

Humeral Neck Fracture after Electrocution – Case Report and Literature Review

A. Zbucnea

Plastic Surgery Department, County Emergency Hospital of Ploiesti, Romania

Rezumat

Fractură de col humeral după electrocuție - prezentare de caz și analiza literaturii

Este prezentat un caz de fractură de col humeral după electrocuție, la un bărbat de 56 de ani, care a fost asociată cu arsuri de profunzime parțială ale mâinii stângi. O fractură după un șoc electric accidental reprezintă o situație foarte rară, datorată contracțiilor musculare. Chirurgii implicați în managementul pacienților electrocuțați trebuie să cunoască posibilitatea leziunilor musculoscheletice. Neglijarea acestor leziuni poate conduce la întârzierea diagnosticului și la complicații defavorabile.

Cuvinte cheie: injurie electrică, fractură de col humeral, contracții musculare

Abstract

A case of left humeral neck fracture following electrocution is reported in a 56-year old man, associated with partial-thickness burns on his left hand. A fracture after accidental electrical shock injury represents a very unusual situation, due to muscle contractions. Surgeons involved in the management of the electrocuted patients should be aware of the possibility

of musculoskeletal injuries. Neglecting these injuries can lead to delay in diagnosis and to detrimental complications.

Key words: electrical injury, humeral neck fracture, muscle contractions

Introduction

Electricity can damage human organism in several ways:

- the impairment of the physiologic conduction systems, such as cardiac contraction and diaphragm excursion, which may result in arrhythmia and apnea;
- the electroporation or the electroporabilization of the cell membranes, which can lead to the deterioration of transmembranar exchanges, intracellular ion and protein balance, and finally, to apoptosis;
- the thermal energy generated by the electrical current can determine dermal and internal lesions (burns, necrosis, perforations);
- the mechanical injury due to a fall or to the forceful muscle contraction (1, 2).

The factors that influence the degree of electrical injuries are: the voltage of the current, the duration of the contact, the tissue resistance, and the pathway of the electrical current through the organism (1). The fractures after electrical injuries are very rare, usually as a result of a fall after electrical shock (1, 3).

This work presents the case of a 56-year old male, who suffered left humeral neck fracture and partial thickness burns on his left hand, as a result of an electrical injury. A review of the literature have evidenced some cases of unilateral or

Corresponding author:

Andrei Zbucnea, MD, PhD
County Emergency Hospital of Ploiesti
100, Gageni Str.
E-mail: a_zbucnea@yahoo.com

bilateral scapular fractures, humeral neck fractures or femoral neck fractures following electrical injuries.

Case report

A 56-year old male was admitted to the Plastic Surgery Department of the County Emergency Hospital of Ploiesti in July 2014, following an electrical injury (low voltage), with partial thickness burns at the level of his left hand, approximately 0.5% body surface. The burned wounds were debrided and sterile dressings with antiseptic solutions were applied on the left hand. The EKG, the pulmonary radiologic assessment and the usual blood tests were in normal range. The patient also complained of pain and functional impairment at the level of his left shoulder and proximal arm, which presented swelling, oedema and tenderness. The patient was unable to completely and actively elevate his left arm. Two days later, the X-ray film put in evidence comminuted subcapital fracture of the left humerus (Fig. 1).

The orthopaedic surgeon recommended conservative treatment, by immobilization through thoraco-brachial bandage for 30 days. The burned wounds evolution was good and the patient was discharged the fourth day, with subsequent complete epithelisation in other two weeks.

A literature review was performed, taking into account this unusual association between the burn lesions and the fractures due to electrical shock. Medical data bases (such as Medline) and journals (such as *Annals of Burns and Fire Disasters*) were investigated and also search engines (Google) were used for this purpose.

