



TRANSITION SERIES

**TOPICS** FOR THE **EMT**

TOPIC **48**

Lightning Strike  
injuries

ALWAYS LEARNING

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## Objectives

- Review incident rates and characteristics of lightning strikes.
- Discuss physics of lightning strikes and the pathophysiologic changes in the body.
- Identify triage process when confronted with multiple patients.
- Define current treatment strategies for lightning strike victims.

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Review objectives.



## Introduction

- Lightning is a very dramatic natural phenomenon.
- It may result in a mortal outcome for the victim, or have no residual effects.

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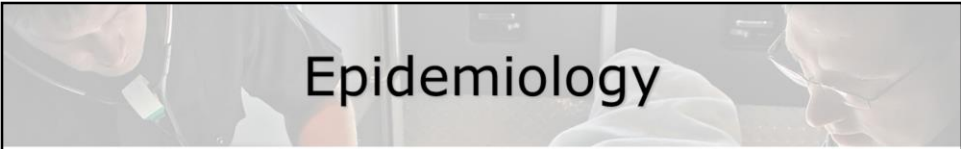
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Lightning is a very dramatic natural phenomenon that captures the attention of many people.

A lightning strike can produce a catastrophic or mortal outcome for the victim, or it can leave very little to no residual physical or physiologic effects.

It is very important to recognize that a lightning strike is both a:

- Medical event
- Traumatic event



## Epidemiology


- Lightning strikes the earth 8 million times a day.
- 2<sup>nd</sup> leading cause of storm-related deaths.
- Men struck more than women.
- Highest incidence in children under 16 and adults ages 26-35.
- 90% of lightning strike victims survive.

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Review basic statistics.



## Physics of Lightning

- Occurs from a transfer of electrical charge
- Electrical disturbance as low and high pressure air travel near each other
- Creates electrical potentials
  - Earth is positive
  - Inferior cloud is negative

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Discuss the mechanism of lightning strikes. Understanding this also contributes to the realization that strikes cannot be predicted (and remind the students that lightning can strike the same place more the once – even multiple times).

# Pathophysiology

- Common effects on body systems
  - CNS
    - Confusion, AMS, coma, seizures
  - Sympathetic nervous system
    - Massive vasoconstriction, HTN, mottling of skin
  - Autonomic nervous system
    - Shuts down cardiac and breathing centers
    - Breathing center takes longer to recover than cardiac

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A lightning strike is both a serious medical and a traumatic event that can lead to:

- Significant injury
- Permanent disability
- Sudden death

The central, autonomic, and peripheral nervous systems are extremely sensitive to electrical energy that can lead to acute and chronic neurologic disruptions and damage.

On arrival at the scene you find four patients who have been struck by lightning. Which of the following patient presentations would be the first patient to receive priority emergency care? a pulseless and apenic patient

# Pathophysiology

- Common effects on body systems
  - Cardiopulmonary arrest
    - Lightning is like massive defibrillation causing asystole
    - Breathing center in brain stem knocked out
    - Cardiac activity recovers first, patient starts with perfusing rhythm, but is not breathing
    - If breathing takes too long to recover, then the heart arrests again, this time due to hypoxia and acidosis

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The initial presenting rhythm immediately following the event is often asystole; however, the patient could also present in ventricular fibrillation (rare).

Eventually, the inherent automaticity property of the cardiac conduction system produces electrical impulses and the heart begins to contract after this period of asystole.

However, the respiratory center in the medulla remains shut off as the result of the lightning strike.

Because of the lack of adequate ventilation, the heart begins to become severely hypoxic and acidic, resulting in a secondary cardiac arrest from ventricular fibrillation.

# Pathophysiology

- Common effects on body systems
  - Soft tissue trauma occurs as well due to being thrown

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A lightning strike patient has a left shoulder dislocation. The injury is most likely caused by severe muscular contraction.

