

Using bipedicle abdominal flap to save left forearm and arm following a high-voltage electrical burn

Ali Karbalaieikhani¹ MD, Hossein Saremi² MD

¹Department of Hand and Microsurgery, Emam Reza Hospital, AJA University of Medical Sciences, Tehran, Iran.

²Department of Hand and Microsurgery, Besat Hospital, Hamedan University of Medical Sciences, Hamedan, Iran.

ABSTRACT

Background: Electrical injury is daily compromise of our life, upper and lower extremities are common sites of injury.

Case Presentation: A 23 years old man who had suffered high voltage electrical injury referred to our center. He had severe left upper extremity burn and suffered from head and thoracic injuries due to falling down from high altitude.

Treatment: Fasciotomy of the left forearm was done. Muscle damage and myoglobinuria were managed. Early reconstruction was performed for prevention of tendons and nerve necrosis. Because of circumferential burning of the left forearm, bipedicle abdominal flap at the skin of left lower thorax and the abdomen was done. Skin necrosis of the flap at the lateral epicondyle area of the bipedicle abdominal flap occurred. Latissimus dorsi muscle pedicle flap was used for coverage of the lateral epicondyle area.

Learned Lessons: Local flap necrosis is an important complication of the bi-pedicle abdominal flap.

Keywords: High voltage electrical burn; bipedicle abdominal flap; latissimus dorsi muscle flap; fasciotomy; reconstructive surgery.

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BACKGROUND

Electrical injury is daily compromise our life and upper and lower extremities are common sites of injury. In electrical burn injury, cutaneous burn size does not correlate with the extent of damage despite thermal burn. High voltage current (>1000 Volts) damages deep muscle compartments and early exploration of deep muscles is mandatory to save these muscles. The reconstruction could be performed by flaps or graft after evaluation and early debridement.

CASE PRESENTATION

A 23 years old man referred to our institute due to high voltage electrical injury. He had severe left upper extremity injury and had suffered from head and thoracic injury due to falling down from height. Immediate physical examination and resuscitation was done. Then brain computerized tomography (CT) scan was performed

and head injury rolled out. Afterwards, the patient was admitted in burns intensive care unit (ICU).

Electrocardiography (ECG) was done and level of creatine phosphokinase in blood was checked twice daily. He had a mild elevation in creatine phosphokinase level that was managed by intravenous (IV) fluid therapy and increasing of urinary output. Examination of the left upper extremity showed that he had full thickness and fourth degree burns of the extremity at distal arm and proximal two third of the forearm. Fasciotomy of the volar and the dorsal compartments of the forearm were done for decompressing the volar and dorsal forearm muscles.

TREATMENT

After early evaluation and resuscitation, debridement of the burned area was done in the operation room. At that time an exposed nerve and elbow joint was

encountered (Figure 1). So bi-pedicle abdominal flap was done because conventional inguinal flap could not cover the wound. A subcutaneous tunnel was made in the left side of the abdomen and lower left of the chest wall enough to let the left hand and forearm pass from it. Next the hand and forearm were passed from the tunnel and the medial and lateral of the tunnel were sutured to the forearm and arm, respectively (Figure 2).

One week after the inset of flap skin, necrosis of the abdominal flap was seen at the lateral epicondyle of the left humerus. This led to exposure of the elbow joint and lateral epicondyle of the left humerus (Figure 3). The abdominal flap was detached in two stages in three weeks and four weeks' interval. First the lower pedicle was detached, and then the upper pedicle was detached after one week. Skin graft was done after pedicle detachment to the raw area of the forearm and arm (Figure 4).

Lateral epicondyle of humeral elbow joint had a problem



Figure 1. The left upper extremity after debridement and before flap coverage.



Figure 2. Insetting the abdominal bipedicle flap for coverage of the left arm and forearm.

and humeral bone had soft tissue defect. So latissimus musculocutaneous flap was used for the coverage of the lateral epicondyle and elbow joint exposed area (Figure 5). After mapping on left latissimus dorsi muscle, the patient was brought to the operation room. Subsequently, muscle was dissected and released from the peripheral tissue for saving the pedicle (Figure 5). Afterwards, a short skin bridge was cut between the muscle flap and recipient site. The muscle was inset into the donor area on the lateral epicondyle and elbow joint (Figure 6). The operation was completed with split thickness skin grafting on the latissimus dorsi muscle flap.

