Case Report

Journal of Emergency Medicine Case Reports

A Misleading Case: Lichtenberg Figures Caused by Illegal Use of Electricity from High-Voltage Transformer

Bahadır Arslan[1]
[1]Department of Emergency Medicine, Nusaybin State Hospital, Mardin, Türkiye

Abstract

Although injuries with high voltage are relatively rare in emergency departments, their morbidity and mortality are high. Findings in the body after the event can guide the diagnosis and treatment. A 21-year-old female patient was brought by her relatives with the complaint of electric shock. Lichtenberg figures, which are known to occur because of high voltage, were observed in the body examination of the patient, who stated that the incident occurred after contact with an open cable at home. When the anamnesis was detailed again, it was learned that she entered the transformer for illegal use. Voltage information is key in electrical injury management. With criminal concerns, patients may describe events differently. The clues in the examination, like Lichtenberg figures, can change the management of the patient.

Keywords: Emergency department, electrical injuries, Lichtenberg figure

Introduction

Electrical injuries, which were initially caused by lightning strikes, have diversified with the beginning of the use of electricity in cities. While the incidence of electrical accidents decreases with age in pediatric groups, it rises among adults, particularly affecting electricians, and construction workers (1). Patients may not have any symptoms and may present from superficial burns to cardiac arrhythmias and even death. In the United States, there are 10,000 emergency room visits due to electrical injuries each year, and approximately 350 deaths are reported (2). Voltage levels affect patient management. In high-voltage injuries, internal organ damage is not directly proportional to the severity of skin burns. Therefore, the percentage of burns should not be relied upon in fluid therapy (3). Even if there are no findings, the observation period should be longer in these injuries, especially in terms of the development of cardiac findings. In this case, a rare electrical accident accompanied by a Lichtenberg figure with anamnesis-examination mismatch is presented.

Case

A 21-year-old female patient presented to the emergency department with the complaint of electric shock. She accidentally stepped on an open cable at home. The patient was conscious and there was no loss of consciousness period, but she was unsure of the contact time.There was paresthesia and pain in both legs. She did not describe any significant medical history.She had no smoking or alcohol use. The patient's vital signs were blood pressure 125/77 mmHg, heart rate 120/min, temperature 36.6° C, respiratory rate 20/min, oxygen saturation 100% in room air respectively. Her Glasgow coma score was 15. She was agitated because of the event and described numbness and pain in the distal of both lower extremities. The patient's left leg Visual Analogue Scale (VAS) pain score was 4/10, and the right leg VAS score was 7/10. Her muscle strength was normal in all extremities, with no additional neurological examination findings. There were no obvious signs of trauma and no electrical input and output hole. The patient, who did not describe any chest pain, had palpitations and

Corresponding Author: Bahadır Arslan
e-mail: bahadir1735@gmail.com
Received: 23.02.2024 • **Revision:** 07.03.2024 • **Accepted:** 11.03.2024
DOI: 10.33706/jemcr.1441022

Cite this article as: Arslan B. A Misleading Case: Lichtenberg Figures Caused by Illegal Use of Electricity from High-Voltage Transformer. Journal of Emergency Medicine Case Reports. 2024;15(2): 35-37

DOI: 10.33706/jemcr.1441022
Journal of emergency medicine case reports. 2024;15(2): 35-37

her ECG was sinus tachycardia. No additional ischemic features were observed. A bolus of 1000 cc %0,9 NaCl isotonic fluid was started for the patient's tachycardia and the patient was monitored. The patient had leukocytosis in blood tests (Table-1). The urine sample was clear with noclinically significant findings.

In the control examination of the patient, performed at the approximately second hour, the most prominent in the posterior of the right lower extremity (Figure-1) and the pink-colored, painless, non-branching, nonfluffy figures were observed on the abdominal skin (Figure-2). We determined that this finding, which was not noticed during the first physical examination but became evident later, was the Lichtenberg figure. After the detection of the finding that can be seen in high voltage injuries, the patient's anamnesis was suspected and repeated. The patient sustained injuries from a transformer while attempting to use illegal electricity. She had walked in barefoot and probably stepped on the exposed wire. Afterwards she was thrown upwards with a loud noise and then she was unconscious for a short time. She explained her anamnesis differently because she was worried about being arrested.

The patient's neurological, cardiological and dermatological findings showed high voltage exposure. Management of the patient was changed. She was followed up in the emergency room for 24 hours with intravenous/oral hydration and analgesia. In blood tests performed before discharge, leukocytosis regressed, and no significant increase was found in cardiac and muscle-destruction markers (Table 1). The vital signs were normal, the patient did not have any active complaints and was discharged in a healthy manner.

Figure 1. Lichtenberg figures (posterior of the right lower extremity)

Figure 2. Lichtenberg figures (Left upper quadrant of the abdomen)

Table 1: Comparison of patient's admission and discharge laboratory analysis

Labs (range and unit)	Admission	Before Discharge
AST (<31 U/L)	22	19
ALT (<34 U/L)	22	18
ALP (35-104 U/L)	114	89
Total protein (64-83 g/L)	82.3	66.9
Albumin (35-52 g/L)	48.9	41.6
Total bilirubin (0.1-1 mg/dL)	0.33	0.22
LDH (135-225 U/L)	209	200
CK (34-145 U/L)	76	119
Myoglobin (25-58 µg/L)	74.43 H	35
Troponin T (<14 ng/L)	<13	<13
Urea (10-50 mg/dL)	20	17
Creatinine (0.6-1.1 mg/dL)	0.66	0.7
Sodium (136-145 mEq/L)	140	142
Potassium (3.5-5 mEq/L)	3.7	4
Chloride (96-110 mEq/L)	105	108
Calcium (8.6-10.2 mEq/L)	10.2	9.2
Magnesium (1.5-2.6 mEq/L)	1.96	1.89
CRP (0-5 mg/L)	4.7	4.8
Beta-hCG (<5.3 U/L)	<0.1	-
Complete Blood Count		
WBC (4.5-11x10^3/µL)	15.41 H	11.71 H
Hemoglobin (11.7-15.5 g/dL)	14.3	12.2
RBC (3.8-5.1x10^6/µL)	5.76	4.88
Hct (35-45 %)	44.7	38.8
Platelet (150-450x10^3/µL)	379	245

