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Case Study *Medical research*

Mass fatality following lightning stroke: Analysis of six cases

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ABSTRACT

Lightning is a natural phenomenon of high energy discharge occurring from cloud to earth. It causes disastrous effect on human being creating a medical emergency in spite of its momentary action. Since it is attracted by highest conducting objects, people taking shelter under a tall tree or metallic roof are the commonest victims. Lightning can cause damage to any organ system, but the immediate cause of death in most cases is cardiac asystole. There may or may not be any external detectable injury. If present, it may be superficial burn or dermal deposit of metal from object worn or carried by the victim. Due to blast action, clothing may be torn or in some situations blown off; making the victim virtually naked. Without any external injury and with histopathological examination returning negative results, forming an opinion regarding cause of death becomes very difficult. In such situations, reliance may have to be placed on examination of clothing along with circumstantial evidence to arrive at an opinion about the cause of death.

Exact incidence of lightning related death is not known because of under reporting of cases. Those reported too are mostly in local newspapers and on many occasions involve one or two victims rather than a mass casualty, thus attracting less media attention. Such an accident took the lives of six victims in Barpeta district of Assam on a rainy afternoon. The cases are presented and discussed in this paper with reference to the autopsy findings.

Keywords: Lightning; cardiac asystole; autopsy.

INTRODUCTION

Lightning is weather related highly localized natural phenomenon causing disastrous direct and indirect effects to civilians globally. It is considered the most powerful and spectacular atmospheric hazard that mankind has ever encountered throughout history. Lightning and thunderstorm were earlier interpreted as divine punishment and such irrational beliefs persisted until Benjamin Franklin in 1752 proved it to be a form of electric discharge.[1] Lightning is usually caused by high current electric discharge formed in the atmosphere between the clouds and the earth. The path is usually in the range of few kilometers, and the movement is downwards in a zigzag and branched pattern. It can be characterized by an extremely strong current for a short exposure period; injuries being caused by electrical energy, high temperature gradient and/or explosive power of the blast.[2]

Worldwide, mortality from lightning is estimated between 0.2 and 1.7 deaths/1,000,000 people, affecting mainly the young and those people working outdoors.[3] In India, lightning related fatal incidences are reported frequently mostly from Orissa, Bihar, Uttar Pradesh, Maharashtra. According to NCRB report of 2015, there were 25.1% lightning related deaths out of 10,510 accidental deaths attributed to nature all over India. The rate was low in

Assam, taking lives of 8.9% individuals out of 236 natural accidental deaths.[4]

In this paper, we are describing six dead victims following lightning flash with respect to their autopsy findings; occurring in Barpeta district of Assam.

CASE HISTORY

Six victims of lightning strike were brought to the tertiary centre of Barpeta district of Assam on 15th August, 2015 for medico-legal autopsy.

The unfortunate accident was reported on 15th August, 2015; about 20 km from district headquarter of Barpeta; Assam. There was heavy rainfall on and off throughout the day since the morning. The six victims, out of whom four were adult male and farmer by occupation; came to a nearby weekly market to sell their cultivated crops in the morning. Two children, one girl and another boy of age around 10-12 years were also accompanied by their respective fathers. After completing trading activities at around 2 pm, they all gathered near the bank of river; which they have to cross to reach their village. Although, raining had stopped; the weather was extremely bad with occasional lightning and thunderclap. All of a sudden heavy storm started which was followed by rain. Hence, they were in a hurry to reach home and somehow boarded into the non-motorized boat regularly used to cross the river. Suddenly, a lightning with heavy thunderclap attacked them directly which was seen by two people working in a paddy field about half a km away. Suspecting some unfortunate happening, they rushed to the spot and found the victims in an unconscious state. They immediately gathered few villagers and took the victims to a nearby primary health centre where all were declared brought dead.

Table no. 1: Autopsy findings of all the victims.

Cases	Age/Sex	External findings	Internal findings
Case 1	28 years/ Male	Superficial burn and singeing of hair seen over chest and abdomen, vest is torn over chest (Fig.1).	Organs are congested. Petechial hemorrhage seen over heart and lungs.
Case 2	55 years/ Male	Superficial burn and singeing of hair seen over anterior aspect of both thighs, clothes (long pants) are torn over left knee (Fig.2)	Organs are congested.
Case 3	11 Years/ Female	Superficial burn over chest, metal deposit over upper chest (Fig.3).	
Case 4	10 Years/ Male	Superficial burn seen over right arm, contusion of size 3 cm x 2 cm seen over occipital region of scalp.	
Case 5	32 years/ Male	Lichtenberg figure seen over left upper chest (Fig.4). No burn injury seen anywhere in the body.	
Case 6	37 years/ Male	Laceration of size 2cm x 1 cm x bone deep over right side of forehead, singeing of chest and thigh hairs. No burn injury seen.	



