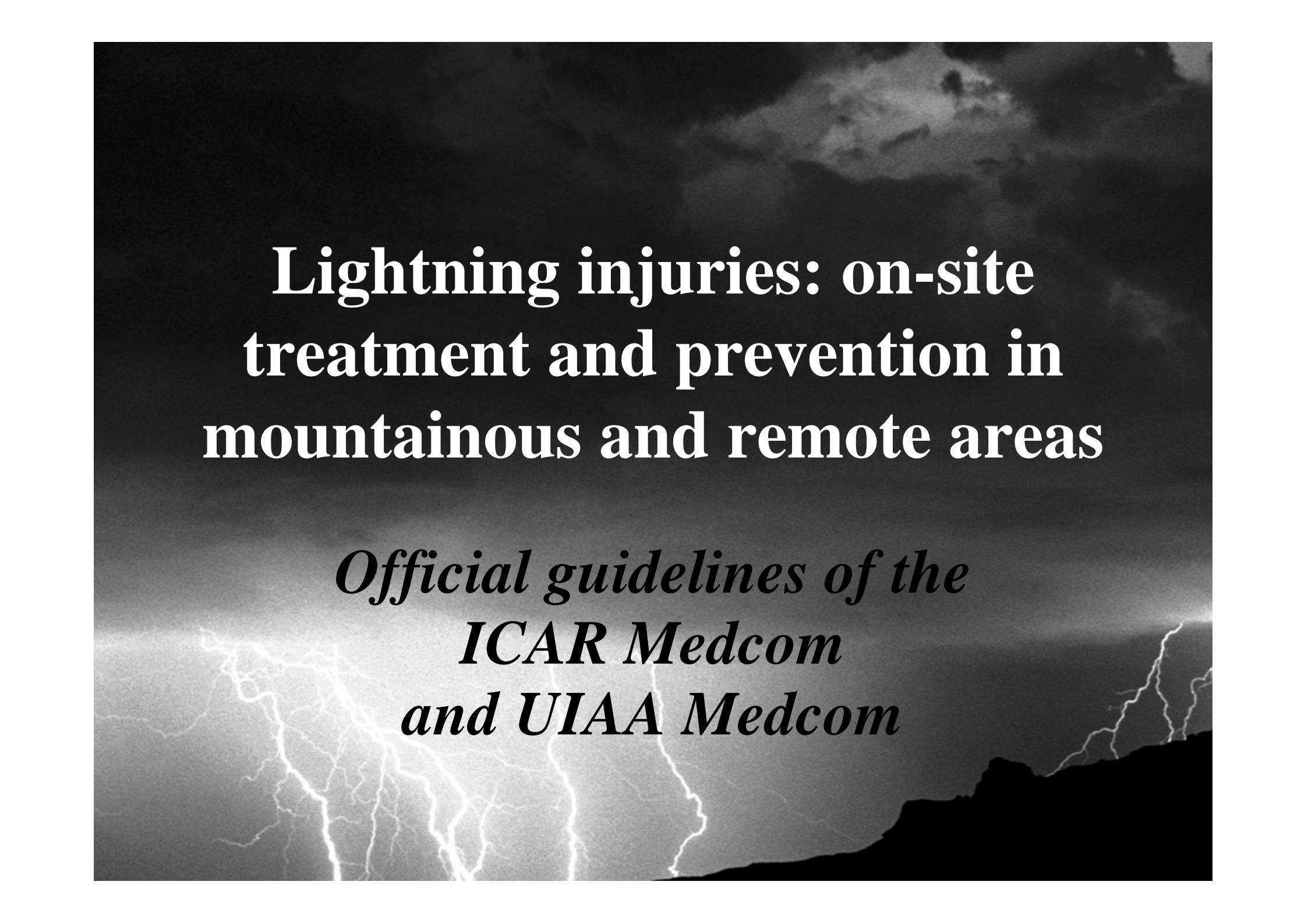


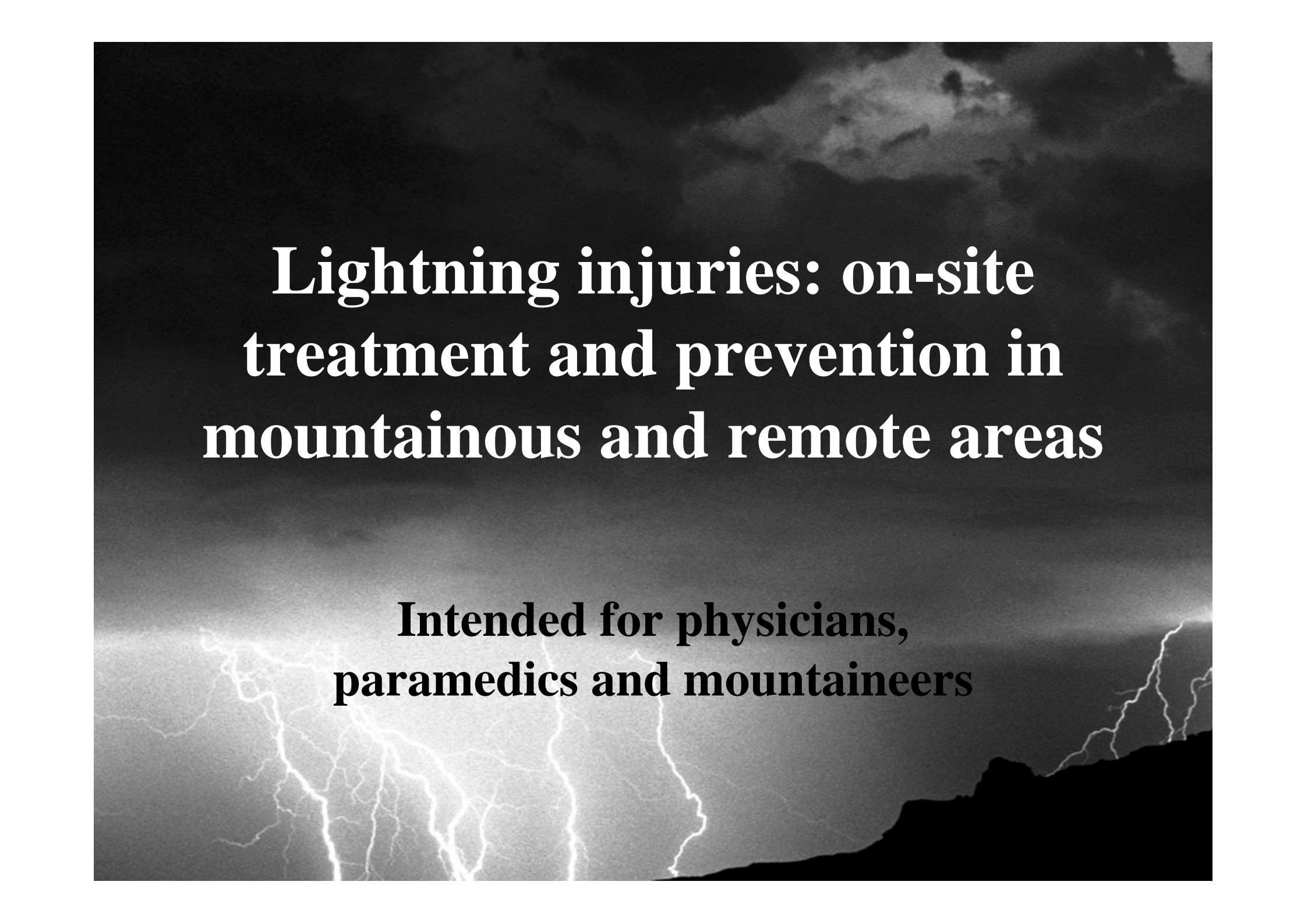
# **Lightning injuries: on-site treatment and prevention in mountainous and remote areas**

Ken Zafren, Bruno Durrer, Jean-  
Pierre Herry, Hermann Brugger



**Lightning injuries: on-site  
treatment and prevention in  
mountainous and remote areas**

*Official guidelines of the  
ICAR Medcom  
and UIAA Medcom*



**Lightning injuries: on-site  
treatment and prevention in  
mountainous and remote areas**

**Intended for physicians,  
paramedics and mountaineers**



**Lightning injuries: on-site  
treatment and prevention in  
mountainous and remote areas**

**Resuscitation 65 (2005) 369-372**



# Introduction

- **Lightning kills about 1000 people a year.**
- **70% of injuries are not fatal.**
- **Lightning is an objective hazard in the mountains.**
- **Lightning injuries are avoidable.**

# Introduction

- **Most deaths are from cardiorespiratory arrest**
- **Persons who do not have immediate cardiorespiratory arrest are likely to survive.**



# Mechanism of injury

- **Direct strike - often fatal**
- **Current splash from object or another person (side flash)**
- **Contact injury**
- **Ground current**
- **Blunt injury**



