(International Print/Online Journal)

SJIF IMPACT FACTOR: 5.565
PUBMED-National Library of Medicine ID-101739732

ISSN (Print): 2209-2870
ISSN (Online): 2209-2862

International Journal of Medical Science and Current Research (IJMSCR)
Available online at: www.ijmscr.com
Volume 6, Issue 3 , Page No: 429-433
May-June 2023

IJMSCR

Electric Shock Induced ST-Elevation: A Case Report

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Type of Publication: Case Report
Conflicts of Interest: Nil

Abstract

Electrical injuries are still not common, yet they can be harmful and lead to severe burns or internal organ damage and cause thermal, electrophysical and metabolic derangements. Cardiac pathology in electric shock is still unknown. On exposure it presented in different forms, such as accelerated hypertension, acute myocardial infarction (MI), arrhythmic complication includes ventricular and atrial premature beats, tachycardia, fibrillation, bundle branch blocks (BBB), cardiac rupture, and more. The primary etiologic cause for the above-mentioned complications, even in normal patients, was due to the coronary artery vasospasm that occurs after the electrical shock. Myocardial Infarction, seen rarely in electrical shock presents with normal coronary arteries. In our case report, we presented a case who developed ST-elevation and left bundle branch block with MI after the electrocution.

Keywords: NIL

Introduction

Electrical injuries are still not common, yet they can be deleterious and lead to severe burns or internal organ damage and cause thermal, electrophysical and metabolic derangements.[1,2] Patients presented with electrical injuries exhibit distinctive diagnostic and therapeutic impediments, which were onerous for the Emergency physicians.[1,2] According to American Burn Association (ABA), electrical injury cases are infrequent, accounting for less than 4% of total visits in burn center admissions.[3]

Most of the electrical injuries are from occupational or household exposures.[4] The extreme form of the electric shock is caused by lightning strike results in instantaneous death.[5] The pathophysiology depends on the voltage, amount of current flow, and the resistance of the skin, moreover the principle pathology is the coagulation necrosis.[6–8] For the management of these patients, there is a dearth of factual information due to underreporting.[9]

Cardiac pathology in electric shock is still unknown. On exposure it presented in different forms, such as accelerated hypertension, acute myocardial infarction (MI), arrhythmic complication include ventricular and atrial premature beats, tachycardia, fibrillation, bundle branch blocks (BBB), cardiac rupture and so on.[6,7,10,11] Fibrillation can be triggered during the vulnerable period in every heartbeat on exposure to energy at a frequency of 50-60Hz, commonly used in household and commercial electrical sources and in high voltage exposure, the cardiac standstill (asystole) occurs.[5] The primary etiologic cause for the above mentioned complications, even in normal patients were due the coronary artery vasospasm that occurs after the electrical shock.[7] In our case report,

we presented a case who developed ST-elevation and left bundle branch block with MI after the electrocution.

Case:

A 43-year-old woman admitted to the emergency within 30 mins of alleged history of accidental electrocution (alternative current 50Hz, 220V). The patient presented that as soon as she touched the switch board following which current passed through her right hand and she collapsed on the floor. After which the patient recovered and had pain over bilateral shoulder, chest, bilateral legs and generalized myalgia. On arrival her first set of vitals showed arterial blood pressure (BP) was 160/90mmHg; pulse rate (PR)70/min; $Sp_{O2}$was 97% at room air; Glasgow Coma Scale (GCS) score was 15/15; blood glucose (CBG) was216mg/dl. She was evaluated under triage category red. Her primary and secondary survey revealed she was having persistent chest pain since the event; entry wound was seen over the first web space in the right index and thumb finger and no exit wound was found. **(Figure 1)** She had no co-morbidities.

Figure 1: Entry wound on the right web space.

