

Lightning Strike Injuries



Lightning strikes are one of the top three cause of death associated with a natural or environmental phenomenon

Introduction

- Lightning is a very dramatic natural phenomenon that captures the attention of many people.
- A lightning strike can produce a catastrophic or mortal outcome for the victim or
- It can leave very little or no residual physical or physiologic effects.
- It is very important to recognize that a lightning strike is both a medical and traumatic event

- It is estimated that a lightning flash occurs approximately 8 million times a day through the world
- When lightning strikes a person or group of people, it is a significant medical and potentially traumatic event



Epidemiology

- Most strikes are benign and cause little damage to property or physical structures and even less injury to humans
- Humans often disregard the potential immediate danger
- It is the second cause of storm related death in the United States

Epidemiology

- Based on storm data from NOAA there are on average 62 reported deaths per year due to lightning strikes in the U.S.
- There is no standard reporting system and most of the data is collected from newspaper accounts.
- The average is thought to be low.
- Of those people struck it is believed that only 10% are killed.

Epidemiology

- Ninety percent of lightning strike victims survive but experience some type of disability
- One of the top three leading causes of death from a natural or environmental phenomenon
- The highest incidence of lightning strikes occur between May and Sept. with the largest report in June, July and Aug.

Epidemiology

- Associated with an increase in recreational, work related or other outdoor activity.
- Approximately 1/3 are work related
- 1/3 struck while on the telephone – (cooper POTS Lines)
- Children under age 16 and adults between 26 and 39 years of age experience the highest incidence of lightning strikes

Epidemiology

- Do not assume that all lightning strike patients will be found outdoors
- A lightning strike can occur indoors if the victim is in contact with sinks, showers, toilets, indoor pools and other plumbing or
- If the victim is near or using electrical equipment that are hard wired into a structure (telephone , computer)

Epidemiology



- A person talking on a landline telephone is at risk of being struck
 - The electrical energy is transmitted through the phone line and receiver being held to the ear.
 - The high electrical energy associated with a lightning strike can overwhelm the ground
 - Acoustic injury from the loud crack of static electricity has been reported in people using a portable phone with a hard – wired base during lightning.

Epidemiology



- Cars, buses, trucks and other vehicles surrounded by metal provide a safe shelter against lightning
- The energy is dispersed along the outside of the vehicle



Transition Highlights

- Incident rates of lightning strikes including morbidity and mortality rates as well as predispositions to the time of year, locations and area distributions
- The physics of lightning strikes
- How a lightning strike alters normal body physiology to cause presenting signs and symptoms

Transition Highlights

- Format for triaging when confronted with multiple patients struck by lightning (such as large outdoor events)
- Current treatment strategies when managing a patient struck by lightning

Physics of Lightning

- Lightning occurs from a transfer of an electrical charge
- An electrical potential is created when warm over pressurized air rises through high pressure air
- The inferior portion of the cloud becomes negatively charged
- The ground remains positive.

Physics of Lightning

- Static electricity generates lightning channels that are dissipated within the cloud or extend downward towards the ground
- Objects on the ground send positively charged strikes upward
- If both the downward and upward strikes make contact a lightning strike is observed
- Lightning can occur 10 miles ahead of a thunderstorm

Physics of Lightning

- EMS Providers must recognize that even though the sky is clear the patient may have been struck by lightning. A massive electrical discharge can create a current with 100 million to 2 billion volts with amperage as high as 200,000 amps.
- The content temperature of lightning is 15,000 to 60,000 degrees Fahrenheit with a duration of an 0.01 to 0.001 second

Physics of Lightning

- Typically produces only superficial burns if the victim has metal on himself, such as coins in his pocket
- The metal may retain the heat for a longer period of time after the strike and produce partial thickness or full thickness burns to that isolated area of the body.
- There will be no entrance or exit wounds

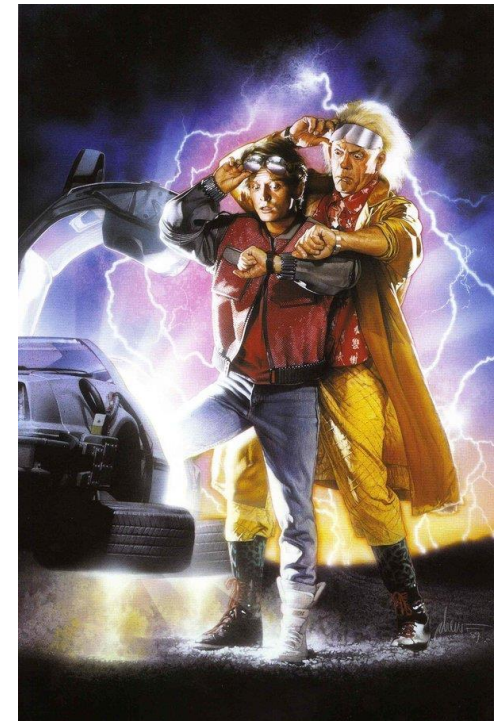
Pathophysiology of Lightning Strikes

- Due to extremely short duration of contact with the electrical current most of the energy flashes over the body and causes superficial burns. Linear burns may occur and appear as lines on the body