Figure: 1 superficial burn and singeing of hair over chest and abdomen in an adult victim.



Figure: 2 Torn long pants at the level of knee joint in an adult male victim.



Figure: 3 Metallization over chest in a girl victim.



Figure: 4 Lichtenberg figure over left side of upper chest (arrow mark).

AUTOPSY FINDINGS

Autopsy of all the victims were conducted on the same day of the incident i.e. on 15th August, 2015 at the mortuary of the tertiary care center, Barpeta (Assam). Autopsy findings are presented in Table 1.Histopathology of heart, lungs and kidney showed no significant findings. Result of chemical examination of viscera also ruled out presence of any poison.

DISCUSSION

Lightning is a naturally occurring global phenomenon. Although, they occur within clouds, discharge from a cloud to earth causes most of the fatalities.[5] Cooper described it as a current phenomenon rather than voltage.[6] It arises from the polarization of water particles of a cloud whose negative charges (mostly located in lower part) are attracted by the positive charge of the earth, causing a mass movement of electrons. This massive energy discharge can move up to 13 kilometers with a heating effect of 50000 F, potential of more than 100 million volts and an intensity of 12,000-20,000 Amp for a transit amount of time i.e. 0.02 seconds. Due to high temperature, air pressure is increased producing a powerful shock wave, which causes the well-known acoustic effects of thunder.[7, 8]

Upon striking, lightning causes injury by the following mechanisms[6]: (1) Direct strike, (2) Ground current (step voltage) - peripheral spread from the direct attacking object through ground, (3) Flash discharge (side flash) - jumping of discharge from the primary object, (4) Contact strike - by direct contact with the primary object, (5) Blunt trauma (6) Upward streamers - a rare form of energy transfer in the opposite direction, from earth upwards to the clouds.

Lightning always attracts the highest point or any metallic object. Individual taking shelter under tall tree or metal roofs is commonly affected. The electric current of lightning enters into the body for a brief time. After lightning meets the body, skin gives resistance and main proportion of current is conducted along the body's surface causing skin breakage and there is an external 'flashover'; irrespective of the mechanism of injury. It can vaporize moisture on the skin and blast clothes and shoes apart, leaving the victim naked. This can raise suspicion of a sexual attack, especially if the victim is a woman. Burns are usually superficial with singing of hair, second and third degree burns can occur when metal objects are melted by the heat.[9, 10, 11] Feathering burns or Lichtenberg figures (Named after the discoverer, Georg Christopher Lichtenberg) are pathognomonic of lightning, leaving an arborescent pattern on the skin. Intensive electron flow causes dielectric degradation of the skin leading to leakage of red blood cell to the superficial skin layers. Hence, they are not considered as true burn.[9, 12]

Although lightning affects all the body systems, death is secondary to cardiopulmonary arrest due to asystole.[13,14] It depolarizes the entire myocardium, and produces cardiac standstill secondary to a forceful, sustained cardiac contraction.[15] Sometimes, mechanical tears of internal organs by pushing the individual towards a hard-blunt or sharp surface/ object due to blast effect may cause death.

Autopsy findings of lightning victims are non-specific. Hyperemia, edema, fluid accumulation and petechial hemorrhage are seen very often on internal examination. Damage to internal organs in absence of secondary trauma is unlikely. Although, superficial skin burns are seen most commonly, sometimes singeing of hairs may be the only finding.[16] Litchenberg's mark is noted only in 20-30% cases.[17] Metallization is seen if the individuals wear or carry any metallic object or ornament on their body. Clothes and footwear are usually torn and fabric may melt if it is synthetic. Since, cardiac abnormalities cannot be detected morphologically; an autopsy along with circumstantial evidence is very important to comment about cause of death.

In the current case series, all the victims had died on the spot. Such type of mass casualty following lightning strike is rare. During the stormy and rainy day, they were on the bank of a river and while they all boarded a boat, lighting struck them. There was no tall tree or any other individual in the vicinity to attract the lightning. Due to such direct impact, most of them showed superficial burn and singing of hair. Clothes were also torn by the blast effect. Absence of

internal organ damage ruled out effect due to shock wave created by lightning. Litchenberg's figure was seen only in one case. Metallization seen in the girl child describes the superheating of her necklace. Histopathology of heart, lungs and kidneys tissues showed no abnormality. Chemical analysis report also ruled out any poison/intoxicant. Based on autopsy findings and crime scene visit, cause of death was given as cardiovascular asystole following lightning.

