Isolated pulmonary hemorrhage after electric shock: a rare phenomenon

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Abstract

Any type of contact with electricity of low or high voltage can cause injury to the human body, with a variable effect on the body. Low-voltage injury is quite common worldwide, but there is very little information present in the available literature. The degree of organ damage depends on many factors, which include the duration of electric current exposure, current type, and nature of the affected tissue. The most common presentations are muscle injury, hyperkalemia, pulmonary edema, and rarely isolated diffuse pulmonary hemorrhage. We present a case of bilateral pulmonary hemorrhage due to electric shock with no visible signs of damage to the chest wall when exposed to a 220 V shock. The diagnosis was confirmed by fresh hemoptysis, chest imaging that showed bilateral perihilar ground glass opacities, and bronchoscopy findings. Given a life-threatening condition, a timely diagnosis is required, as massive hemoptysis can occlude the airways, leading to hypoxia and mortality.

Key message

Despite the rarity of pulmonary hemorrhage caused by electric shock, there is no protocol in place, and early detection will result in a positive prognosis.

Introduction

Electricians, construction workers, truck drivers, and farmers frequently sustain electrical burns from high-voltage current (>1000 V, 50 Hz) owing to workplace mishaps. Direct contact between a worker and a conductor or contact between a car or other objects with power lines are the two main causes of electrocution. Accidental contact with electrical power lines may occur during recreational activities or suicide attempts [1,2]. The majority of the injuries caused by the passage of current through the body are electro-thermal burns at the contact points (entrance and exit) and visceral burns in high-voltage accident victims who do not pass away at the scene from ventricular fibrillation or trauma from a fall [3,4]. Due to the lack of a relationship between the appearance of skin burns and these visceral burns, which may be quite deep and debilitating with only a tiny area of skin burn, the clinical diagnosis of an electrical injury may be challenging. The victim is momentarily in touch with a closed electrical circuit during electrical contact, which could be fatal sometimes. When immediate treatment is not achievable, fatality rates are high, and survivors frequently experience severe aftereffects [3]. In a few case reports, it has been seen that electrocution has an impact on multiple organs, like cardiac arrest [5] or visceral injuries [4], along with lung injuries. But here, we report an exceptional case of an electrocution that affected the lung parenchyma only.

Case Report

A 32-year-old male, store manager by occupation, came in contact with a multi-plug power supply board of 220-voltage power at 2 AM while adjusting the power supply of the computer and suffered from an electric shock. After the impact, he lost consciousness for approximately 30 minutes, as told by the patient's attendant. The patient was brought to the emergency room of our hospital, where he gained consciousness. Subsequently, the patient had five episodes of blood per oral, with approximately 2 mL of blood per episode at approximately every 10-minute interval. Blood was bright red, mixed with some froth and some mucoid secretions. The patient complained of heaviness in the chest while breathing but made no complaints of chest pain, orthopnea, palpitations, or abdominal pain. The patient was well conscious and oriented to time and place and had a pulse of 88/minute and regular blood pressure (BP) of 110/60 mmHg in the right arm, and oxygen saturation by pulse-oximetry was 90% while breathing on room air. There was one entry wound in the left forearm and one exit wound on the right leg near the medial malleolus. There was no evidence of any trauma to the chest in the form of a bruise, ecchymosis, or fractured rib.

On chest examination, inspection was done, which showed bilateral symmetrical and equal chest movement; on palpation, vocal fremitus was found to be equal all over the body; percussion was not done due to active hemoptysis; and on auscultation, bilateral coarse crepitations were found. On the central nervous system examination, there was no neurological deficit, and on the cardiovascular examination, the S1 and S2 were heard regularly with no audible murmurs. Arterial blood gas analysis was pH: 7.43, partial pressure of oxygen: 66, partial pressure of carbon dioxide: 35, and bicarbonate: 24. Chest X-rays showed bilateral heterogeneous opacities (Figure 1). A high-resolution computerized tomography scan of the thorax showed perihilar ground-glass opacities (Figure 2). The electrocardiogram (ECG) and electroencephalogram were normal. Serum creatine phosphokinase: 600 U/L, lactate dehydrogenase: 200 U/L, creatine kinase-MB: 22 U/L, serum urea: 34 mg%, serum creatinine: 0.9 mg%, and urine myoglobin was qualitatively negative. The serum N-terminal pro-B-natriuretic peptide was 138 pg/mL (normal <300 pg/mL). The platelet count and coagulation profile (bleeding time, clotting time, prothrombin time, and partial thromboplastin time) were within the normal range. The repeat ECG and 2-dimensional echocardiogram (2D echo) were normal. On bronchoscopic examination, there was blood in bilateral bronchial trees, which was scanty in amount and not enough to obstruct the airways while doing the procedure; all the visible blood was aspirated (Figure 3).

