Pathological Features of Death From Lightning Strike

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Summary

Lightning strikes cause more deaths in the United States than other natural disasters, such as hurricanes, tornadoes, volcanoes, and floods. Lightning is a transfer of an electrical charge and results from the sudden environmental discharge of static electricity. The power of lightning is estimated to be between 10,000 and 200,000 A of current, with estimated voltage ranging from 20 million to 1 billion V. The effects of lightning on the human body depend on a number of features, such as the intensity of the current, the time it spends passing through the body, the pathway involved, the activity and position of the person at the time of the event in relation to the ground, and the kind of strike (direct strike, contact voltage, side splash, ground strike, or wire-mediated lightning). Lightning strikes result in multisystem dysfunction, and survivors may experience prolonged disability following recovery from the initial insult.
Electrical energy causes muscular spasm and necrosis, thrombosis, blood vessel tears, unconsciousness, and motor and sensory function abnormalities. Most deaths after lightning strikes occur either because of primary cardiac arrest or hypoxia-induced secondary cardiac arrest. If multiple persons are struck, attention at the scene should be directed first to those who appear dead, because they may be in respiratory arrest and in urgent need of immediate cardiopulmonary resuscitation that can be successful in lightning strike victims for far longer than would seem reasonable in other types of injury.

**Key Words:** Lightning strike; lightning injuries; direct strike; ground strike; contact voltage; side splash; side flash; wire-mediated lightning; flashover; Lichtenberg figures; burns.

1. **INTRODUCTION**

Lightning is a transfer of electrical charge resulting from the sudden environmental discharge of static electricity sandwiched between an upper negative-charged region, such as thunderheads, and a lower positive area (1). When voltage between two oppositely charged fields exceeds atmospheric resistance, discharge occurs (2). The most common types of lightning strikes are intracloud (the majority of discharges) and cloud-to-ground (some 20%), with ground-to-cloud and cloud-to-cloud lightning occurring only rarely (2–4). However, a lightning strike may occur under fair weather conditions from a clear sky, far from any thunderstorm clouds (5-8). Cherington and colleagues (9) discussed a case where the discharge originated in a cumulonimbus cloud that was approx 10 miles away and that was obscured by mountains. They called this phenomenon a “bolt from the blue.”

The power of lightning is estimated to be between 10,000 and 200,000 A of current, with estimated voltage ranging from 20 million to 1 billion V (10-12). A strike produces an intense burst of thermal radiation of up to 30,000 K within milliseconds and is accompanied by a shock wave of up to 20 atm that can contuse or perforate human organs (10,11,13,14). Electrical energy follows the path of least resistance. Because tissues that have a low water and electrolyte content have a higher resistance, tissue resistance decreases in the following order: bone, fat, tendon, skin, muscle, blood vessel, and nerve (4,11,15,6). The most important resistor to the flow of current is skin. Skin resistance varies from 1000 ohms on a sweaty palm to 1 million ohms on a dry, calloused hand (11). The phenomenon of current traveling on the surface of wet skin without much penetration to deeper tissues is called “flashover” (1-3,14). If it is raining or the person is perspiring, the water can vaporize with such force that the clothes are shredded and the shoes are blown off (2,14).