"Thunderstruck": Penetrating Thoracic Injury From Lightning Strike

Oscar J. F. van Waes, MD; Pieter C. van de Woestijne, MD, PhD; Jens A. Halm, MD, PhD

Lightning strike victims are rarely presented at an emergency department. Burns are often the primary focus. This case report describes the improvised explosive device like-injury to the thorax due to lightning strike and its treatment, which has not been described prior in (kerauno)medicine. Penetrating injury due to blast from lightning strike is extremely rare. These "shrapnel" injuries should however be ruled out in all patients struck by lightning. [Ann Emerg Med. 2013;■:1-3.]

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INTRODUCTION

Penetrating injuries as a result of lightning strike are rare, especially in pediatric patients. Referral of lightning strike victims to a burn unit is currently usually advised.[1,2] This article reviews the epidemiology, clinical presentation, and management principles of penetrating injury resulting from lightning strike blast.

CASE REPORT

Male twins aged 8 years presented to our emergency department (ED) after being injured as a result of lightning strike in an alternating current transformer housing. At the strike, the victims were located in a textile dome tent approximately 15 m from the housing.

On physical examination by a dispatched helicopter emergency service team, both patients had a Glasgow Coma Scale (GCS) score of 15 without respiratory distress or hemodynamic abnormalities. The patients were referred to a regional Level I trauma center. On arrival in the ED, they were evaluated with pediatric trauma life support guidelines. During the primary survey, the first patient was normotensive (117/70 mm Hg), with a normal pulse rate of 90 beats/min, a free airway, and a maximum pediatric GCS score. During full exposure, 2 protruding copper wires were noted at the level of the scapulae, as well as a second-degree burn mark on the face. Conventional thoracic radiography revealed no fractures or pneumothorax. Routine electrocardiography showed no signs of cardiac injury. The facial burn wound was treated per protocol and the copper wires were removed surgically under local anesthesia. The patient was admitted to the pediatrics ward for observation and treatment of the burn wound and was discharged the ensuing day.

His twin brother was normotensive (125/65 mm Hg), with a normal pulse rate of 100 beats/min, a free airway, normal chest auscultation bilaterally, and a saturation of 97% without supplemental oxygen. Routine electrocardiography showed no signs of cardiac arrhythmia. Despite a large occipital laceration of 5-by-2 cm, the pediatric GCS score was 15. On inspection of the body, a minute puncture wound was identified at the lateral border of the right pectoral muscle (at the level of the fourth rib). Conventional thoracic radiograph in 2 directions showed a hematopneumothorax on the right side. Furthermore, a foreign body was identified in the thoracic cavity (Figure 1). Additional computed tomographic (CT) angiography revealed a missile trajectory through the lung, a projectile located in lung parenchyma, and an increase of the pneumo- and hematothorax compared with the conventional thoracic radiograph (Figure 2).

During urgent exploratory right-sided anterolateral thoracotomy, the lung lacerations were sutured with polypropylene sutures, and a fragment of copper wire approximately 2 cm long was removed from the dorsal thoracic wall. Two chest drains were inserted. On the second day postoperatively, the 2 chest tubes were removed. The patient was discharged on day 7 after uneventful recovery.

DISCUSSION

Most commonly, lightning strikes act through 1 or more of 5 separate mechanisms recognized in keraunomedicine.[3,4]

Direct strikes by lightning result in current flowing through the body. Additionally, contact voltage, side splash, ground strike, and wire-mediated lightning injury has been described extensively in the literature.[3-5] Only recently have Blumenthal et al[6] added a possible sixth mechanism, in which a nearby strike causes a blast wave to create barotrauma to the hollow viscus of the patient (Table).

