Case Report

An Unusual Case of Pulmonary Injury Due to Electrical Burns

Anuj Kumar Soni, Deepali, Varinder Saini, Kranti Garg and Kashish Dutta

Department of Pulmonary Medicine. Government Medical College and Hospital, Chandigarh, India

Abstract

Exposure to electrical current can affect any organ in the body. The nature of the affected tissue; the damage depends on the type of current and the duration of exposure. Cardiac lesions are the most typical visceral lesions associated with electrical burns. Pulmonary involvement is an infrequent manifestation. We report here a case of electrical injury to the lung parenchyma, with chest wall damage in a labourer; who sustained a high voltage electrical shock while working on a construction site. Chest radiograph and contrast-enhanced computer tomography (CECT) of chest was suggestive of consolidation of bilateral lung fields with pneumomediastinum. All other possible causes of parenchymal abnormalities were ruled out. This case demonstrates that a high voltage electric current can cause isolated lung damage and timely management is the crux to salvage the life of the patient. **[Indian J Chest Dis Allied Sci 2021;63:41-43]**

Key words: Electric burn, Pneumonitis, Pneumomediastinum, Thorax, Chest.

Introduction

Electrical damage can be categorised based on the level of voltage; high voltage, level of more than 1000 volts; whereas low voltages less than 1000 volts.[1] Since there is no relationship between the skin burns and the visceral injury, it can become very complex for a clinician to clinically assess an electrical injury as a minor area of skin burn could mask an underlying severe visceral injury.[2] Visceral injuries are not manifest at the time of presentation, with the reported rates ranging from 0 to 1.7%.[3,4]

Due to their substantial morbidity and mortality, the investigation and treatment of visceral injuries, due to electrical burns, *albeit* uncommon, must be closely monitored. A high index of suspicion is very important to detect visceral injuries in electrical burn patients. However, it needs to be emphasised that the initial diagnosis and appropriate treatment are the two factors those determine the prognosis in electrical burn patients. Cardiac injuries are typically reported with electrical burns. Isolated pulmonary involvement is an infrequent manifestation of this potentially life threatening electrical injury.

Case Report

A 25-year-old male construction worker came in contact with a high voltage 20 kilovolt (kV) cable. After the impact, he fell down and had a brief period of loss of consciousness. He was brought to emergency services of our hospital. The patient was conscious, oriented to time, place and person. His vital signs were: respiratory rate–25 breaths per minute, blood pressure–96/60 mmHg, heart rate – 110 beats per minute and oxygen saturation by pulse oximeter was 91% under room air. Chest examination revealed bilateral coarse crepitations. Other systemic examinations were normal. There were second- and third-degree burns involving 10% of body surface area on arm and frontal chest (Figure 1).

Figure 1. Photograph of the patient showing second- and third-degree burn injuries on thorax and arm.

Haemogram, electrocardiogram, liver function tests renal function tests and creatinine phosphokinase assay and urine examination were normal. Non-contrast computed tomography of head, echocardiography and focused assessment with sonography for trauma (FAST) were normal. Chest radiograph was suggestive of pneumomediastinum with bilateral infiltrates (Figure 2). Contrast-enhanced computed tomography (CECT) chest was suggestive of bilateral consolidation in the lung fields with pneumomediastinum (Figure 3).

[Received: September 16, 2019; accepted after revision: September 23, 2020]

Corresponding author: Dr Anuj Kumar Soni, Senior Resident, Department of Pulmonary Medicine, D-Block, Level-5, Government Medical College and Hospital, Sector 32, Chandigarh, India; E-mail: dranujsoni87@yahoo.com

There was no significant past history. Sputum for acid-fast bacilli, cartridge-based nucleic acid amplification test (CBNAAT) for tuberculosis, Gram's staining and pyogenic culture were negative.

Figure 2. Chest radiograph (postero-anterior view) showing pneumomediastinum with bilateral infiltrates involving all the zones.

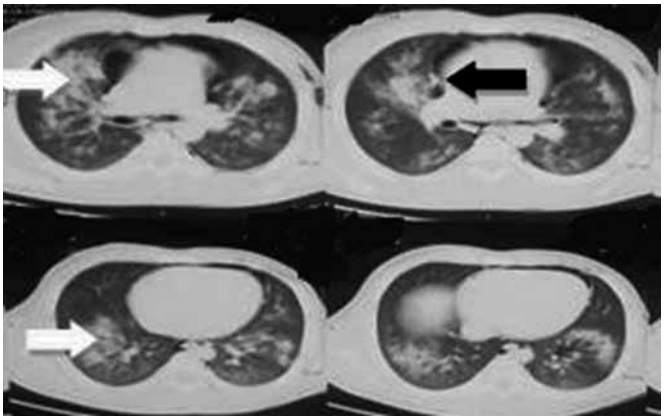

Figure 3. Contrast enhanced computed tomography of the chest showing of bilateral consolidation of lung fields (white arrows) with pneumomediastinum (black arrow).

The patient was managed with oxygen therapy, parenteral fluids, analgesics and parenteral amoxycillin-clavulanic acid), topical ointments as advised by surgery department for management of burn injuries. With conservative management, patient started showing improvement from the 3rd day onwards. On 10th day, chest radiograph showed marked improvement (Figure 4). Subsequently on follow-up CECT chest was also normal (Figure 5).

