HOW LIGHTNING HURTS US
A lightning strike in a crowded stadium is hazardous out to roughly 50 feet from the strike point, with one or two fatalities and dozens of injuries. People are occasionally injured 100 feet away from a strike. This is roughly equivalent to the kill radius and injury radius of a hand grenade. The mechanisms that hurt us are the millions of volts of electricity, the heat, and the thunderous blast from the rapidly expanding air.

Ground current occurs with each strike. You can minimize your exposure to ground current by keeping your feet close together, especially avoiding lying flat on the ground. Ground current contributes to half of lightning fatalities (Fig. 1). This is the primary mechanism where we can easily reduce lightning risks.

Side flash jumps from tall objects like trees when they are struck by lightning, so don’t seek shelter near tall trees, other tall objects, or tall vertical surfaces.

Contact is from touching long conductors like railings, cables, and fences. Conduct a web search for dead cow lightning to see morbid images of contact and sideflash.

Ground current emanates from high ground and tall objects when downward leaders approach the ground: even if they don’t connect with a downward leader, they can be fatal.

Direct strikes cause about 3–5 percent of lightning fatalities. Avoid high places and open ground to decrease risk of a direct strike. The explosive force of lightning can cause blunt trauma resulting in fractures or soft tissue injuries.

We should primarily focus our efforts on avoiding ground current and side flash.

HOW LIGHTNING KILLS
The mechanisms that hurt us are electricity, heat, and the air blast. These cause many different kinds of neurological problems, burns, and trauma.

TREATMENT PRINCIPLES
Scene Safety: Avoid further injuries. It may be safer to wait for the storm to pass before treating victims in extremely hazardous locations.

Basic Life Support: Be prepared to provide rescue breathing.

Triage: Unlike normal triage protocols, attend first to those who are in cardiac or respiratory arrest without obvious lethal injury.

Assessment: All patients require a complete body survey and careful evaluation for head, spinal, long bone, or cardiac injuries. Assess peripheral pulses, and sensory and motor status. Check the skin for small hidden burns.

Monitor for cardiovascular, respiratory, and neurological problems.

Evacuate anyone obviously injured by lightning. Be alert for lingering issues that need further evaluation and treatment. Survivors could be disoriented or confused. Their decision-making ability (including judgment, direction finding, and planning) could be dangerously impaired.

Fig 1. Ground current causes about half of all lightning injuries. A difference in voltage drives current through us. In this simplified illustration the cow has a 800,000-volt differential, one farmer has a 100,000-volt differential, and the other farmer has her feet together so her voltage difference is minimal.

Fig 2. The frequencies of the primary lightning fatality mechanisms.

FIRST AID FOR LIGHTNING VICTIMS

National Weather Service Lightning Safety: www.lightning.safety.noaa.gov

NOLS Backcountry Lightning Risk Management: www.nols.edu/lightning

Medical Aspects of Lightning: www.uic.edu/labs/lightninginjury

Lightning Safety for Boaters: www.wrh.noaa.gov/volf/boatersafety.php#lightning

Youtube keywords for waiting for the storm to pass: (use wireless devices) lightning strike tree, car, or plane; Faraday cage; lightning on the lawn

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No place outdoors is safe from lightning. Lightning is an objective hazard. Your behavior can reduce the risk of that hazard harming you.

**High-Risk** areas are those areas before a storm hits. Move through high-risk terrain quickly to reduce exposure time. High-risk areas include:

- On or near high terrain like peaks and ridges
- On or near tall objects like relatively taller trees
- On the windward side of mountains, where the storm can come from
- On boats, on open water, and near trees at the edge of open water

**Least objectionable** areas are those areas that may reduce your chances of being struck or affected by ground current. If you are in a tent in “safer terrain” and you hear thunder, you don’t stand in water, avoid metal conductors like ladders, cables, and railings, and avoid bridging the gap between ceiling and floor.

