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CASE REPORT

Small Bowel Perforation Resulting From a Lightning Strike Injury: A Case Report

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Abstract: Lightning strike injuries are a relatively common natural phenomenon, but documented cases of lightning causing hollow visceral perforation are extremely rare. In our case, male patient a 50-year-old, suffered acute abdominal pain and burns on the abdominal skin after being struck by lightning. Subsequent tests confirmed a bowel injury, leading to the need for surgery to repair the perforation in the small bowel and evacuate a hematoma in the omentum. This highlights the importance of understanding and addressing the potential medical consequences of lightning strikes.

Keywords: lightning strike, acute abdomen, bowel injury

Introduction

Lightning injuries pose an extreme danger to humans, often resulting in severe damage. The most fatal consequences include cardiac and neurological injuries, with a mortality rate of 20–30%. Cardiac complications are the leading cause of death after lightning strikes. Burns are the second most common injury, ranging in severity from mild to severe.[1,2] Additionally, tinnitus and blindness can occur. It is important to note that hollow visceral injuries after lightning strikes are not commonly documented. Farmers and swimmers are particularly susceptible to lightning strikes.[3,4]

Gastrointestinal complications are uncommon in patients with electrical burns, which account for about 5% of admissions to major burn centers. These burns usually result from high-voltage currents exceeding 1000 volts at 50 hz and often occur in workplace accidents due to direct or indirect contact with electrical energy. The injuries cause damage through heat and electrical current, leading to coagulative necrosis and ruptured cell membranes. The resistance of different tissues to electrical current varies significantly. In nerves and blood vessels low but in fat and bone become high. Consequently, electrical currents of the same intensity can cause different levels of damage, depending on individual susceptibility and the quality of immediate care received at the scene. Electrical burns undeniably sustain injuries at both the entry and exit points of the electrical current. Furthermore, they frequently endure internal injuries that can be far more severe than what is suggested by the visible damage on the skin. It's crucial to recognize the full extent of these injuries for effective treatment and recovery. Simonin reported a perforated small intestine and documented it in 1927, the case of visceral injury, Since then, additional rare cases have emerged, predominantly involving the colon and small intestine. Several vital organs can be affected by various conditions; however, it is noteworthy that organs such as the heart, lungs, esophagus, stomach, pancreas, liver, gallbladder, and kidneys are impacted less frequently. For instance, Glazer described three instances of pancreatic necrosis observed during autopsies of two lightning strike victims and one electrocution victim.[5] Understanding and addressing these injuries is crucial for improving outcomes in patients who suffer from electrical burns. The severity of electrical burns is influenced by factors such as voltage, amperage, the type of current (alternating or direct), flow direction, contact duration, entry point resistance, and individual susceptibility. Tissue injuries can arise from both thermal and non-thermal mechanisms. Electrical currents can modify the transmembrane potential, making muscle fibers and nerves particularly susceptible to damage. Electroporation can lead to cell necrosis without generating heat, and electrical currents may cause

Received: 23 July 2024
Accepted: 2 March 2025
Published: 8 March 2025

Figure 1 Burned abdominal skin.

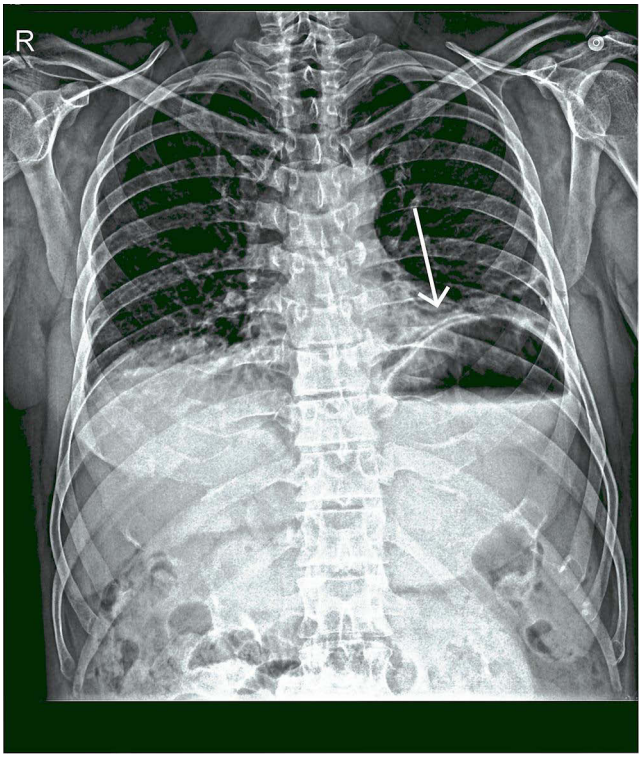

Figure 2 Air under diaphragm (white arrow).