OUTCOME

Two weeks after latissimus dorsi flap transfer, the patient was discharged from the burns ward. He had intact radial, ulnar and median nerves. He started physical therapy for getting the range of motion for elbow and wrist. The patient was satisfied of his arm and forearm function.

After 6 months physical therapy, range of motion of the elbow was about 85 degrees and range of motion for



Figure 3. Necrosis in lateral epicondyle area of the abdominal flap.



Figure 4. Left upper extremity after detaching pedicles and skin grafting.



Figure 5. Repairing left lateral exposed condyle by latissimus dorsi muscle flap.

the wrist was acceptable. However, the patient cannot go back to his previous work as a construction worker. Other than that, he does not have any problems in his daily activities.

DISCUSSION

The spectrum of electrical injury is very broad, ranging from minimal injury to severe multiple organ involvement. Initial management of electrical burns is imperative to optimize function and minimize long-term complications. High voltage electrical burn injury is a devastating trauma that leads to the severe injuries to the upper and lower extremities as entering and exiting sites of electricity. Burning surface area at the high voltage electrical injury is low but deep structural injury to muscles and nerves is very high. The initial treatment is fluid therapy. Myoglobinuria, fasciotomy or escharotomy may be needed for management of compartment syndrome, as it was done for the presented patient of this report for decompressing left forearm deep muscles. The upper extremities are the most frequently involved contact sites in electrical burn injuries.^{1,2} Work-related accidents are the most common cause of this type of burns.¹

At our center this type of trauma is more common in construction workers (many of them are foreigners) who manage the round steel shaft. Contact of that shaft to the side electrical conducting wire during skeletal reconstruction of buildings leads to electrical injury. This type of trauma leads to an electrical injury and falling down from a high altitude with multiple organ injuries. The other groups who are in risk of this injury are electricity organization workers, thieves who cut urban electricity wires for money, and those who have unauthorized access to electrical grid energy. Early

management of cardiac arrhythmias has great impact in the life saving of electrical injured victims.³

Reconstructions in high voltage electrical injury victim require multiple surgical options such as distant flaps, musculocutaneous flaps, micro-vascular flaps, pedicle flaps and full and split thickness skin grafting. Early and correct impact on the full thickness electrical injury and use of fasciocutaneous and musculocutaneous pedicle flaps promptly has a great role in preventing the partially injured structures which are more vulnerable when exposed, such as nerve and tendons from progression to full thickness necrosis.^{4,5} Some late complications of high voltage electrical injury include cataract, epileptic seizure and muscle atrophy due nerve injury. Here, making patients aware that they can use their health insurance to cover their treatment costs and retirement in the future can be very important.⁶

Our patient was a 23 years old man who had high voltage electrical injury of the left upper extremity. He was admitted to the ICU and monitored for cardiac arrhythmias. After his stabilization, serial debridement of the proximal two third of forearm and distal arm were performed. Scheduled bi-pedicle abdominal flap was done. A tunnel was made in left of the abdomen and chest wall. Then hand and forearm were passed from this tunnel. Local area necrosis of the lateral epicondyle of humerus occurred. We waited three weeks and detached abdominal flap at two stages. First lower pedicle was separated after three weeks. Then after detaching the upper pedicle one week later, skin grafting was made for full coverage of the remained raw area.

The patient was scheduled for receiving pedicle latissimus dorsi flap for coverage of the lateral epicondyle. Afterwards, skin grafting of the muscle flap was done. The patient was discharged from the hospital with acceptable left upper extremity function. Our main goal was saving the patient's left upper extremity, with an acceptable function. We did our best to treat this patient by bipedicle abdominal flap, skin grafting and pedicle latissimus dorsi muscle flap and the patient is very satisfied.

LESSONS LEARNED

We learned that necrosis of the skin or local flap is one of the important complications of the bipedicle abdominal flap which should be considered. This necrosis may be because of high local pressure to the flap and a solution must be found for this problem in the future.

CONFLICT OF INTEREST

None Declared.

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Corresponding Author:

Hossein Saremi, MD

Address: Besat Hosptial, Mazdaghineh St., interjunction with Beheshti Blvd., Hamedan, Iran.

Postal Code: 6514845411

Tel: +98 813 8218541

Fax: +98 811 2561515

Cell Phone: +98 9185861512

E-mail: drsaremi.shoulder@yahoo.com

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