Case Report

Lightning Death: A Case Report

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Abstract

Death due to lightning is a rare phenomenon in day to day autopsy. Even though, fatalities due to lightning are more in rainy, hilly areas, such cases are rarely encountered in and around Bangalore. Lightning is mostly associated with rain and many a times electrocution are also commonly seen which has to be differentiated from injuries due to lightning. Adults and elderly are people involved in lightning related injuries and many are non fatal but, if children are involved it may lead to a fatal consequence. Such parameters are to be studied in cases of fatal lightning death in both adults and children. Lightning fatalities are rarely read in literature in medical science and lot needs to be studied in this view as many bread earners are involved in such fatalities. In a country like India where the climate is of both tropical and subtropical type study about lightning deaths needs more emphasis in aspects of both treatment and prevention of human fatalities. Here, one such fatal case of lightning of a child is reported, though uncommon in children than in adults.

Key Words: Lightning, Injury, Death, Electrocution, Fatalities

Introduction:

In many cultures, lightning has been viewed as part of a deity or a deity itself including the Hindu God Indra. In French and Italian culture it express “Love at first sight”.

For some political parties such as the People’s Action Party in Singapore and the British union of Fascists lightning flashes are symbol of power. [1] Lightning is defined as a momentary, atmospheric, transient, high current electric discharge whose path length is measured in kilometers from sky to earth.

In lightning, very high voltages and amperages are involved and happen when highly charged thunder cloud discharges via a huge arc to the ground. Most lightning discharges are within clouds, while some cause electrical discharge from a cloud to earth. Most human deaths are caused by cloud-to-earth lightning strikes. [2]

Lightning injury can occur in five ways: direct strike, orifice entry, contact, side flash, and blunt trauma. The primary cause of death in victims of lightning strike is cardiac arrest, which may be associated with primary ventricular failure or asystole.

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Lightning acts as an instantaneous, massive direct current shock, simultaneously depolarizing the entire myocardium.

In many cases intrinsic cardiac automaticity may spontaneously restore organized cardiac activity and a perfusing rhythm. But concomitant respiratory arrest due to thoracic muscle spasm and suppression of the respiratory center may continue after return of spontaneous circulation.

Unless ventilation is supported, a secondary hypoxic (asphyxial) cardiac arrest will develop. [3] In fact, lightning injuries have panoply of clinical signs and several pathologies might follow, among which brain injury; sensory-neural hearing loss; esophageal perforation; and even polyradiculoneuritis.

If this list of particularities is incomplete, nevertheless it is clear that cardiac arrest or fatal arrhythmias represent the main cause of immediate or sudden death; but renal failure, septicemia and other complications might have their role.

Generally, under the term ‘electrocution’ authors include lesions caused from the accidental contact with an electricity conductor (fulguration); lesions related with the discharge of atmospheric electricity (lightning); and tissue damage due to the creation of an electrical arc (burn).

Authors have as well classified through a diversity of ways the electrical lesions that lead to thermal tissue damage and depending on the gravity of the situation; with the lesions classified in electrical petechiae; erosive lesions; necrotic

wounds and carbonization of the corpse in extremely severe electrical shocks.

Apart from all this obvious external signs, lightning is notorious as well for a very particular cutaneous sign, namely the Lichtenberg figures, which are not burns, but arborescent red areas on the skin following such an injury, described initially from the German physicist Georg Christoph Lichtenberg in 1777. [4]

Case Report:

An eleven year old female child, resident of a village around 100 kms from Bangalore is said to have sustained lightning at around 8.30 pm on 28th April 2012. On the next day, 29th April 2012 the child developed fever, vomiting and generalized edema and was taken to a local hospital for treatment. As the condition deteriorated the child was referred to higher center for further treatment on 30th April 2012.

Clinical Findings:

Medical examination of the child revealed irritable general condition, absence of pulse and blood pressure. Cold peripheries, cyanosis and generalized edema were noted.

Respiratory examination revealed the presence of surgical emphysema. Later the child is said to have succumbed to the same on 30th April 2012.Treatment with Inter-costal drainage, IV fluids and anti-inflammatory drugs were done.

Post-Mortem Findings:

Externally Edema was present. On internal examination Organs were congested with petechiae present in the white matter of the brain. Lungs exuded blood mixed with froth.