Secondary cardiac arrest following a lightning strike is typically caused by myocardial ischemia and acidosis from persistent respiratory arrest.

dilated pupils that are nonreactive to light would indicate a possible lightning strike



**Table 48-1** Assessment Findings in Lightning Strike Injuries

| Assessment Finding   | Associated Pathophysiology  |
|--|---|
| Cardiac dysrhythmias (atrial fibrillation, premature ventricular contractions, supraventricular tachycardia, and persistent tachycardia) | Electrical disturbance in the conduction system   |
| Apnea  | Disruption to the respiratory center in the medulla   |
| Cyanosis   | Hypoxia from respiratory insufficiency owing to disruption to the respiratory center in the medulla or cardiac arrest   |
| Low SpO <sub>2</sub> reading   | Hypoxia from respiratory insufficiency owing to disruption to the respiratory center in the medulla or cardiac arrest or severe vasoconstriction in the extremities from excessive sympathetic stimulation from the electrical energy |
| Retrograde amnesia   | Disruption of the central nervous system from the electrical energy   |
| Hemiplegia or temporary paralysis to an extremity  | Disruption of the central nervous system or peripheral nervous system from the electrical energy  |
| Aphasia  | Disruption of the central nervous system from the electrical energy   |
| Vertigo or dizziness   | Disruption of the central nervous system from the electrical energy   |
| Mottling to an extremity   | Severe vasoconstriction from arterial spasm in the extremities from excessive sympathetic stimulation from the electrical energy  |
| Pain, numbness, burning or tingling sensation  | Disruption of the central nervous system or peripheral nervous system from the electrical energy  |
| Fixed and dilated pupils   | Disruption of the central nervous system from the electrical energy   |
| Transient hypertension   | Severe vasoconstriction from excessive sympathetic stimulation from the electrical energy   |
| Sight disturbance or corneal burn  | Intense heat and light associated with the strike, retinal detachment, or retinal hemorrhage  |
| Hearing loss and ruptured tympanic membrane  | Disruption of the central nervous system from the electrical energy or barotrauma owing to explosive force or a basilar skull fracture  |
| Fracture or dislocation  | Severe muscular contraction or propulsion of the victim   |

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Discuss assessment findings, describing them based off the associated pathophysiology.



## Emergency Medical Care


- Ensure your own safety on scene
- Consider complete spinal immobilization
- Douse with water anything smoldering
- Assess, establish, and maintain airway

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Lightning strike patients may require a wide variety of interventions, based on their specific pathophysiology; these might range from very minimal emergency medical care, such as oxygen therapy, to complete respiratory and cardiac resuscitation.



## Emergency Medical Care

- Provide O<sub>2</sub> by NRB or PPV as needed
- Assess circulation
- Perform CPR if warranted
- Treat any soft tissue injuries as needed

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## Case Study

You are called to the local park where a group of kids were playing flag football. Despite it starting to rain, they kept playing and reportedly lightning had struck a nearby tree and ricocheted to a player standing near it. When you arrive, the active lightning has passed and it is raining lightly.

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Present case study.



## Case Study

- What kinds of injuries could this patient have?

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Although the patient received an indirect hit from the lightning, it could still have been a strong enough stike to cause disturbances to the CNS, the autonomic nervous system, the sympathetic nervous system, as well as cause cardiac arrest.



## Case Study

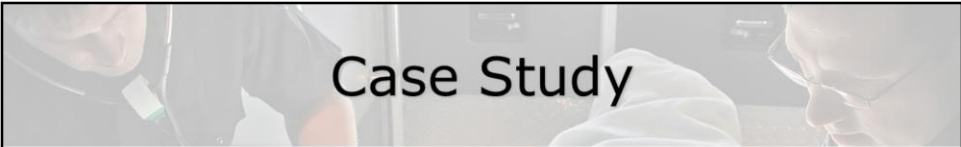
- Scene Size-Up
  - Standard precautions taken
  - Scene is safe, no entry or egress problems
  - 20-year-old male, 190 pounds
  - Patient found in lateral position
  - MOI is lightning strike
  - ALS notified in dual-dispatch, but are not yet on scene

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Present case study.