Her electrocardiogram (ECG) findings showed that ST-elevation in V2, V3, AVR with reciprocal ST depression in V5, V6, I, II, aVF suggestive of antero-septal myocardial infraction (MI) and myocarditis

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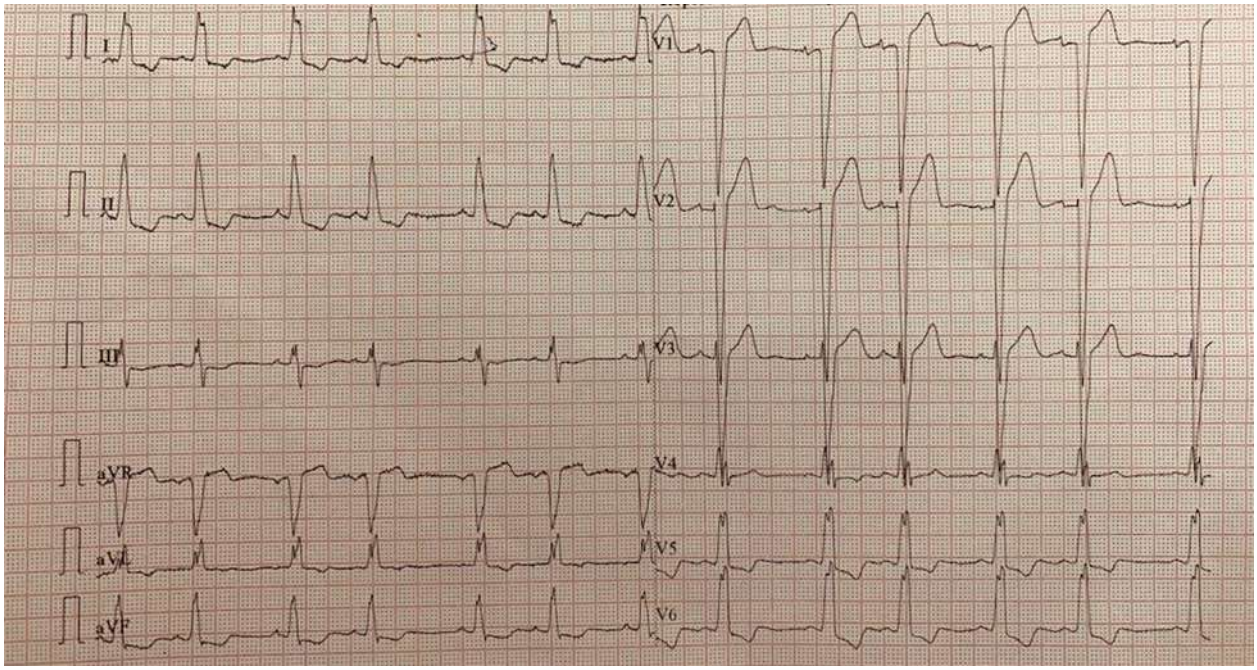
with the impression of complete left bundle branch block (BBB) **(Figure 2)**. She was at once treated with Inj. Clexane 0.6mg IV, Tablet (tab) Aspirin 325mg, tab. Clopilet300mg, tab. Atrovas 80mg and IV analgesics. Other blood investigations showed elevated creatine phosphokinase-MB (CKMB) 42 IU/l and troponin-I (TROP-I) positive with deranged renal function test (RFT) include serum urea nitrogen in blood 76 mg/dl and serum creatinine was 2.3 mg/dl and estimated glomerular filtration rate (eGFR) was 26 ml/min/1.73m^2. The Echocardiogram (ECHO) was done, and the ejection fraction (EF) was estimated as 50 to 55% and segmental motion defect was not detected. After hemodynamically stabilizing the patient, she was shifted to Cardiac Catheterization Laboratory (Cath-lab) for emergency angiogram which revealed normal pericardial coronaries. Post angiogram patients were shifted to coronary care unit (CCU) and monitored periodically. Adequate management was done for deranged RFT with fluids. On the 3rd day the patient became asymptomatic and was shifted to step down Intensive care unit (ICU). Her ECG showed sinus rhythm, CKMB, RFT were within normal range. The patient was discharged with full recovery with follow-up.

Figure 2: The Electrocardiogram (ECG) shows the ST-elevation in V2, V3, AVR with reciprocal ST depression in V5, V6, I, II, aVF suggestive of antero-septal myocardial infraction (MI) and myocarditis.



