

## CASE REPORT

# Lightning Strike in Pregnancy With Fetal Injury



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Injuries from lightning strikes are an infrequent occurrence, and are only rarely noted to involve pregnant victims. Only 13 cases of lightning strike in pregnancy have been previously described in the medical literature, along with 7 additional cases discovered within news media reports. This case report presents a novel case of lightning-associated injury in a patient in the third trimester of pregnancy, resulting in fetal ischemic brain injury and long-term morbidity, and reviews the mechanics of lightning strikes along with common injury patterns of which emergency providers should be aware.

**Key words:** lightning strike, lightning injury, electrical injury, pregnancy, fetal injury, third-trimester injury

## Case Report

### PREHOSPITAL COURSE

After a Fourth of July fireworks show in the Southwestern United States, a family was packing up because of a distant but rapidly approaching thunderstorm, when witnesses described a sudden bright flash followed by an earth-shaking boom. Two of the family members dropped unconscious to the ground. In the background, a car horn apparently began blaring as a result of electrical system damage caused by the lightning power surge. A bystander called 911, noting that both victims were unconscious but still breathing. The local fire engine and fire rescue were finishing up another response less than 1.6 km away when the call came in.

The engine was the first to arrive on the scene, with the paramedics close behind. A quick assessment of the scene revealed no immediate hazards or fire, with 2 patients on the ground, both slightly slow to respond but awake, alert, and oriented to person, place, time, and situation. The first patient was a 22-year-old woman, 37 weeks 5 days pregnant, gravida 4, parity 3 (0-1-2), with mild patchy erythematous lesions to her chest and a 5-mm circular lesion at the tip of her left thumb, with no additional visible trauma. Her only complaint was lower back and bilateral calf pain; she had no other complaints on further review of systems, and no past medical history. The second patient was a 32-year-old man

complaining of left ear pain and hearing loss, numbness and tingling in his arms and legs, and pain in both feet. Examination demonstrated erythema and singed hair of the chest, along with mild erythema of the right flank and calf, and mild drainage from the left ear canal. He reported no past medical history. Both patients were rapidly transported to a level-1 trauma center to prevent further additional injury and exposure from continued rain and thunderstorms. En route to the hospital, more detailed evaluation revealed no additional injuries or burns, and vital signs were normal with the exception of mild tachycardia in both victims. The man's initial electrocardiogram (ECG) demonstrated sinus tachycardia at a rate of 102 beats/min without any ectopy or arrhythmia, and the woman's ECG also demonstrated sinus tachycardia of 105 beats/min, with no evident abnormalities.

### EMERGENCY DEPARTMENT AND HOSPITAL COURSE

On arrival at the emergency department at 2220 hours, the female patient's primary survey revealed a patent airway with normal phonation. Breath sounds were equal bilaterally, with mild tachypnea at 22 breaths/min but no respiratory distress. Circulatory assessment revealed tachycardia at 116 beats/min with normal cardiac tones and symmetric distal pulses throughout, with well-perfused skin. Evaluation for disability revealed a Glasgow Coma Score (GCS) of 15 and symmetric movement of all 4 extremities. On exposure, there was no evidence of gross deformities, and the patient's skin was mildly damp from the rain. A detailed secondary

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survey was performed. Head, eyes, ears, nose, and throat examination was unremarkable, with normal pupils, normal nares, and normal oropharynx. There was no evidence of tympanic membrane rupture, including no hemotympanum or otorrhea. The neck was atraumatic and nontender. The chest was atraumatic with normal breath sounds bilaterally. The patient's abdomen was notable for a gravid uterus above the level of the umbilicus, and was soft and nontender throughout. The pelvis was stable and nontender. The skin was mildly damp but warm, and initially had no rash or lesions. The extremities were nontender with a full range of motion without any discomfort. Neurologic examination revealed intact cranial nerves, 5/5 motor strength with intact sensation in all 4 extremities, and 2+ deep tendon reflexes in all 4 extremities. Bedside fetal ultrasound revealed a well-developed fetus with a heart rate of 155 beats/min, after which the obstetrics and gynecology service was immediately consulted. During the subsequent hour, the patient's skin developed Lichtenberg figures ("ferning") on her right flank and right lateral thigh.

