to the peculiarities of anatomy and function. An interesting solution for the full reconstruction of the neck tissues is the use of their own tissues in the form of skin-fascial flaps with the inclusion of the lymphatic system - nodes and capillaries. The presented case indicates the expediency of studying the features of the lymphatic system before and after the operation, with a view to better understanding the lymphangiogenesis of the displaced tissues and their complexes in complex non-standard clinical situations, to predict and improve functional and aesthetic results in recovery operations.

Riassunto

Tra tutte le cause di ustione termica, quelle da elettricità sono tra le più imprevedibili e sono caratterizzate da importanti danni a carico di strutture anatomiche di importanza funzionale, oltre che di estesi danni tissutali.
Le tattiche da adottare per il trattamento di questi danni da ustione richiedono sempre un approccio individuale e non standardizzato.
Con questo articolo viene presentato un esempio clinico di chiusura plastica di un difetto cervicale dovuto ad una ustione elettrica ad alto voltaggio, utilizzando un flap muscolo-cutaneo con l'uso del platisma.
In considerazione del maggior ruolo svolto dai linfatici nel sistema della microcircolazione nella patogenesi dei processi infiammatori e della risposta immunitaria dell'organismo, nel pianificare l'intervento chirurgico sono state studiati le caratteristiche anatomiche del vasi linfatici del versante anteriore del collo.
Il risultato dell'intervento è stato un riempimento a tutto spessore del difetto con due flap muscolo-cutanei contrapposti, e conservazioni linfonodale unilaterale con pieno restauro della funziona motoria del collo,

References

1. Kochin OV: *Electrical injury. Emergency medicine*. Selected Clinical Lectures, 2012; 4:365-79.

2. Kuzin MI, Sologub VK, Yudenich VV: *Burns disease*. Meditsina, 1982, p. 158.

3. Mirmohammadi SJ, Mehrparvar AH, Kazemeini K, et al: *Epidemiologic characteristics of occupational burns in Yazd, Iran*. Int J Prev Med, 2013; 4 (6):723-27.

4. Kumar S, Ali W, Verma AK, et al: *Epidemiology and mortality of burns in the Lucknow Region, India-a 5 year study.* Burns 2013; 39 (8):1599-605.

5. Vyrenkov Yu.E, Moskalenko VI, Moskalenko VV, Shishlo VK, Kruglova JS: *The role of lymphatic system in the pathogenesis of inflammatory processes. Methods of lymphatic therapy*.

6. Sapin MR: *Lymphatic system and its role in immune processes*. Morphology, 2007;131(1):18-22.

7. Pan Hiroo Suami, Russell J Corlett, Mark W Ashton: *Lymphatic drainage of the nasal fossae and nasopharynx: preliminary anatomical and radiological study with clinical implications.* HEAD & NECK-DOI 10.1002 hed January 2009; 52-58.

8. Petrenko VM: *Lymphatic system: Definition. Advances in modern natural science.*2011;3:23-27.

9. Rockson SG: *The unique biology of lymphatic edema*. Lymphat Res Biol, 2009; 7:97-100.

10. Becker C, Julie V Vasile, Joshua L Levine, Bernardo N, Batista M, Rebecca M, Studinger RM, Chen CM, Riquet M: *Microlymphatic surgery for the treatment of iatrogenic lymphedema.* Clin Plastic Surg, 2012; 39:385-39.

11. Cheng MH, Huang JJ, Wu CW, et al.: *The mechanism of vascularized lymph nodeovenous drainage.* Plast Reconstr Surg, 2014; 133:192e-198e.

12. Kym E, Seo DK, Hur, GY Lee JW: *Epidemiology of electrical injury: differences between low- and high-voltage electrical injuries during a 7-year study period in South Korea*. D. Scandinavian Journal of Surgery, 2014; 124(26): 1-57.

13. Rahul K, Thakkur A. Shrey R: *Pandya posterosuperiorly based platysmal myocutaneous flap: the underutilized reconstructive option*. J Maxillofac Oral Surg, 2015; 14(2):476-48.

14. Koch WA: *The Platysma myocutaneous flap: Under used alternative for head and neck reconstruction.* Laryngoscope, 2002; 112:1204-208.

15. Lazaridis N, Dimitrakopoulos I, Zouloumis L: *The superiorly based platysma flap for oral dissection: a case series.* J Oral Maxillofac Surg, 2007, 65:895-900.

16. Puxeddu R, Dennis S, Ferreli C, Caldera S, Brennan PA: *Platysma myocutaneous flap for the reconstruction of skin lesions in the head and neck*. Br J Oral Maxillofac Surg, 2008; 46:383-86.

17. Tregnaghi A, De Candia A, Calderone M, et al.: *Ultrasonographic evaluation of the superficial lymph node metastases in melanoma.* European Journal of Radiology, 1997; 24:216-21.

18. Szuba A, Strauss W, Sirsikar SP, et al.: *Quantitative radionuclide lymphoscintigraphy predicts the outcome of manual lymphatic therapy in breast cancer-related lymphedema of the upper extremity*. Nuclear Medicine Communications, 2002; 23: 1171-175.