## Case Study

- Primary Assessment Findings
  - Patient unresponsive
  - Airway appears open
  - Breathing absent
  - Carotid and radial pulses absent
  - Peripheral skin cool and wet from rain
  - No major bleeds noted to body

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Discuss case presentation.



## Case Study

- Is this patient a high or low priority? Why?
- What are the patient's life threats?

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Obviously the patient in cardiac arrest is a high priority patient.

The patient in cardiac arrest will quickly enter in anaerobic metabolism and cause the blood to become:

- Very acidic
- Hypoxic
- Hypercapnic

These are all detrimental effects for a successful resuscitation.





## Case Study

- Medical History
  - Unknown
- Medications
  - Unknown
- Allergies
  - Unknown

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Discuss case study.



## Case Study

- Initial Management
  - 2 minutes of compressions/ventilations started while AED readied
  - OPA inserted and patient ventilated with 100% oxygen
  - AED completes analysis cycle and gives verbal message “No Shock Advised”

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Discuss case presentation.



## Case Study

- What rhythm is the patient likely in?
- If you arrived within minutes of the strike, would this patient likely be in primary or secondary cardiac arrest?
- What are the chances for a successful resuscitation?

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If the AED advised no shock, the patient is likely still in asystole.

Commonly the only two rhythms following a strike are:

- V-fib
- Asystole

Most likely primary arrest.

Chances for a successful resuscitation are good since:

- You arrived quickly
- You have a previously young and healthy patient
- The mechanism behind the arrest was a lightning strike



## Case Study

- Pertinent Secondary Assessment Findings
  - Pupils sluggish to respond to light
  - Airway patent, patient still apneic
  - Central pulse has returned, peripheral still absent

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Discuss case study.



## Case Study

- Pertinent Secondary Assessment Findings
  - Pulse oximeter reading 92% on oxygen
  - Superficial burns noted to chest and neck
  - B/P unobtainable, heart rate 48, respirations 0
  - No other findings are contributory to this report

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Discuss case study.



## Case Study

- Why are the pupils dilated and sluggish to respond to light?
- Discuss why the patient only has superficial burns.
- Explain how a lightning strike could be a traumatic event and a medical event.

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The pupils are dilated most likely due to the sympathetic dump following the lightning strike. They are now sluggish to respond to light because perfusion is now just returning the brain and body.

Although the heat from a lightning strike is massive, the duration of the strike is so short there is insufficient time for tissues to warm to a point of injury from the heat load. Typically the lightning flashes over the body and creates fernlike and linear burns to the body.

Although often considered a traumatic event – its medical effects can impair the following body systems:

- Central system
- Autonomic system
- Nervous system
- Sympathetic nervous system

It can be traumatic from the burns, or from blunt trauma after being thrown by the lightning strike.



## Case Study

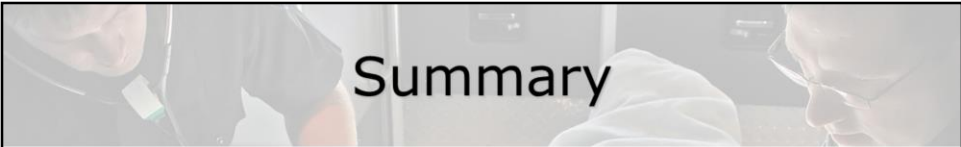
- Care provided:
  - Patient cervical spine manually immobilized
  - High-flow oxygen via PPV, with OPA
  - CPR administered till pulse returned
  - ALS arrived on scene and began ACLS
  - Patient reassessed and transported without change in condition
  - Patient survives the event with minimal residual effects

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Discuss management.



## Summary

- Lightning strikes are an uncommon but important type of emergency.
- Often the patient may appear dead, but with proper management, resuscitation is often successful.
- The primary goal, though, is not to place yourself in danger while caring for another.

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Review as appropriate.