Results and Discussions

Skeletal injuries following electrocution are uncommon. The usual cause of skeletal injury after electrocution is a fall due to the electrical shock. Also, fractures following electroconvulsive therapy (ECT) for psychiatric patients are a well-known complication described in literature, but skeletal injuries as a result of accidental electrical flow are very unusual (1, 3, 4). Thus, fractures or dislocations can result from tetanic muscular contractions (4). The most commonly affected level after electroconvulsive therapy (ECT) was a vertebra, in 40% of all fractures (5). ECT therapy represents the major cause of most bilateral femoral neck fractures (4) and the fractures of the lower limbs represent 28% of all fractures due to ECT, all of them being femoral neck fractures (5).

The performed review of literature has revealed several cases of fracture after accidental electrical injuries, only 22 cases identified in a review published in 2014 (1), at the following sites:

- vertebrae (1, 2);
- neck of femur (1, 3-6);
- shoulder: scapula and proximal humerus (1, 7-16);
- forearm: Colles, Galeazzi, greenstick and distal radius (1, 17-20).

Fractures after electrocution occur in places with significant and bulky muscular bodies, such as spine, hip and shoulder.



Figure 1. Comminuted subcapital fracture of the left humerus

These fractures occur due to musculoskeletal contractions. The threshold for tetanic contractions from direct current is approximately 50 V. Muscle contractions may result from contact with a direct current of at least 20 mA or with an alternating current of 10 mA (3).

In the reported patient, the electric current probably affected only the left side of his body, with unilateral proximal humeral fracture and partial-thickness burns on his left hand.

Delay in diagnostic of fractures after electrocution may be of days or even weeks after injury (1, 3), taking into account that there is no direct trauma to the musculoskeletal system, the fractures being caused by tetanic muscle contractions. The pain and swelling can be related to deep muscle contractions and to the damage to the soft tissues. Therefore, a detailed and complete physical examination of the musculoskeletal system should be practiced in these patients, especially when they complain of musculoskeletal damages. X-ray films are often unnecessary in awake and cooperative patients, with no significant pain and tenderness, full active range of motion of the joints, and good function. In the unconscious or uncooperative patient, x-ray films of the shoulders, spine, and pelvis are recommended, especially if such structures were in the pathway of the electric current (3).

In the presented case, there was a delay of two days to diagnose the left humeral fracture. The pain and the tenderness were initially attributed to the soft tissues lesions due to the electrical flow, but the lack of clinical improvement and the deficit of the left arm elevation led to a shoulder X-ray, which

established the diagnosis. Also, the particularity of this case consists in the unilateral association of proximal left humeral fracture with partial-thickness burns on his left hand. However, the association between burns and fractures following electrocution has been also reported in other cases (18).

In general, the delay in diagnosis of fractures after electrocution may be attributable to a delay in presentation of the patient, to the investigation and the treatment of apparently greater comorbidities (cardiac disturbance, dermal burns, myonecrosis leading to renal failure), and to the difficulty in obtaining a clear history and physical examination on a recently electrocuted patient (1). Especially for femoral neck fractures and in young patients, the delay in diagnosis determines common detrimental complications and unfavourable long-term outcomes: the progression of undisplaced fracture to a displaced fracture of femoral neck, the risk of non-union and osteonecrosis of femoral head with functional disability, pain and degenerative joint disease (3, 4).

Conclusions

This work has reported a very rare case of proximal humeral fracture after electrocution due to violent muscle contractions, associated with partial-thickness burns of the left hand. This case highlights that fractures and dislocations can occur following electric shocks, due to muscular contractions. Therefore, all practitioners involved in the management of the electrocuted patient need to be informed of this possibility: plastic surgeon, general surgeon, orthopaedic surgeon, emergency physician and general practitioner. To avoid a delay in diagnosis, the detailed and complete physical examination of the musculoskeletal system should be practiced in the electrocuted patients with suggestive symptoms and signs. The early recognition, the confirmation by X-ray examination and the prompt treatment ensure a favourable outcome and remove the harmful complications.

Conflict of interest statement

None.

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