irreversible damage to membrane proteins. Effective management of electrical burns should follow guidelines from the Advanced Trauma Life Support (ATLS), Advanced Burn Life Support (ABLS), and Advanced Cardiac Life Support (ACLS) protocols. Ventricular fibrillation is a known cause of sudden death in the aftermath of electrical burn injuries; thus, rigorous cardiac monitoring during the first 24 hours post-trauma is vital.

Case Presentation

A 50-year-old male soldier with no prior history of chronic diseases or drug and alcohol use, apart from smoking one pack of cigarettes per day, presented to the emergency department seven hours after being struck by lightning at his home when he watched the rain. He exhibited abdominal burns and was experiencing intense abdominal pain. Upon clinical evaluation, the patient was fully conscious, oriented, and cooperative, with a Glasgow Coma Scale (GCS) score of 15/15. He showed no signs of respiratory distress or pallor, but he had a fever of 38°C. A local examination of the abdomen revealed symmetrical distension and skin burns ranging from first to second degree, covering an area of 15×35 cm on the anterior abdominal wall (Figure 1). Tenderness was noted upon palpation, along with guarding. No abnormalities were

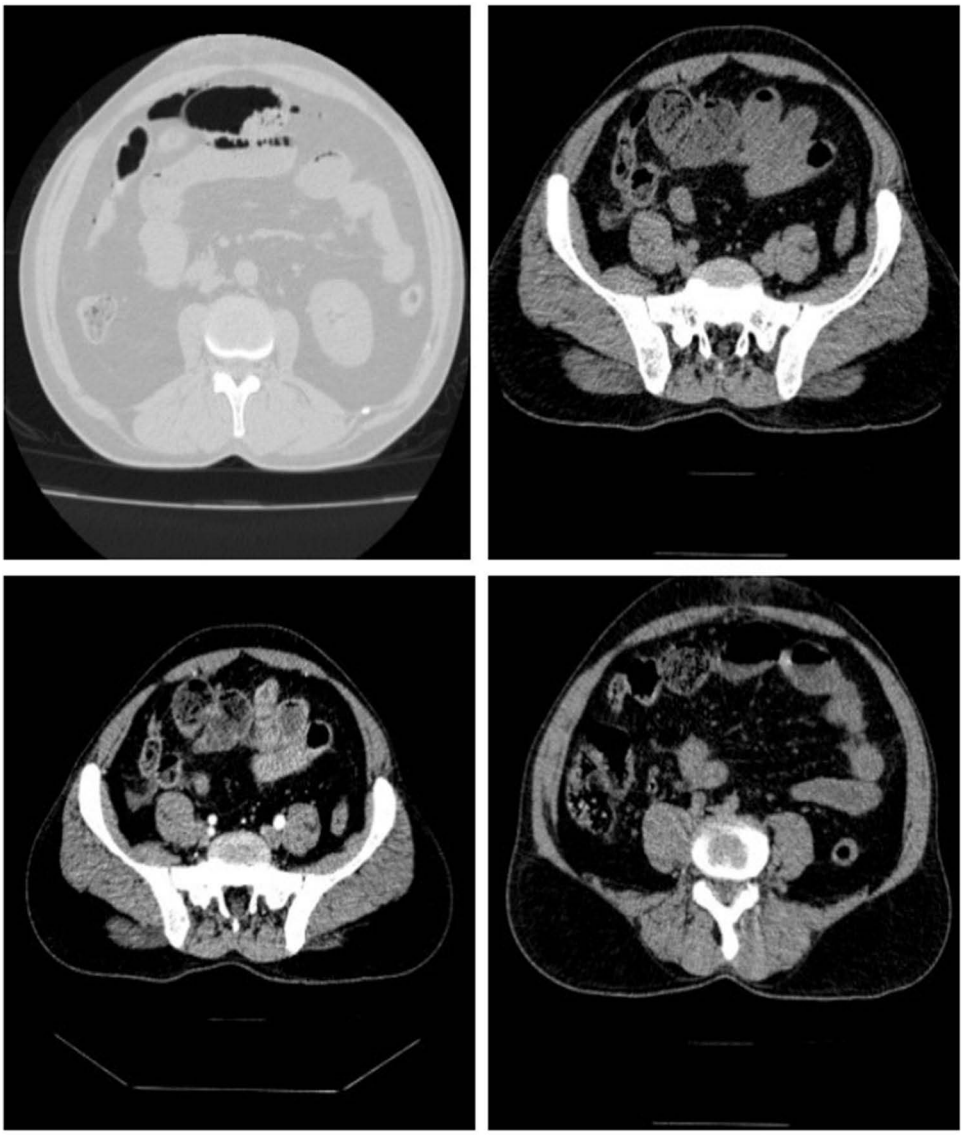

Figure 3 The abdominal CT scan indicates the presence of pneumoperitoneum along with free fluid and hematoma on the omentum.

