Learning Objectives

- Differentiate EMS treatment priorities for cold and heat related illnesses
- Describe EMS treatment considerations for high altitude, diving, and other water related injuries
- Review lightning and electrical injuries

Question

- A key component in determining the severity of hypothermia in a patient without a thermometer is:
  A. Skin Temperature
  B. Mental Status
  C. Shivering
  D. Pupil size and Reactivity
Introduction

- Environmental injuries are commonly encountered in many EMS systems.

**Environmental Injuries**

Introduction

- Specific treatment priorities are required for environmental injuries to decrease morbidity and mortality.
- **Excess:** have unique effects on the human body

Cold-Related Illnesses

**Hypothermia (Core Temp <35C)**

- Accidental
  - Primary or Acute
  - Secondary (elderly)
- Afterdrop – body may initially cool further despite rewarming
- Therapeutic
  - Controlled (32-34 C)
  - For ROSC and other injuries (head, etc.)
Two main considerations of Cold-Related Injuries:
1) Hypothermia (Core Temp <35°C) obtain temp by esophageal (best), rectal temps
2) Frostbite

Normal body temperature 35-38.2°C (regulated by hypothalamus)

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**Hypothermia**

- Active Rewarming in field generally not recommended
  - Active: External vs. Internal (foley lavage vs. CP Bypass)
  - Passive: Blankets, remove from environment
  
  But, prevention of further heat loss is very important

- Gentle handling and transport in supine position
  - in severe hypothermia – decreases chance of hemodynamic instability and arrest

- Hypothermic cardiac arrests may have improved survivability if transport to a medical facility is timely

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When to terminate resuscitation in Hypothermia cases is difficult.
System specific criteria need to be established. Several organizations have put out some consensus guidelines, but generally aren’t uniformly accepted. AK Cold Injury Guidelines, Wilderness Medical Society, and IKAR have guidelines. Beyond the scope of this review course.

Passive – blankets (ok for mild hypothermia, body will generally regenerate enough heat to return to normal)
Active External – Warm bottles in groin/axilla
Active Internal Noninvasive – Warm IV Fluids and humidified air/oxygen
Active Internal Invasive – Cardiopulmonary bypass, Venous Extracorporeal membrane oxygenation (ECMO)
Hypothermia

- Clinical diagnosis without use of thermometer
  - Mild (patient feels cold, normal mental status)
  - Moderate (altered mental status, uncontrolled shivering)
  - Severe (unresponsive and possibly in cardiac arrest)

Cold-Related Illnesses

Frostbite

- Superficial vs. Deep
  - Hard to determine clinically at the time of exposure
- Prevention
- Rewarming should only occur if refreezing will not occur
- Pain Control
  - Immersion in 37-39 °C water bath
  - NSAIDs and Thrombolytics may be considered per protocol

May have a combination of both hypothermia and frostbite

Wilderness Medical Society Practice Guidelines for the Prevention and Treatment of Frostbite

To simplify classification, either in the field or before rewarming and/or imaging, we favor the following 2-tier classification scheme:
- Superficial no or minimal anticipated tissue loss, corresponding to 1st- and 2nd-degree injury
- Deep deeper injury and anticipated tissue loss, corresponding to 3rd- and 4th-degree injury

Summary of field treatment of frostbite (over 2 hrs from definitive care)
1. Treat hypothermia or serious trauma
2. Remove jewelry or other extraneous material from the body part
3. Rapidly rewarm in water heated and maintained between 37-39 °C (98.6-102.2 °F) until area becomes soft and pliable to the touch (approximately 30 minutes). Allow spontaneous/passive thawing if rapid rewarming is not possible
4. Ibuprofen (12 mg/kg per day divided twice daily) if available
5. Pain medication (eg, opiate) as needed
6. Air dry (ie, do not rub at any point)
7. Protect from refreezing and direct trauma
8. Apply topical aloe vera cream or gel if available
9. Dry, bulky dressings
10. Elevate the affected body part if possible
11. Systemic hydration
12. Avoid ambulation on thawed lower extremity (unless only distal toes are affected)
Summary of initial hospital management of frostbite