Discussion

It is widely accepted that tissue damage caused by electrical current is caused by the heat generated from the body's resistance to the current passing through it.[6] The major point of concern to the clinicians in electrical burns of the trunk is injuries to the viscera. Damage to the lung is rare because the air in the lung is a poor

Figure 4. Chest radiograph (postero-anterior view), after 10 days of hospitalisation showing significant improvement with resolution of consolidation and pneumomediastinum.

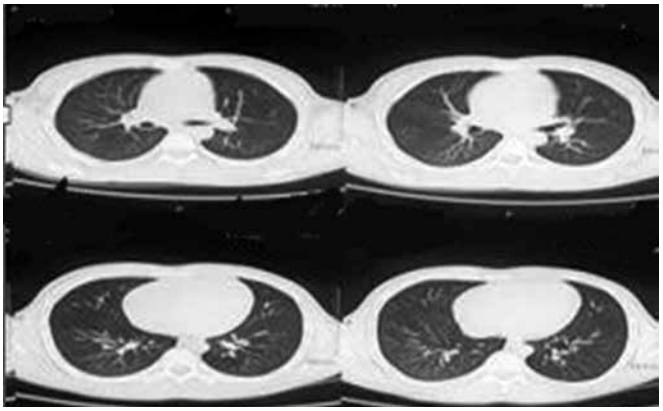

Figure 5. Follow-up, computed tomography of the chest showing complete resolution with normal lung fields.

conductor of electricity.[5] As our patient was a healthy young person with no prior history of lung disease with the site of electric contact over the thorax suggests that the current passed through the trunk and the underlying lungs, resulting in the pulmonary injuries.

The magnitude of the energy delivered, the resistance encountered, the pathway followed by the current, the type of current and the duration of contact are the various factors that determine the degree of injury.[3] The magnitude of current delivered to the victim is directly proportional to the tissue damage and the systemic effects. Pulmonary damage due to electrical current can cause pneumonitis, lung infarction, pleural effusion, pneumothorax and pneumomediastinum.[7] The pathophysiology of the electrical injury to the lung is not clearly understood; but electrically-injured lung parenchyma appears to develop coagulation necrosis. The three major mechanisms of electricity-induced injury are: (1) electrical energy causing direct tissue damage, altering cell membrane resting potential, and eliciting muscle tetany; (2) conversion of electrical energy into thermal energy, causing massive tissue

destruction and coagulative necrosis; and (3) violent muscle contractions or falls which can result in direct trauma with mechanical injury.

Apart from the above mechanisms, this damage may be in relation to electrical non-thermal affect known as electroporation. In electroporation, conformational damage of channel proteins occurs because of reorientation of polar amino acid residues.[8] There are very few reported cases of lung injuries associated with electric shock. The manifestations reported in earlier studies include focal lung consolidation and pulmonary haemorrage,[5,9-12] following low voltage shock.[11,12]

In conclusion, isolated lung parenchymal injuries are an exception in patients of electrical burn. It can lead to different manifestations, such as pneumonitis, which can often be confused with pneumonia. In all the patients who have sustained a high-voltage electrical accident, a thoracic CT scan must be performed on admission, for the suspicion and early identification of mediastinal and pulmonary injuries.

References

1. Spies C, Trohman RG. Narrative review: electrocution and life threatening electrical injuries. *Ann Intern Med* 2006;145:531–7.
2. Lee RC. Injury by electrical forces: pathophysiology, manifestations and therapy. *Curr Probl Surg* 1997;34:677–764.
3. Hussmann J, Kucan JO, Russell RC, Bradley T, Zamboni WA. Electrical injuries: morbidity, outcome and treatment rationale. *Burns* 1995;21:530–5.
4. Haberal M, Uçar N, Bayraktar U, Oner Z, Bilgin N. Visceral injuries, wound infection and sepsis following electrical injuries. *Burns*1996;22:158–61.
5. Masanès MJ, Gourbière E, Prudent J, Lioret N, Febvre M, Prévot S, *et al.* A high voltage electrical burn of lung parenchyma. *Burns* 2000;26:659–63.
6. Rai I, Jesche MG, Barrow RE. Electrical injuries: a 30-year review. *J Trauma* 1999;46:933–6.
7. Lai CC, Lin CM, Xiao QC, Ding LW. Pneumothorax: a rare complication of electric injury. *Burns* 2008;34:125–6.
8. Marques EG, Junior GA, Neto BF, Freitas RA, Yaegashi LB, Almeida CE, *et al*. Visceral injury in electrical shock trauma: proposed guidelines for the management of abdominal electrocution and literature review. *Int J Burns Trauma* 2014;4:1–6.
9. Schleich AR, Schweiger H, Becsey A, Cruse CW. Survival after severe intrathoracic electrical injury. *Burns* 2010;36:61–4.
10. Karamanli H, Akgedik R. Lung damage due to low-voltage electrical injury. *Acta Clin Belg* 2017;72:349–51.
11. Truong T, Le TV, Smith DL, Kantrow SP, Tran VN. Low-voltage electricity-induced lung injury. *Respirol Case Rep* 2018;6:e00292.
12. Acharya S, Ghewade B, Shukla S, Prothasis M. Electric shock induced pulmonary hemorrhage: a rare phenomena. *Indian J Respir Care* 2020;9:127–8.