Pathophysiology of Lightning Strikes

- Both external and internal burns are usually not a significant consideration in lightning – strike injuries



Pathophysiology of Lightning Strikes

- A lightning strike is both a serious medical and traumatic event that can lead to significant injury
 - Permanent disability
 - Sudden death
- The central automatic and peripheral nervous systems are extremely sensitive to electrical energy that can lead to acute and chronic neurological disruptions and damage

Pathophysiology of Lightning Strikes

- Confusion, AMS, coma, headache, seizures, personality changes and a decrease in cognitive ability are some of the manifestations of the central nervous system
- The sympathetic nervous system may respond with massive vasoconstriction, producing hypertension and mottling of the extremities

Pathophysiology of Lightning Strikes

- May cause the Autonomic Nervous System to shut down the vital respiratory and cardiac centers in the medulla, resulting in cardiopulmonary arrest.
- Cardiopulmonary arrest although rare is typically the cause of death of a lightning strike victim. The strike acts like a massive defibrillator. Energy depolarizes the myocardium and produces a prolonged period of asystole

Pathophysiology of Lightning Strikes

- Patients may present with
 - Asystole
 - V-fib
- The respiratory center, the medulla, remains shut off as the result of the lightning strike
- Lack of ventilation, causes the heart to become severely hypoxic and acidotic which results in a secondary cardiac arrest from V-fib

Pathophysiology of Lightning Strikes

- Persistent apnea causes the patient's contracting myocardium to become severely ischemic and acidotic, leading to secondary cardiac arrest.
- V-fib is frequently the pulseless rhythm associated with the secondary cardiac arrest

Pathophysiology of Lightning Strikes

- The sudden discharge of electrical energy causes muscles to contract forcefully, which may cause the patient to fall to the ground
- The air around the strike is rapidly heated and then cooled causing a sudden explosive and implosive displacement of air propelling the victim and causing blunt trauma to the:

- Head

- Abdomen

- Spine

- Internal organ damage and baro - trauma to surrounding structures

- Chest

Note: Consider C – Spine precautions

Pathophysiology of Lightning Strikes

- You should approach the lightning strike victim as both a medical and trauma patient and gear your assessment and treatment to both.
- A thorough physical assessment must be considered
- A high index of suspicion for traumatic injuries and spinal immobilization

Mechanism of Lightning Strikes

- Ground current or ground strike
 - Occurs when the lightning strikes a distance away from the victim and spreads out across the ground, energizing it and eventually striking the victim.
 - If the victims legs are spread apart, the energy may travel up one leg and down the other.

Assessment Findings

- Your patient may have suffered burns but it is usually not your primary concern or a major injury
- Superficial burns are normally present in lightning strikes due to the short duration as discussed
- Deeper burns from the electrical current are rare ,but if present
 - Suspect internal organ damage and tissue damage.

- Deeper burns are usually associated with a thermal source from the ignition of clothing and metal objects (coins, keys, golf cleats, belt buckles) retaining heat thus causing more extensive burns.

Assessment Findings

- Linear burns result from sweat or rainwater running down the body at the same time of the strike.
 - The water is heated and then vaporized
- Thermal burns (usually as a result of heated metal on the body).
- Punctuate burns may occur and appear similar to cigarette burns.

Emergency Medical Care

- ENSURE YOUR SAFETY

- Scene safety is a major consideration for EMS personnel.
- If the storm clouds producing the lightning are still in the area or you hear thunder you are also at risk

Move the patient into the ambulance as quickly as possible to reduce your risk of being struck.



Triage

- If multiple patients are struck by lightning, conduct your triage in reverse order.
- The patients who are not in cardiac arrest and breathing spontaneously will almost always survive.
- Immediate resuscitation of respiratory and cardiac arrest patients is the most important factor to their survival
- Lightning strike patients who are apneic or in cardiac arrest will receive priority emergency care.
- Those with adequate cardiac or respiratory function will be considered a lower priority for treatment and transport.

- Consider spinal immobilization
- If clothing is on fire or smoldering, put out the fire. Immediately cool the burning area with water
- Assess, establish and maintain an airway
- If tidal volume or ventilation rate is inadequate begin positive pressure ventilation

Emergency Medical Care

- Assess circulation
- Treat soft tissue injuries
- Immobilize fractures
- Start CPR as needed
- Dress wounds or burns
- Immobilize suspected fractures