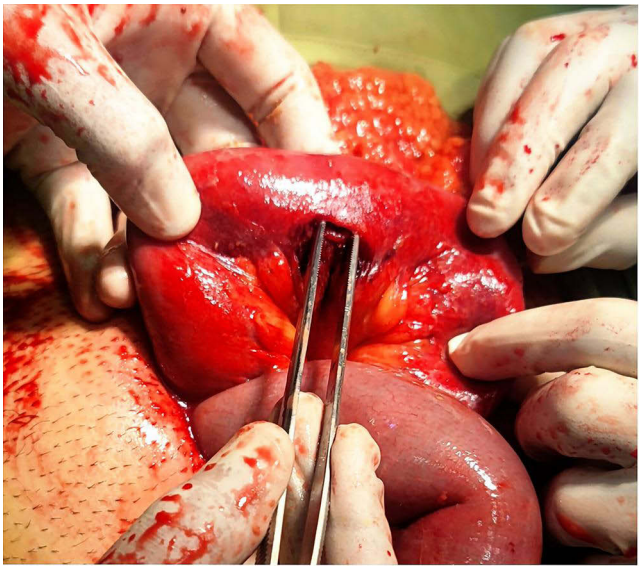

Figure 4 Perforation in the ileum.

Figure 5 Omentum hematoma.

detected in his chest or heart, and the ECG results were normal. His laboratory results were as follows: hemoglobin level of 16.5 g/dL, white blood cell count of 14.2 x 10^9/L, serum creatinine of 1.1 mg/dL, potassium level of 4.2 mmol/L, and a sodium level of 142 mmol/L. The troponin I test was negative, and the CK-MB level was 30 U/L. Following prompt resuscitation with intravenous normal saline and effective pain management, a chest X-ray revealed the presence of air under the diaphragm (Figure 2). An abdominal ultrasound and a CT scan were conducted, which identified a small bowel perforation with free air and fluid in the abdominal cavity, along with a hematoma in the omentum (Figure 3). The patient

underwent an exploratory laparotomy, which revealed a 1×1 cm perforation in the ileum, located 90 cm from the ileocecal valve, as well as a hematoma on the inner surface of the omentum (Figures 4 and 5). A hematoma containing mixed blood from the small bowel was detected, and prompt measures were taken to evacuate it and achieve effective hemostasis. The perforation was successfully repaired using primary closure, and all intra-abdominal organs were examined and found to be normal. The patient was discharged in good health after five days and was scheduled for follow-up outpatient care.

