Lightning Injury With Survival in Five Patients

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Of a total of 4,153 admissions, five patients with lightning-associated injuries were admitted to a burn center during a 15-year period, 1969 through 1983. In these patients, the burned portion of the total body surface ranged from 3% to 23% (average, 16%), and all survived. The associated injuries and complications in these "lightning-strike victims and a review of treatment guidelines are presented (JAMA 1985;263:243-245).

LIGHTNING injury is uncommon, as evidenced by the fact that most physicians have never treated such a victim, yet its rarity does not diminish the interest in, or severity of, this fascinating injury. Reports of lightning injuries range from the anecdotal to collective reviews of large numbers of patients injured in natural electrocutions. The physician must understand the pathophysiology, treatment, and initial and potential complications of this severe form of high-voltage electric injury to treat patients with such injury effectively.

There were 4,153 admissions to the US Army Institute of Surgical Research Burn Center during a 15-year period, 1969 through 1983, of which five were for lightning-associated injuries. These five patients survived; all were treated and resuscitated appropriately on arrival at each of the respective receiving hospitals.

Their treatment and hospital courses are described, along with comments on the pathophysiology of such injuries and a review of treatment recommendations. If present, serious complications such as myoglobinuria, cardiac arrhythmias, fractures, abnormal neurological symptoms, or visual or auditory aberrations experienced during the hospital course are cited.

Report of Cases

Case 1.—A 16-year-old boy sustained a 23% total body surface (TBS) burn when he was struck by lightning. The lightning bolt first struck a television antenna on a nearby trailer, arced, and struck him. He was thrown to the ground with his clothing on fire. He did not lose consciousness and was immediately transported to a hospital. On route, premature ventricular contractions were noted on the cardiac monitor, but his ECG reverted to normal sinus rhythm on arrival at the hospital. His condition remained stable, and after administration of intravenous fluids was initiated, he was transferred to our burn...
CASE 3.—A 22-year-old man sustained a 14% TBS burn when he and 20 other soldiers were standing near a tree as it was struck by lightning. Many of the men suffered a brief shock, but only this patient received serious injuries. He allegedly lost consciousness for two to three minutes. He was resuscitated at a hospital and underwent bilateral lower-extremity fasciotomies. On arrival at our burn center, his physical examination was remarkable for four small entry burns on the right flank; both feet and both legs were grossly edematous; fasciotomy incisions were present bilaterally; distal pulses were palpable; and exit wounds were noted on the toes of both feet and on the dorsum of the right foot. There was no plantar sensation in either foot. The patient did not experience any serious complications during his 65-day hospital course. He regained sensation in both feet and areas of third-degree burn were excised and autografted. He was discharged fully healed.

CASE 4.—A 14-year-old boy sustained a 12% TBS burn when a lightning bolt struck the bathroom in which he was seated. The associated explosion blew off the bathroom's outer wall, and the patient was found semicomatose. He was resuscitated, and there was ECG evidence of subendocardial myocardial infarction. On physical examination, he had bilateral perforated tympanic membranes, normal sensorium and neurological examination findings, and a partial-thickness burn in a serpiginous pattern extending down the anterior and posterior sides of the trunk (Fig 2). He was transferred to our burn center on the third postburn day in stable condition. No other symptoms or complications developed during his hospital course, and his burns healed spontaneously. He was discharged with persistent but not progressive ECG evidence of subendocardial myocardial infarction and decreased auditory acuity secondary to bilateral perforated tympanic membranes.

CASE 5.—An 11-year-old boy sustained a 29% TBS burn caused by a combination of lightning and high-voltage electric power line contact injury. A lightning bolt struck a power line directly above the head of the patient, arced, and knocked him to the ground. The power line then fell on his right shoulder. He lost consciousness, and a bystander gave external cardiac massage, for which the indications were unclear. On arrival at our burn center, he was in moderate distress with a 29% TBS burn of which 20% was full thickness. He was resuscitated, and during his 43-day hospital course all full-thickness burns were excised and autografted. The patient was discharged in stable condition, fully healed, and without neurological deficit.
Lightning Victims Data Summary

<table>
<thead>
<tr>
<th>Patient No.</th>
<th>Associated Burn</th>
<th>Loss of Consciousness</th>
<th>Associated Injuries and Complications</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Clothes ignited</td>
<td>No</td>
<td>Premature ventricular contractions (resolved)</td>
</tr>
<tr>
<td>2</td>
<td>None</td>
<td>No</td>
<td>None</td>
</tr>
<tr>
<td>3</td>
<td>None</td>
<td>Yes</td>
<td>Bilateral lower-extremity swelling requiring fasciectomy</td>
</tr>
<tr>
<td>4</td>
<td>None</td>
<td>Yes</td>
<td>Subendocardial infarction, bilateral ruptured tympanic membranes</td>
</tr>
<tr>
<td>5</td>
<td>High-voltage electric burn</td>
<td>Yes</td>
<td>Median nerve neuropathy</td>
</tr>
</tbody>
</table>

### Results

A summary of the associated injuries and complications noted in the five patients is presented in the Table. The burned portion of the TBS ranged from 3% to 29% (mean, 16%). Two patients (patients 2 and 4) sustained only partial-thickness thermal injuries that healed spontaneously. In the other three patients (patients 1, 3, and 5), the average full-thickness injury was 12% (range, 4% to 20%). There were no deaths, and the hospital stay ranged from eight through 11 days after the patient was struck. 

### Comment

The extent of injury is related to the power, duration, and site of entry of the lightning bolt and to the position and grounding of the victim. The thermal injuries are, to our knowledge, unique with respect to the arborizing or serpiginous pattern of dermal burn (Figs 1 and 2) caused by the splash effect of the arcing by lightning while standing on a balcony in a thunderstorm. Another associated injury frequently seen in lightning victims is damage to the ear. Tympanic membrane rupture is the most common injury in this category. Bilateral tympanic membrane rupture as noted in patient 4 is treated as in any other patient and may be associated with hearing loss.

Crichtley has described the main types of neurological injury attributed to lightning. In particular, the aftereffects that he cited included peripheral nerve lesions, isolated and multiple. Only one of our patients, patient 2, had a peripheral neuropathy develop, evidenced by median nerve deficit that was confirmed by EMG. This injury was especially unfortunate, since she had been a concert pianist and at the time of the accident was employed as a piano teacher.

A late complication that seems to be related to lightning is the development of cataracts. Noel et al noted that this cause and effect relationship was first described by St Yves in 1722, and that 90 cases had been subsequently reported in the literature by 1972. We noted no visual aberrations in any of the five patients, nor did any cataracts develop while the patients were in our center. However, it is possible that cataracts could have developed after even the longest hospital stay of 65 days.

In summary, victims of lightning injuries may be seen initially with a characteristic arborizing or serpiginous superficial dermal burn pattern. Since the effects of lightning injury may produce coma lasting from several minutes to several days, cardiopulmonary resuscitation should be immediately instituted and continued until the degree of cerebral function can be fully assessed in any individual with no spontaneous respirations at initial examination. Other resuscitative measures include maintenance of vital signs, appropriate fluid administration, tetanus prophylaxis, and antibiotics when necessary. Awareness and prompt treatment of associated complications is also an integral part of the treatment of the lightning-strike victim.

### References