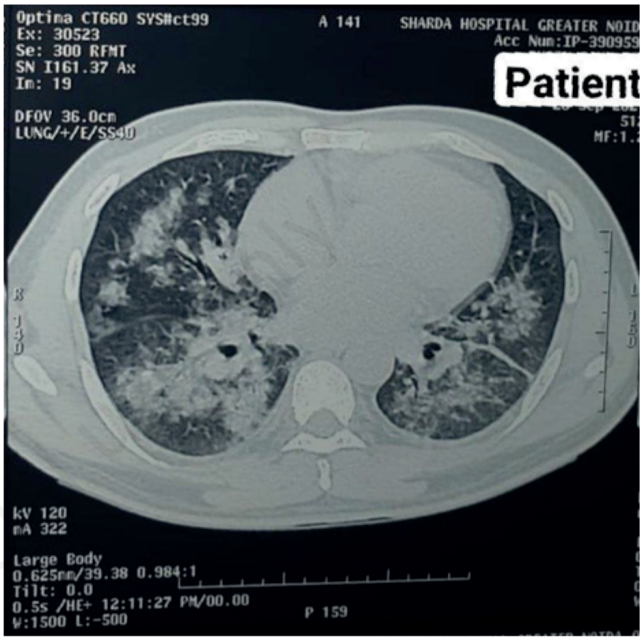

Figure 2. High-resolution computerized tomography scan of the chest with multiple showed perihilar ground-glass opacities.

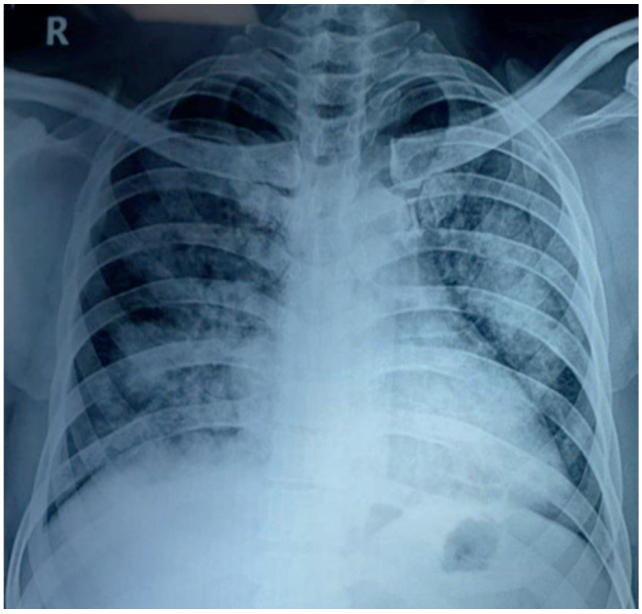

Figure 1. Post electrocution bilateral heterogenous opacities.

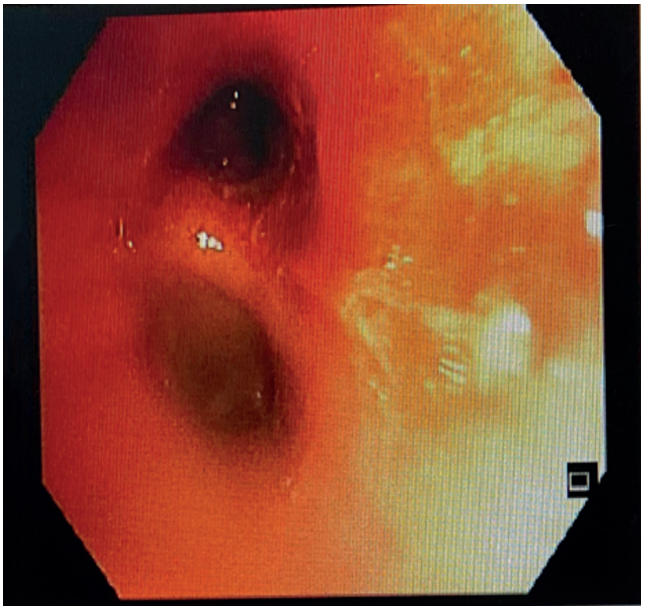

Figure 3. Diffuse bloody patches in bilateral bronchial trees.