Discussion

The lightning strikes with tremendous force can cause serious harm to the human body, particularly to the heart, blood vessels, and nervous system, often with fatal consequences as case reported by Saglam et al, lightning indirectly led to myocardial infarction.[6] Lightning strikes can also result in severe lung injuries such as pulmonary contusion, hemothorax, and pneumothorax. Burns are a common outcome, and some individuals may even experience tinnitus and blindness.[1] Visceral injuries, while rare, can have serious consequences that lead to significant morbidity and mortality, often necessitating invasive interventions. It is important to consider these types of injuries when managing electrical burns, as their treatment requires a coordinated effort from a multidisciplinary team.[3,4] Abdominal visceral injury can be associated with electrical injury, Williams et al, presented small child girl with terminal ileum perforation post low voltage electrocution, which developed cardiac arrest and expired post surgery.[7] It's important to note that people who live or work in open areas are at significant risk of sustaining serious injuries from lightning.[2] Two cases post lightning strikes, reported in literature, Aslan, Sahin et al report one case with visceral injury and laparotomy exploration done with primary repair for two perforations in the terminal ileum.[8] Also, Kilbas et al presented adult patient with Stomach wall perforation, underwent laparotomy and repair done.[9] In our case report adult male post lightning strikes, with ileum perforation, laparotomy exploration and primary repair done for him, and discharge with good general condition (Table 1).

The potential impact on abdominal organs as a result of electrical current is influenced by factors such as voltage, duration of contact, and the pathway of the current through the body upon direct skin contact. Injuries can vary from minor issues like temporary stomach upset and reduced bowel movements to rare but serious problems such as hollow visceral perforation, gallbladder necrosis, and mesenteric thrombosis, which can occur due to exposure to high-voltage

Table 1 The Documented Cases of Hollow Viscera Injury Post- Lightning Strike

No	Age/Sex	Type of Injury on Abdominal Hollow Viscera	Associated Injuries	Hospital of Admission	Management Result	Time of Injury	References
1	12y/boy	Perforation in the terminal ileum	- Burns on face, neck and abdominal wall - Right pneumothorax - Short-term disturbance in mental status	Department of General Surgery, Atatürk University, Turkey.	The patient has achieved good results and has been discharged in good condition	2004	Aslan, Sahin, et al. Lightning: an unusual etiology of gastrointestinal perforation. *Burns* 31.2 (2005): 237–239.
2	22y/male	Stomach wall perforation	- Cardiac injury inverted T wave in lead 2 and 3 - Pulmonary contusion - Pulmonary hemorrhage - Short-term disturbance in mental status	Department of General Surgery Gulhane Military Medical Academy	The patient died from acute respiratory distress syndrome and pulmonary edema at the 10th postoperative day	2008	Kilbas Z, Akin M, Gorgulu S, Mentes O, Ozturk E, Kozak O, Tufan T. Lightning strike: an unusual etiology of gastric perforation. *Am J Emerg Med.* 2008 Oct;26(8):966.e5-7. doi: 10.1016/j.ajem.2008.01.049. PMID: 18926369.
3	Our case 50y/male	Perforation in the terminal ileum	- Burn on the abdominal wall. - Short-term disturbance in mental status	Department of General Surgery, Al-Hawbani hospital, Bajel, Al-Hodeidah, Yemen	The patient has achieved good results and has been discharged in good condition	2024	

current resulting in blunt abdominal injury, as observed in lightning strikes where there have been two documented cases of hollow visceral injury. As most patients with this type of injury have died before receiving medical assistance.[9,10]

Conclusion

Following the primary survey, it is imperative to thoroughly evaluate individuals who have been struck by lightning for potential high-voltage electrical injuries from head to toe. Emergency physicians must prioritize addressing common causes of fatality, such as cardiovascular and nervous system complications. Pain management, sepsis prevention, and meticulous treatment of burned areas are critical. If a patient experiences acute abdominal pain, it may indicate an internal organ injury, warranting a radiological assessment. In the case of a confirmed bowel injury with free fluid, a laparotomy is essential for thorough exploration and resolution, which can be carried out using open or laparoscopic techniques based on the surgeon's expertise.

Statement of Ethics and Informed Consent

Written informed consent was obtained from the patient, including for the publication of the paper and its content, and approval by Institutional Al-Hawbani Hospital, Bajel, Al-Hodeidah, Yemen, was obtained for the publication of this work.

Acknowledgments

The authors would like to express their utmost gratitude to the patient for their involvement in this scientific work. The authors also would like to express their utmost gratitude to admin Al-Hawbani Hospital for their help in collecting data and using figures to publish this case report.

Disclosure

The authors declare no competing interests in this work.

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