Histo-Pathological Examination:

1. **Brain:** Congestion and edema
2. **Lungs:** Multiple sections studied show widened alveolar septae with numerous congested capillaries and edema. Bronchioles appear within normal limits. Occasional alveoli show Intra-alveolar haemorrhages.
3. **Liver:** Dilated and congested sinusoids.
4. **Heart:** Left circumflex artery, right coronary artery, left anterior descending artery are within normal limits. Aorta and pulmonary artery are within normal limits. Both atria and ventricles are within normal limits.

Based on Post-mortem findings, Histo-pathological examination report, cause of death was opined as "**Death is due to surgical emphysema, consistent with lightning**".

Discussion:

Lightning is unique from other forms of generator-produced high-voltage electricity. One must understand the physical properties of lightning to understand the spectrum of injuries incurred from a lightning strike. The duration of exposure is the single most important factor in understanding the difference between high-voltage injuries and lightning injuries. [5]

Lightning is a unidirectional massive current impulse to be clearly differentiated from direct or alternating current. Lightning occurs when the large potential difference between cloud and ground, measured in millions of volts, is broken down. Upon attachment, this potential difference disappears as an enormous current flow impulsively for a short time. Thus, lightning is best thought of as a ''current'' phenomenon rather than a ''voltage' 'phenomenon. [6]

According to Joule's law (energy = current^2 _ resistance _ time), as the resistance goes up, so does the heat generated by the passage of the current. In humans, when low energy levels are encountered, much of the electrical energy is dissipated by the skin.

It takes a finite amount of time for the skin to break down when exposed to heat or energy. After lightning meets the body current it is initially transmitted internally, after which the skin breaks down and there is an external ''flashover.''

As current flashes over the outside of the body it can vaporize moisture on the skin and blast apart clothes and shoes, leaving the victim nearly naked. While the current from a lightning strike only flows internally for a short time, it can cause short-circuiting of electrical systems such as the heart, respiratory centers, and autonomic nervous system, as well as spasm of arterioles and muscles. [7]

India had 473 lightning deaths from 1982 to1989. [8] The number of fatalities ranged from 117 in 1983 to 28 in1987. The resulting annual fatality rate of 0.1deaths per million people seems very low in view of several factors.

First, at least two thirds of the population of India lived in rural areas during this period. Second, the author describes that the majority of the lightning deaths occurred in the country side. Finally, a report for a portion of one year in the state of Orissa (Table 1) found an annual rate of 2.5 deaths per million. Since India is so populous, a better determination of its rate has a major effect on the lightning death rate worldwide. [9]

A study by Asha Nath et al shows the variation of lightning storms in different geographic regions of India, annual variation, surface temperature, thermodynamic structure, occurrence of thunderstorms and development of lightning in relation to temperature change of

surface air, comparative study of lightning flash count between pairs of typical land/ oceanic regions of India, and a correspondence between lightning flash count and climate regimes over India. [10] All these parameters are to be studied for further research.

Conclusion:

Adults and children are to be educated about the dangers of lightning. Precautions are to be taught to children at schools and at home.

Precautions for Avoiding Lightning Injury:

The key to safety is individual education and responsibility. The exceptions to this rule are when adults are in charge of groups of children and for large, planned events. In the former situation the adult must assume responsibility for the children and have a plan for evacuation. A simple motto to teach children is *"If you see it, flee it; if you hear it, clear it."*

The ''30-30 rule'' states that when the time between seeing lightning and hearing thunder is 30 seconds or shorter, persons are in danger and should be seeking shelter.

Outdoor activities should not be resumed for 30 minutes after the last lightning is seen or the last thunder is heard. Because lightning can strike where there is no rain, people should not delay evacuation just because there is no rainfall. [11]

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Table 1: National rates of Annual lightning deaths per million people during the first decade of the 21st century

Country	Decadal fatality rate	Maximum annual rate
Bangladesh	0.9	0.9
Brazil	0.8	0.8
Canada	0.1	0.3
China	0.5	0.7
Guangdong	0.9	0.9
Guizhou	1.2	1.2
Hainan	10.6	10.6
Hong Kong	0.04	0.04
Greece	0.2	0.4
India (Orissa)	2.5	2.5
Lithuania	0.1	0.1
Malaysia	3.4	3.4
Nepal	2.7	2.7
South Africa (rural)	8.8	8.8
South Africa (urban)	1.5	1.5
Srilanka	2.4	2.4
Vietnam	1.2	1.2
Bac Lieu	8.8	8.8
United States	0.2	0.2
Yemen (Saada)	71.4	71.4
Zimbabwe	14.2	14.2