**1. TIME YOUR VISITS TO HIGH-RISK AREAS WITH LOCAL WEATHER PATTERNS.**

Timing activities with safe weather requires knowledge of both typical and recent local weather patterns. There is no such thing as a surprise or freak storm. You must set turnaround times that will get you off of exposed terrain before storms arrive. You need to observe the changing weather and discuss its status with your group. If you have logistical delays, you may need to change your plan rather than summiting a peak or crossing open ground during a thunderstorm. Begin your turnaround if you hear thunder (which means lightning is less than 10 miles away).

**2. FIND SAFER TERRAIN IF YOU HEAR THUNDER.**

Safer terrain in the backcountry can decrease your chances of being struck. Lightning tends to hit high points and the surrounding terrain. Avoid peaks, ridges, and significantly higher ground during an electrical storm. If you have a choice, descend a mountain on the side that has no clouds over it, since strikes tend to be less frequent on that side until the clouds move over it. Once you get down to low, rolling terrain, strikes are so random you shouldn’t worry about terrain as much. Move to safer terrain as soon as you hear thunder, not when the storm is upon you.

Select tent sites that may reduce your chances of being struck or affected by ground current. If you are in a tent in “safer terrain” and you hear thunder, you at least need to be in the lightning position. Lying flat increases the risk of injury by ground current.

**3. AVOID TREES AND LONG CONDUCTORS ONCE LIGHTNING GETS CLOSE.**

Wide open ground offers high exposure to lightning. Avoid trees and bushes that rise above others, since some strikes tend to be less frequent on that side until the clouds move over it. Once you get down to low, rolling terrain, strikes are so random you shouldn’t worry about terrain as much. Move to safer terrain as soon as you hear thunder, not when the storm is upon you.

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**4. GET IN THE LIGHTNING POSITION IF LIGHTNING IS STRIKING NEARBY AND YOU CAN’T GET TO SAFER TERRAIN.**

The lightning position (Fig. 4) is for waiting out a storm. If you have a choice, descend a peak or cross open ground during a thunderstorm. If you have a choice, descend a peak or cross open ground during a thunderstorm. If you have a choice, descend a peak or cross open ground during a thunderstorm. If you have a choice, descend a peak or cross open ground during a thunderstorm. If you have a choice, descend a peak or cross open ground during a thunderstorm.

If your tent is in a more dangerous location, such as on a ridge, in a broad open area, or near a tall tree, you must exit the tent and get to safer terrain before the storm arrives, and stay there until it has passed.

In gently rolling hills, lower flat areas are not safer than the higher flat areas because none of the gentle terrain attracts leaders. Strikes are random in this terrain. Look for a dry ravine or other significant depression to reduce risk. The flash-bang ranging system measures how far away a thunderstorm is, but sometimes it is impossible to tell which flash is associated with which bang. The flash of light travels fast enough that it is virtually instantaneous. The sound travels a mile every 5 seconds (1km/3 sec) so ideally you just count the number of seconds between the obvious flash and the obvious bang, and divide by five to determine how many miles away the storm is. Divide the time by three to see how many kilometers distant the storm is. Do not stake your life on the reliability of this ranging system.

Backcountry settings are at least a 30-minute walk from the nearest vehicles or modern buildings, where you can easily find safe shelter. There are four actions that can reduce your lightning risk in the backcountry, but none of them can make you as safe as getting in a modern building or a metal-topped vehicle. These behaviors are listed in order, and each is roughly twice as important as the next.

**REDUCING LIGHTNING RISK IN THE BACKCOUNTRY**

- **1. TIME YOUR VISITS TO HIGH-RISK AREAS WITH LOCAL WEATHER PATTERNS.**
- **2. FIND SAFER TERRAIN IF YOU HEAR THUNDER.**
- **3. AVOID TREES AND LONG CONDUCTORS ONCE LIGHTNING GETS CLOSE.**
- **4. GET IN THE LIGHTNING POSITION IF LIGHTNING IS STRIKING NEARBY AND YOU CAN’T GET TO SAFER TERRAIN.**