1. Treat hypothermia or serious trauma
2. Rapidly rewarm in water heated and maintained between 37-39°C (98.6-102.2°F) until area becomes soft and pliable to the touch (approximately 30 minutes)
3. Ibuprofen (12 mg/kg per day divided twice daily)
4. Pain medication (eg, opiate) as needed
5. Tetanus prophylaxis
6. Air dry (ie, do not rub at any point)
7. Debridement: selectively drain (eg, by needle aspiration) clear blisters and leave hemorrhagic blisters intact
8. Topical aloe vera every 6 hrs with dressing changes
9. Dry, bulky dressings
10. Elevate the affected body part if possible
11. Systemic hydration
12. Thrombolytic therapy: consider for deep frostbite with potential significant morbidity if less than 24 hours after thawing; use angiography for pre-thrombolytic intervention and monitoring of progress
13. Clinical examination (plus angiography and/or technetium-99 bone scan if necessary) to assist determination of surgical margins
14. Evaluation by an experienced surgeon for possible intervention

Heat Related Illnesses

Heat Exhaustion (volume/electrolyte depletion)
Heat Stroke (elevated Temperature >40°C)

- Rapid core temp cooling is a must
- Should be started in the field before transport
  - Controlled Immersion if proper equipment is available
  - Misting and ice to axilla/trunk/groin/neck
  - Paralysis may be required to stop shivering

Exertional Hyponatremia

- Seizures may occur (Need Na⁺ - Normal Saline)

High Altitude Illness

Acute Mountain Sickness (AMS)
- Headache, N/V, anorexia
- Hydration, hold ascent, NSAIDS, oxygen

High Altitude Cerebral Edema (HACE)
- Ataxia, Altered Mental Status, Seizure, Death
  - Descent, Dexamethasone (Decadron), Oxygen

High Altitude Pulmonary Edema (HAPE)
- Cough, severe hypoxia, death
  - Descent, Oxygen, PDE-5 (tadalafil)
High Altitude Illness (cont.)

- Rescuer Prophylaxis
  - Acclimatization (rescuer staged prior to rescue)
  - Chemoprophylaxis (acetazolamide, dexamethasone, others)
  - Oxygen supplementation

- Portable Hyperbaric Chamber
  - Drop 3,000 ft with continuous foot pumping
  - Limited patient access during treatment

Diving Injuries

- Decompression Sickness (DCS) aka 'Bends'
- Arterial Gas Embolism
  - Generally on ascent, gas bubble lodges in critical body system(s)
- Overpressure Syndromes (Barotrauma)
  - Ears / Sinus / Lungs / Eyes / GI
- Nitrogen Narcosis / Oxygen Toxicity (high partial pressures)
  - Hyperbaric Chambers and Oxygen
    - Divers Alert Network (DAN)

Near Drowning/Submersion

- Drowning = suffocation and death as result of submersion in liquid environment

- Near Drowning/Submersion
  - Less emphasis on:
    - Dry vs. Wet Drowning (fluid in airway/lungs)
    - Fresh water vs. salt water
  - Evaluate for other trauma (i.e. Head, neck, etc.)
  - Supportive Care

- >1 hour of submersion unlikely to be resuscitated
  - Standard resuscitation algorithms should be used in most cases (except possibly severe hypothermia)
Lightning and Electrical Injuries

**Lightning**
- Direct Strike generally equals death
- Temporary paralysis ("keraunoparalysis")
- Barotrauma/Blunt Trauma
- Burns
  - Superficial
  - Deep

**Electrical Injuries**
- Alternating Current (AC) vs Direct Current (DC)
- AC likely to cause VFib
  - Timely Defibrillation is needed
- Deep burns may occur from both
- Scene safety is of utmost important to prevent rescuer injuries

Lightning

- Reverse Triage
  - Immediate CPR and other advanced treatments have improved survivability (different from traditional BLACK)
  - Return of brainstem function
- Delayed Rhabdomyolysis and Compartment Syndromes
- Spread out group to reduce multiple casualties
- Remove metal jewelry, climbing/hiking gear, etc.
- Prevention (seek shelter, pre-plan to avoid storms)

Take-Home Points

- Environmental Emergencies are commonly encountered in EMS and basic knowledge of general categories of care is essential

- Clinical Aspects of EMS Medicine = 40% of test
  - Includes core content related to Trauma/Injury (Environmental, Medical, and other Special Clinical Considerations (Cardiac Arrest, Airway, Procedures, etc.))
Question
• A key component in determining the severity of hypothermia in a patient without a thermometer is:
  A. Skin Temperature
  B. **Mental Status**
  C. Shivering
  D. Pupil size and Reactivity

Question
• The definitive treatment for HAPE and HACE when possible is:
  A. Oxygen
  B. NSAIDS
  C. Descent
  D. **Portable Hyperbaric Chamber**

References
• Wilderness Medical Society Consensus Guidelines