Around 0130 hours, the patient was taken for an emergency cesarean section because of decreasing fetal activity with nonreassuring fetal heart tracings that demonstrated tachycardia and minimal variability, and a biophysical profile score of 2/10. A 2.8-kg female infant with Apgar scores of 4 and 7 was transferred to the neonatal intensive care unit with respiratory distress and depressed neurologic status. The neonate experienced periodic episodes of shaking and was initiated on fosphenytoin owing to concerns of seizure activity. Electroencephalogram (EEG) on the first day of life revealed abnormal burst suppression and diffuse cerebral dysfunction. This was further compounded by a magnetic resonance image on day 2 of life demonstrating bilateral symmetric areas of ischemia involving the posterior limbs of the internal capsules. Although there was some improvement in the level of cortical dysfunction noted on a repeat EEG 2 weeks later, the patient was ultimately diagnosed with diffuse cortical injury. All 10 previous prenatal care visits, including 3 fetal ultrasounds, had revealed no evidence of abnormalities, and there was no history of congenital aberrancies in the siblings or extended family. One month later, the neonate required placement of a gastrostomy tube for failure to thrive. On follow-up at 1 year, the child had marked developmental delays and was unable to sit up, crawl, or swallow food adequately. The patient still requires a feeding tube for nutrition.

The mother was discharged home on postoperative day 4 without any complications, although she continued to experience muscle spasms in her lower back and bilateral calves on reassessment 1 week after the event. She presented with new-onset depression 3 weeks later.

The male patient was found to have an isolated ruptured left tympanic membrane, and was discharged home 2 days later with persistent mild symptoms. On reevaluation 1 week later, he had yet to regain any hearing in the left ear, and required a cane for stabilization secondary to bouts of vertigo.

## Discussion

### LIGHTNING INJURY PATTERNS

Skin findings in lightning burns most commonly present in 4 patterns: linear, punctate, Lichtenberg figures, and thermal. Linear burns are generally first- to secondary-degree burns between 1 and 4 cm wide, and are caused by vaporization of sweat or rain.<sup>1,2</sup> Punctate burns generally present as multiple subcentimeter lesions too small to require invasive treatment. Lichtenberg figures, also known as flowering, feathering, or ferning, are pathognomonic of lightning. These are transient skin findings that resolve within minutes to hours, and are not actually burns, as there is no damage to the skin and no evidence of histologic changes.<sup>3-6</sup> It is thought that the slightly palpable pattern, pink to brown in color, is caused by the electron current path during flashover. Thermal burns from clothing or metal objects touching the skin result when the object becomes superheated during the extreme current flow.<sup>2</sup> Victims may exhibit one or more combinations of the different burn types. Because of the minor and superficial nature of many lightning burns, they may take several hours to manifest clinically.<sup>7</sup> Patients with burn patterns to the head and face have a higher mortality rate.<sup>8</sup>

Lightning injuries should not be treated like other high-voltage injuries owing to many factors. Most notably, lightning exposure is on the order of milliseconds, whereas typical high-voltage injuries tend to involve a more sustained connection with an electrical source. Per Joule's law ( $\text{energy} = \text{current}^2 \times \text{resistance} \times \text{time}$ ), the total energy is proportional to the length of exposure to a current source. The brief energy exposure from lightning results in flashover, in which the electrical current rapidly flows over the external surface of the victim's body, potentially vaporizing moisture on the skin, which can blast apart clothes and shoes. Flashover spares most lightning victims from sustaining more than minor burns. Discrete entry and exit points are rare in mild to moderate lightning injury because of the limited amount of time of exposure to the current, and fasciotomy is rarely required in victims of lightning strike.<sup>7</sup> Sustained exposure from other high-voltage sources can result in skin breakdown and secondary flow of current within the body, resulting in greater internal burns. In contrast to other types of high-voltage injuries, lightning

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