CONCLUSION

Death following lightning strike amongst farmers have been reported from time to time in India. Because of their activities in the fields during the months of monsoon, fatalities are common among the farmers. Due to its obvious mechanism, lightning cannot be prevented. However, fatalities amongst the highly vulnerable groups can be minimized by public awareness programs and prompt health care delivery system.

During autopsy performed in suspected lightning victims, there may not be any findings to give opinion regarding cause of death. Moreover, cardiac rhythm abnormality cannot be identified by either gross examination or by histopathology. Hence, in every suspected cases of death due to lightning, autopsy findings must be corroborated by findings of the location where the body is found. Additional help may be obtained from the local meteorological department regarding the climate around that period. When a body is found lying in a paddy field on a rainy day with hearing of occasional thunderclap, possibility of lightning must be ruled out.

CONFLICT OF INTEREST

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REFERENCES

1. Lightning TK. Sacrifice, and possession in the traditional religions of the Caucasus. Anthropol S. 2004;99:143-59.
2. Lifschultz BD, Donoghue ER. Deaths caused by lightning. J Forensic Sci. 1993;38(2):353-8. doi: 10.1520/JFS13415J, PMID 8454996.
3. Forster SA, Silva IM, Ramos ML, Gragnani A, Ferreira LM. Lightning burn--review and case report. Burns. 2013;39(2):e8-12. doi: 10.1016/j.burns.2012.08.003, PMID 22995421.
4. Available from: ncrb.gov.in [internet]. India: accidental deaths and suicide in India 2015; c2018 [cited May 22 2018]. Available from: http://ncrb.gov.in/StatPublications/ADSI/ADSI2015/adsi-2015-full-report.pdf.
5. Maio Di VJM, In DS E. Handbook of forensic pathology. Landes Biosci. 1999:195-7.
6. Cooper MA. Emergent care of lightning and electrical injuries. Semin Neurol. 1995;15(3):268-78. doi: 10.1055/s-2008-1041032, PMID 8570929.
7. García Gutiérrez JJ, Meléndez J, Torrero JV, Obregón O, Uceda M, Gabilondo FJ. Lightning injuries in a pregnant woman: a case report and review of the literature. Burns. 2005;31(8):1045-9. doi: 10.1016/j.burns.2005.01.025, PMID 16308099.
8. Uman MA. All about lightning. New York: Dover Publications; 1986. p. 73-158.
9. O'Keefe Gatewood M, Zane RD. Lightning injuries. Emerg Med Clin North Am. 2004;22(2):369-403. doi: 10.1016/j.emc.2004.02.002, PMID 15163573.
10. Carte AE, Anderson RB, Cooper MA. A large group of children struck by lightning. Ann Emerg Med. 2002;39(6):665-70. doi: 10.1067/mem.2002.124438, PMID 12023713.
11. Cooper MA. A fifth mechanism of lightning injury. Acad Emerg Med. 2002;9(2):172-4. doi: 10.1111/j.1553-2712.2002.tb00237.x, PMID 11825846.
12. Bartholome CW, Jacoby WD, Ramchand SC. Cutaneous manifestations of lightning injury. Arch Dermatol. 1975;111(11):1466-8, PMID 1200654.
13. Cooper MA. Lightning injuries: prognostic signs for death. Ann Emerg Med. 1980;9(3):134-8. doi: 10.1016/s0196-0644(80)80268-x, PMID 7362103.
14. Lichtenberg R, Dries D, Ward K, Marshall W, Scanlon P. Cardiovascular effects of lightning strikes. J Am Coll Cardiol. 1993;21(2):531-6. doi: 10.1016/0735-1097(93)90699-2, PMID 8426021.
15. Kleiner JP, Wilkin JH. Cardiac effects of lightning stroke. JAMA. 1978;240(25):2757-59, PMID 713014.
16. Koumbourlis AC. Electrical injuries. Crit Care Med. 2002;30(11);Suppl:S424-30. doi: 10.1097/00003246-200211001-00007, PMID 12528784.
17. Browne BJ, Gaasch WR. Electrical injuries and lightning. Emerg Med Clin North Am. 1992;10(2):211-29. doi: 10.1016/S0733-8627(20)30710-0, PMID 1559466.

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