A provisional diagnosis of an electricity-induced lung injury with pulmonary hemorrhage was considered. He was advised absolute complete bed rest, to lie in lateral positions, to have a Foley catheter inserted, and to receive intravenous hemostatic drugs, intravenous antibiotics, intravenous fluids, and O_2 inhalation support with other supportive and symptomatic treatment. Later in the evening, he had two additional episodes of hemoptysis, although the amount was minimal in the hospital ward. On the second day, the patient's hemoptysis stopped. For a week, the patient had serial chest X-rays taken every other day, and the results showed improvement. The patient was monitored for the following two weeks. A contrast-enhanced computed tomography (CECT) of the chest was performed two weeks following discharge and showed a significant improvement, with a recommendation to follow up one month later.

Discussion

Very few cases of electric shock-associated lung injuries have been reported. Electric shock can cause pulmonary edema and/or hemorrhage from either a cardiac or direct lung injury. With the help of an ECG and a 2D echo, a detailed cardiac evaluation was done, and the cardiac cause was ruled out; therefore, this was the case of a direct lung injury. Patients can present with hemoptysis, respiratory distress, and respiratory failure [3,6]. The main pathologic manifestation of an electrical lung injury is usually coagulative necrosis. The mechanisms attributed are direct tissue damage, which alters the resting membrane potentials of the cells; conversion of electrical energy to thermal energy (Joule heating), which causes tissue destruction and necrosis; and finally, direct trauma from violent contraction of muscles. In addition, electrical energy can also cause electroporation, in which conformational damage to channel proteins occurs because of the reorientation of polar amino acid residues. All these mechanisms finally cause cell membrane dysfunction, injury, rupture, and necrosis [2,3].

In diffuse pulmonary hemorrhage, blood accumulates inside the alveoli as a result of diffuse pulmonary small vessel injury. Gas exchange is hampered if enough alveoli are damaged. Depending on the underlying reason, many path physiologies and symptoms exist [7].

Many disorders can cause alveolar hemorrhage, including autoimmune disorders like systemic vasculitis, Goodpasture syndrome, anti-phospholipid antibody syndrome, connective tissue disorders, cardiac disorders like mitral stenosis, coagulation disorders caused by diseases or anticoagulant drugs, drug reactions with propyl-thiouracil, methotrexate, nitrofurantoin, bleomycin, and infliximab, hematopoietic stem cell transplantation or solid organ transplantation, pulmonary infections, and occasionally electrical shock [7]. In this index case, there is no history of any of the known co-morbidities. The patient's attendant and the patient himself gave a detailed history of the event. In follow-up, serial chest X-rays of the patient were taken every other day for a week and indicated recovery. Two weeks after discharge, chest X-rays and a CECT of the chest were taken, and they revealed a dramatic improvement. The patient should be observed under strict monitoring along with the proper required treatment.

Conclusions

The electrocuted patients require comprehensive care that includes a multidisciplinary team including the intensive care unit team and surgery team, pulmonologists, nephrologists, and trauma team, as well as other professionals involved in the treatment and rehabilitation of these patients, such as qualified trained nurses, physiotherapists, occupational therapists, and nutrition and diet experts. Hemodynamic stabilization with all body pressure monitoring (BP/intra-abdominal) is fundamental to maintaining water balance and adequate management of rhabdomyolysis to prevent renal and heart failure [4,8].

All potential injuries to visceral organs should always be suspected in electrocuted patients with polytrauma, along with a detailed analysis of the mechanism of trauma. A thorough physical examination, along with radio-imaging and laboratory tests, helps in the early diagnosis of severe injuries, reducing morbidity and mortality by enabling early intervention [4].

Although rare, pulmonary hemorrhage produced by electrical currents is associated with high morbidity and mortality. Being a life-threatening condition, early detection is imperative for a positive outcome [8]. As there are no existing guidelines for the management of electrical burns according to advanced trauma life support, advanced burn life support, and advanced cardiac life support, the treatment is more symptomatic, and patients need regular follow-up in case of survival. There should be a vivid protocol set in place for tackling such a condition.

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