Discussion:

Electrical injuries are considered as the emergency that affects the individual in various ways with direct effects of the current as simple burns to indirect effects results in the dysfunction of various tissues or systems of the body.[1,5] Most of the electrical injuries were accidental and often preventable that was associated with morbidity and mortality based on the type of current, the voltage and the resistance (Ohm's law).[1] In an occupational study by Ozkanet al,[12] about 2.2% of the patients admitted to emergency department were due to electrical shock injuries and also 42.9% were the exits patients, shows that it can be fatal too.[1,9]

Among the various organs, heart is most often affected by the electrical shock.[1] The cardiac pathologies occurs when the current travels from hand-to-leg or hand-to-hand across the body, with the potential fatal arrhythmia, yet the pathophysiology is not fully understood.[1,13]Also, it leads to MI, accelerated hypertension and even myocardial rupture of the heart depends on the effects of voltage.[2,7,10]In a study done by Gille J et al,[14] 14.2% of patients were presented with cardiac arrhythmias,

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and found that it was independent predictor for the mortality due to electrical shock. The primary contributing factors have been determined to be necrotic areas resulting from current and damage to the heart muscle with scar formation leading to disturbances in cardiac sodium/potassium pump function and abnormal electrical activation of the heart.[1,5–7,10,15]Similarly, in our case, there was an abnormal ECG on admission showed that disturbance in the electrical activation of the heart as BBB.

In our case, normal pericardial coronaries were found during the emergency angiogram and her ECG findings showed that ST-elevation in V2, V3, AVR with reciprocal ST depression in V5, V6, I, II, aVF suggestive of antero-septal MI and myocarditis with the impression of left BBB. This shows that coronary arteries were found to be normal in patients who experienced electric shock, yet their ECG projects the MI.[7] This shows that etiology of the MI were unrelated to coronary arteries,[7,13,15] which was similar in our case. Added to that, development of ST-elevated electric shock induced MI were rarely encountered,[7,16] was seen in our case. There are few etiologies that were encompassed the rationale behind the electric shock induced MI including coronary arterial vasospasm,[17] arrythmia induced hypotension,[18] shock-initiated cardiac injury,[18] cardiopulmonary arrest due to hypoxia,[10,15,19] and injury to the myocardium.[1,5,16] Studies done by Al B et al,[20] and Celebi A et al,[21] reported the case with electric shock induced inferior MI in ECG with normal coronary artery findings in ECHO and angiogram, and also with elevated cardiac enzymes, were similar to our case findings added with deranged RFT. These findings project the underlying case as the coronary vasospasm.[7,16,17,20,21]

Elevated troponin I and CK-MB were found in our case. Increase in CK-MB were related to the concomitant skeletal muscle injury and the cardiopulmonary resuscitation, yet they were less specific marker for MI in patients with electric shock.[20] While, the troponin-I were considered more likely to elevate in MI events rather than the skeletal muscle injury.[20,21]

In electric injury induced MI, the priority is to treat the patients without delay. In our case, our patient was taken at once to perform angiography and monitored in CCU. Also, oral medication to prevent MI and fluid management was done. In essence, coronary angiography were considered as the first choice not only for treatment as it also aid in guiding the therapy, and also for the detection of the MI, hypokinesia as general or at regional level due to electrical shock.[20]Since there is uncertainty over the optimum way to manage ST segment elevation myocardial infarction after electrical shock, governing myocardial damage after electrical shock might prove to be daunting.[20] Cardiac complications, need to be addressed in the timely way to reduce the risk of mortality.

Conclusion:

Among the various investigations, troponin I and ECG, can be considered as the primary matter to detect and assess the extent of damage due to electrical shock induced MI. Coronary angiography can help detect whether myocardial injury is of occlusive or non-occlusive origin, assisting in a more tailored treatment, despite the ambiguity of therapeutic alternatives and the lack of guidelines. It is best to constantly oversee individuals both throughout their stay in the hospital and after they are discharged who had field-documented dysrhythmia, and an irregular ECG upon admission.

Abbreviations:

American Burn Association - ABA; Myocardial infarction - MI; bundle branch blocks - BBB; blood pressure - BP; pulse rate - PR; Glasgow Coma Scale - GCS; blood glucose - CBG; electrocardiogram - ECG; creatine phosphokinase-MB - CKMB; troponin-I - TROP-I; renal function test - RFT; estimated glomerular filtration rate - eGFR; Echocardiogram - ECHO; ejection fraction - EF; coronary care unit - CCU; Intensive care unit - ICU.

Acknowledgement: I express my sincere gratitude to the entire Cardiology Department. I would like to acknowledge my sincere gratitude and thankfulness to the patient who consented to write a case report.