AST: Aspartate aminotransferase, ALT: Alanine aminotransferase ALP: Alkaline phosphatase, LDH: Lactate dehydrogenase, CK: Creatinin kinase, CRP: C reactive protein,
Beta-hCG: Beta-human chorionic gonadotropin, WBC: white blood cells, RBC: Red blood cells, Hct: Hematocrit H: High

Discussion

Although the pathophysiology is not clearly known, they often appear with typical branching and pink-red shapes after lightning injuries (4-6). One hypothesis suggests that these patterns result from the activation of keratocytes, and T-cells triggered by high-voltage discharge. Extravasated blood cells also may contribute to its appearance (6). Typically, these figures begin to appear approximately 1 hour after the event and vanish within 48 hours without leaving a trace (4,7). Notably, the figures were not clearly visible before the patient's discharge. As far as we know, there are two more cases reported in the literature for Lichtenberg figures resulting from an industrial electrical accident. In the first reported case, a 49-year-old male patient who was caught in a 3 of 4 25000 V alternating current was presented and was followed up in the burn intensive care unit with the diagnosis of 15% total second-degree body burns and rhabdomyolysis (5). In the other case, a 47-year-old male

patient with a second-degree burn covering 7% of his body due to 20000 V alternating current was reported (6). Interestingly, although the electrical voltage in our case was not known (the electrical current in transformers in Turkey ranged from 10000 to 36000 volts (8), no complications were observed unlike the reported cases. Transient leukocytosis seen in the patient's blood results may be associated with acute inflammation findings because of the severity of the event (5). No additional evidence of infection was detected in the patient's physical examination and anamnesis. The patient did not remember which foot she had contacted. The patient's pain was mostly in his right leg, and these patterns were more prominent in the dorsal side of the same leg. Therefore, in our case, as mentioned in George et al., the electric arc may have terminated in the leg (9). The patient had a short-term loss of consciousness, and her cardiac rhythm was sinus tachycardia. Benign arrhythmias such as sinus tachycardia are frequently seen in these injuries at presentation and are temporary. Although the accompanying sinus tachycardia and high respiratory rate can be attributed to anxiety, the patient was continued to monitor. According to the literature, patients with symptoms such as altered consciousness, arrhythmia and chest pain should be followed up for at least 24 hours for deterioration (2,3). It should be noted that rhabdomyolysis may accompany another treatable fatal condition.Fluid therapy in appropriate amounts should be started without waiting for blood test results.

Conclusion

Lichtenberg figures emerge as a result of high-voltage electrical injuries, primarily associated with lightning incidents but also observable in industrial accidents. In such cases, patients may be unconscious. Even when conscious, obtaining relevant medical history may be challenging due to forensic concerns. Knowledge of these pathognomonic findings by emergency service healthcare providers can contribute to preventing patient mortality through the implementation of appropriate care.

Informed Consent:

The written informed consent of the patient was taken.

References

1. J. C. Cawley and G. T. Homce, "Occupational electrical injuries in the United States, 1992-1998, and recommendations for safety research.," J. Safety Res., vol. 34, no. 3, pp. 241–8, 2003.
2. Ganti Arun, McAnaney Cara. Lightningand Electrical Emergencies. In: Mattu A andSwadron S,ed.CorePendium. Burbank,CA:CorePendium,LLC.https://www.emrap.org/corependium/chapter/recvSOMEAyiX3hmtw/Lightning-and-Electrical-Emergencies#h.69uy2hlbr1j. Updated April 7, 2022. AccessedFebruary 17, 2023.
3. C. Bailey, "Electrical and lightning injuries," in Tintinalli's Emergency Medicine A Comprehensive Study Guide, 9th ed., T. JE, Ed. New York: McGraw-Hill, 2020, pp. 1396–1404.
4. Raniero D, Uberti A, Del Balzo G, Vermiglio E, Farinelli A, Turrina S et al. Unusual Lichtenberg figures in a lightning strike's victim: Case report and literature review. Leg Med (Tokyo). 2022;56:102028.
5. Arnould JF, Le Floch R. Lichtenberg figures associated with a high-voltage industrial burn. Burns. 2011;37(3):e13-e15.
6. Lindford A, Juteau S, Jaks V,Mariliis K, Lagus H, Vuola J et al. Case Report: Unravelling the Mysterious Lichtenberg Figure Skin Response in a Patient With a High-Voltage Electrical Injury. Front Med (Lausanne). 2021; 8:663807.
7. Mahajan AL, Rajan R, Regan PJ. Lichtenberg figures: cutaneous manifestation of phone electrocution from lightning. J PlastReconstrAesthet Surg. 2008;61(1):111-113.
8. Trafo ve yüksek gerilim hatlarının yaydığı elektromanyetik radyasyonun sağlığımıza etkisi nedir? (2016). Accessed: 16 February 2023: https://www.herkesebilimteknoloji.com/k/haberler/saglik
9. George N, Bandi S, Ganti L, Aaron U, Desai BBouncedoff a Truck Out of the Blue: A Case Report of a Lightning Strike During a Thunderstorm. Cureus. 2020;12(11):e11534.