# **Mechanism of injury: Blunt injury**

- **Shock wave**
- **Muscle contractions from current**
- **Falls**



# Prevention

- **Lightning injuries are avoidable.**
- **Check weather forecast.**
- **Most thunderstorms are in summer during late afternoon and night.**





# Prevention

- **Lightning is associated with cumulonimbus clouds, but may travel many kilometers in front of a storm**



# **Prevention: The 30-30 Rule**

- **Danger of being struck when flash-to-thunder time less than 30 seconds**
- **Don't continue climbing until 30 minutes after last lightning or thunder.**



# Prevention: Shelter

- **Hut or mountain refuge away from open doors or windows**
- **Small, open huts - risk from side flash**



# Prevention: Shelter

- **Tents don't provide protection.**
- **Metal poles may act as lightning rods.**





# Prevention: Shelter

- **Large caves or valleys are protective.**
- **Small caves, overhangs, and wet stream beds increase danger.**



# Prevention: Safe spots

- **Stay off ridges and summits.**
- **Avoid single trees, power lines, ski lifts.**

# Prevention: Safe spots

- “Safe triangle”
- Safe distance from wall = height of wall
- In forest - low area with small trees safer than clearing



# Prevention: In the Open

- **Crouch with feet or knees together to minimize ground current.**
- **Sit on dry pack or rope.**
- **Do not lie flat.**



# Prevention: In the Open

- **Metal ski edges, ski poles, ice axes, or antennae may act as lightning rods if carried above the shoulders.**

# Prevention

- **Carry mobile phones and radios in the center of the rucksack.**
- **Put away metal objects.**

# Prevention

- **Do not remove helmet.**
- **Stay belayed.**
- **Avoid wire ropes and safety ladders.**

# Prevention

- **If hair stands on end or skin tingles, crouch with feet together.**
- **Crackling noises or “St. Elmo’s fire” also warn of imminent strike.**





# Prevention

- **Groups of people should stay apart.**
- **Have a lightning safety policy.**
- **Lightning detectors may be helpful.**



# **Injuries from Lightning: Direct Injuries**

- **High voltage**
- **Heat production**
- **Explosive force**



# **Injuries from Lightning: Cardiorespiratory Arrest**

- **Asystole or ventricular fibrillation**
- **Spontaneous return of circulation is the rule after asystole if ventilation is maintained.**



# **Injuries from Lightning: Cardiorespiratory Arrest**

- **Respiratory arrest may be prolonged.**
- **Death may result from hypoxia if patient is not ventilated.**



# **Injuries from Lightning: Blunt Injuries**

- **Head injury**
- **Burns**
- **Fractures**
- **Tympanic membrane rupture**



# **Injuries from Lightning: Neurologic Injuries**

- **Usually temporary**
- **Confusion, amnesia, loss of consciousness, seizures, deafness, blindness**
- **Paralysis (keraunoparalysis)**

# Injuries from Lightning

- Burns - direct or indirect
- Feathering - not a burn
- Most burns are partial thickness.
- Entry and exit wounds are full thickness.



# Differential Diagnosis

- **Diagnosis usually clear, but victims may be found later, especially on sunny days.**
- **Look for linear or punctate burns or feathering.**





# **Risk management during rescue operations**

- **Postpone evacuation if thunderstorm continues.**
- **Consider moving patient to area of lower risk.**

A black and white photograph of a stormy sky with multiple bright lightning bolts striking down. The bottom of the image shows a dark silhouette of a mountain range.

# **Risk management during rescue operations**

- **Air rescuers at high risk**
- **Airborne helicopters can be struck by lightning.**
- **People can be struck by lightning while standing near aircraft.**

# Patient Care

- **ABCs (airway, breathing, circulation)**
- **BLS and ALS**
- **First responders may use AED.**

# Patient Care

- **Patients may benefit from prolonged CPR.**
- **Monitor (ECG, pulse oximeter)**
- **Follow ALS and trauma guidelines.**

# Patient Care

- Usual signs of brain death do not apply.
- Amount of external damage does not predict internal injuries.

# Patient Care

- **Serious problems may be delayed.**
- **All patients should be transported hospital and admitted.**



# Special Triage Considerations

- **More than one person can be struck.**
- **“Resuscitate the dead.”**
- **Ventilatory support may be all that is necessary.**



# Lightning Myths

**It is dangerous to touch a lightning victim.**



# Lightning Myths

**Lightning never strikes the  
same place twice.**



# Lightning Myths

**Lightning always hits  
the highest object.**





# **The End**

**Please check the person  
next to you for signs of  
lightning injury.**