Reference:

1. Zemaitis MR, Foris LA, Lopez RA, Huecker MR. Electrical Injuries. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2023 [cited 2023 Mar 31]. Available from: http://www.ncbi.nlm.nih.gov/books/NBK448087/

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2. Electrical Injuries in the Emergency Department: An Evidence-Based Review - Trauma CME. EB Medicine [Internet]. [cited 2023 Mar 31]. Available from: https://www.ebmedicine.net/topics.php?paction=showTopic&topic_id=589
3. Burn Incidence Fact Sheet – American Burn Association [Internet]. [cited 2023 Mar 31]. Available from: https://ameriburn.org/who-we-are/media/burn-incidence-fact-sheet/
4. Centers for Disease Control and Prevention. Multiple Cause of Death, 1999-2020 Results Form [Internet]. [cited 2023 Mar 31]. Available from: https://wonder.cdc.gov/controller/datarequest/D77;jsessionid=13734817A9FF6575B5B9C1BF1BD4
5. Waldmann V, Narayanan K, Combes N, Marijon E. Electrical injury. BMJ. 2017 Apr 12;357:j1418.
6. Frank CD, John AM, Basil APJ. Electrical injuries: a review of 65 cases. J Trauma Acute Care Surg. 1969 Jun;9(6):497.
7. Gursul E, Bayata S, Aksit E, Ugurlu B. Development of ST Elevation Myocardial Infarction and Atrial Fibrillation after an Electrical Injury. Case Rep Emerg Med. 2015;2015:953102.
8. Neniwal VK, Sharma RK, Meena A. Epidemiological clinical profile and outcome of electric burn at our tertiary care center in Hadoti region. Indian J Burns. 2021;29(1):19-25.
9. Helman A. Electrical Injuries - The tip of the iceberg. [Internet]. Emergency Medicine Cases. 2019 [cited 2023 Mar 31]. Available from: https://emergencymedicinecases.com/electrical-injuries/
10. Wander GS, Bansal RK, Anand IS, Arora S, Khurana SB, Chawla LS. Atrial fibrillation following electrical injury. Jpn Heart J. 1992 Jan;33(1):131–4.
11. Hafeez I, Sohail MM, Lone A, Gupta A, Iqbal K, Aslam K, et al. Low Voltage Electric Injury induced Atrial Fibrillation as a Presenting Feature of Wolff-Parkinson-White Syndrome: A Case Report. Oman Med J. 2013 Nov;28(6):e061.
12. Ozkan S, Kiliç S, Durukan P, Akdur O, Vardar A, Geyik S, et al. Occupational injuries admitted to the Emergency Department. Ulus Travma Ve Acil Cerrahi Derg Turk J Trauma Emerg Surg. 2010 May;16(3):241–7.
13. Bøggild H, Freund L, Bagger JP. Persistent atrial fibrillation following electrical injury. Occup Med Oxf Engl. 1995 Feb;45(1):49–50.
14. Gille J, Schmidt T, Dragu A, Emich D, Hilbert-Carius P, Kremer T, et al. Electrical injury - a dual center analysis of patient characteristics, therapeutic specifics and outcome predictors. Scand J Trauma Resusc Emerg Med. 2018 May 31;26(1):43.
15. Jensen PJ, Thomsen PE, Bagger JP, Nørgaard A, Baandrup U. Electrical injury causing ventricular arrhythmias. Br Heart J. 1987 Mar;57(3):279–83.
16. Chandra NC, Siu CO, Munster AM. Clinical predictors of myocardial damage after high voltage electrical injury. Crit Care Med. 1990 Mar;18(3):293.
17. Xenopoulos N, Movahed A, Hudson P, Reeves WC. Myocardial injury in electrocution. Am Heart J. 1991 Nov;122(5):1481–4.
18. Oltman CL, Clark CB, Kane NL, Zhang Y, Gutterman DD, Dellsperger KC, et al. Coronary vascular dysfunction associated with direct current shock injury. Basic Res Cardiol. 2003 Nov;98(6):406–15.
19. Koumbourlis AC. Electrical injuries. Crit Care Med. 2002 Nov;30(11 Suppl):S424-430.
20. Al B, Yarbil P, Özer HO, Aslan S, Yildirim C, Davutoğlu V. A Rare Complication of Electric Shock: Myocardial Infarction. J Emerg Med Case Rep. 2012 Jan 1;3(1):4–8.
21. Celebi A, Gulel O, Cicekcioglu H, Gokaslan S, Kututcularoglu G, Ulusoy V. Myocardial infarction after an electric shock: a rare complication. Cardiol J. 2009;16(4):362–4.

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