In a case report, Blumenthal[7] describes an autopsy of a patient with secondary missile injury to the lower extremities after lightning strike to the adjacent pavement. Small pieces of concrete shrapnel were found embedded within the wounds. The patient died from the lightning strike. Penetrating thoracic blast injury caused by a nearby lighting strike has not been reported previously and is potentially devastating. The authors hence

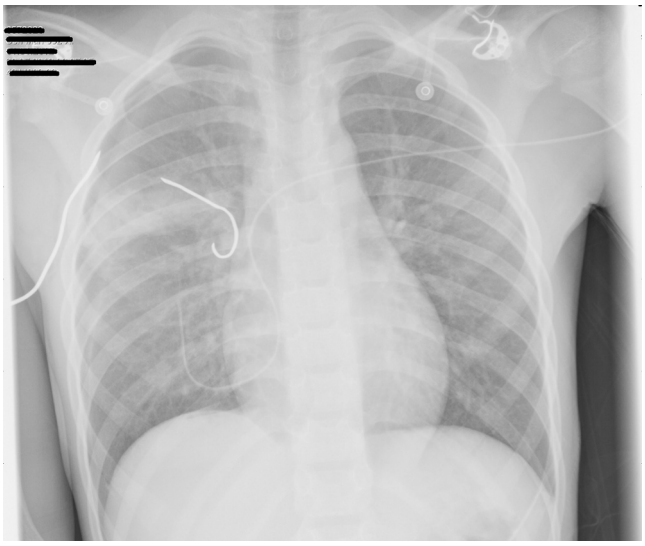

Figure 1. Chest radiograph with "shrapnel" in the right side of the hemithorax.

Figure 2. CT with an improvised explosive device–like trajectory through the lung parenchyma.

propose a seventh type of lighting strike injury: penetrating blast injury caused by lighting strike–induced explosion of a nearby structure (Table).

The penetrating injury pattern and mechanism described in this case have similarities with those observed in victims of improvised explosive devices.[8,9] Blast injuries are commonly categorized by mechanism into primary, secondary, tertiary, and quaternary (eg, burns, toxic effects) injuries. Primary injury is the result of blast overpressure followed by underpressure and affects (air-filled) organs that are stretched beyond their limits. The secondary mechanism results in penetrating injury through shrapnel. In the tertiary mechanism, the patients are hurled by the blast, resulting in blunt trauma from impact.[10,11] Blast injuries with penetrating injury in the civilian setting are rare.[12]

The authors are familiar with the treatment of types of improvised explosive device injuries from deployment in the recent military conflict in Afghanistan, where the victims arrive in the hospital "peppered" by shrapnel, and several body cavities are violated and the respective organs injured. It is of utmost importance to include full and complete exposure during the primary survey in these patients to identify possible sites of injury. Special attention needs to be given to the body folds (neck, axillae, groin, and gluteal) because wounds located there may be easily missed. In the case described in this article, the missile entered the thoracic cavity through a small puncture wound in the axilla, which could have been easily missed, but revealed gross injury to the lung parenchyma at surgical exploration.

Table. Type of lightning strike and ways the human body is affected.

Type	Description	Effect on the Human Body
1	Direct strike	Current flows through the body; high mortality
2	Contact voltage	Lightning strikes an object the victim is touching
3	Side splash	Splashing of current from a nearby direct strike
4	Ground strike	Ground current passes to the victim from the ground strike point
5	Upward streamer	Current flows through the body from the ground upwards
6	Blast barotrauma	Explosion of the air around the lightning channel, causing injury to hollow viscus or fractures by a blast wave
7	Blast penetrating injury	Lightning strike–induced explosion of nearby structure in which shrapnel causes penetrating injuries to patient.

The most common injuries from exposure to lightning are burns, which usually require immediate care in specialized burn units. However, one must be prepared for additional barotrauma and penetrating blast injuries or possible fractures as a result of the pressure wave.

CONCLUSION

Lightning strike victims rarely present at an ED. The range of injuries is broad and often burns are the primary focus. Lightning strike resulting in improvised explosive device–like blast injuries has now been added to its possible trauma mechanisms. These "shrapnel" injuries should be ruled out in all patients struck by lightning.

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Author affiliations: From the Department of Trauma Surgery (van Waes, Halm) and Department of (Paediatric) Cardiothoracic Surgery (van de Woestijne), Erasmus MC, University Medical Centre Rotterdam, Rotterdam, the Netherlands.

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Address for correspondence: LTC Oscar J. F. van Waes, MD, E-mail o.vanwaes@erasmusmc.nl.

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