

Too Hot

Hyperthermia and heat related illness

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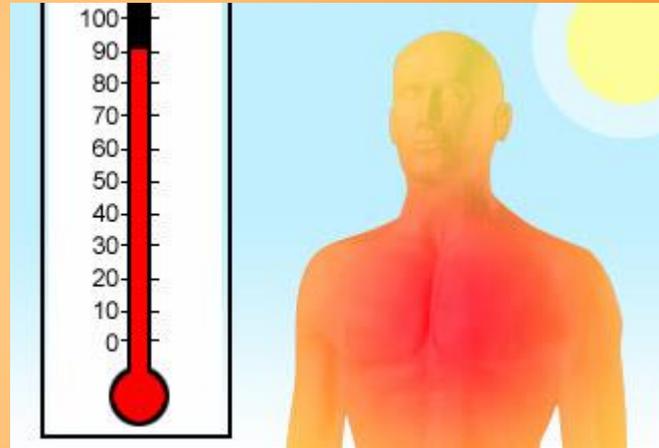
Virginia Tech Carilion Clinic

Objectives

- **Discuss epidemiology and causes of heat illness**
- **Review pathophysiology of heat illness**
- **Determine severity of heat illness from exhaustion to stroke**
- **Discuss treatment of heat illness**
- **Prevent heat related illness**

Four Methods of Heat Dissipation:

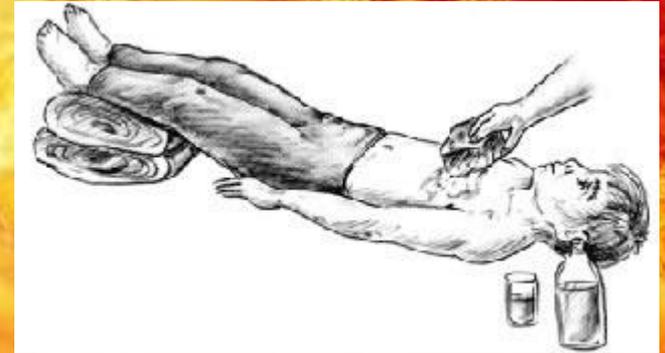
- Conduction
- Convection
- Radiation
- Evaporation



Pathophysiology-

- Exertional hyperthermia: heat generated from muscular activity accumulates faster than it can dissipate
- Heat dissipation: heat gradient between core and periphery allows cooling when periphery is cooler than core
- Hot periphery (environment, exercise, etc) = no heat dissipation

Heat Exhaustion-----> **Heat Injury**-----> **Heat Stroke**



Case:

- 18 year old VMI Cadet presents after 6 mile trail run in September
- Ambient temperature 81 degrees F
- Presents to ED stumbling, diaphoretic, pale, mottled skin, slurred speech, muscle pain



Case:

Vitals:

Core temp: 103F

Heart rate: 122

BP: 90/50

SpO2:95%

Labs:

Troponin 1.5

LFTs elevated

CK 10,000

Urine: tea colored +myoglobin



Case:

- Skin misted with cool water
- Ice packs over large superficial vessels
- Cooled IV fluids
- Cooling halted when core temp 102F
- Admitted to ICU
- Troponin, Cr, LFTs continued to rise
- Normalized after 1 week



ED/ Hospital Treatment:

HYPERTHERMIA GUIDELINES: use in patients with core temp greater than 40°C (104°F)

- Communicate with EMS to initiate cooling measures in the field
- Obtain a rectal temperature
- Mist with cool water, initiate evaporative cooling with fans (if available)
- Pack ice into axillae, groin and neck overlying large vessels, be sure to protect skin from frostbite
- Goal of treatment is to reduce the temperature by at least 0.2°C/min to approximately 39°C.*
- Supplemental O2 if needed
- Obtain finger stick glucose and administer D50 as required
- Establish 2 large bore IVs
- Place a 3-way, temperature sensing foley

ED/ Hospital Treatment:

HYPERTHERMIA GUIDELINES: use in patients with core temp greater than 40°C (104°F)

- Send istat chem 8, troponin and other labs and cultures immediately
- Begin cooled (4°C) crystalloid fluid bolus based on fluid status
- Initiate bladder and/or gastric lavage if hyperthermia is unresponsive to other measures
- Obtain 12 lead EKG
- If AMS present, intubate and sedate to lower metabolic demand
- Insert an NGT to monitor for GI bleeding and fluid losses
(can also be used for cooled fluid irrigation)

ED/ Hospital Treatment:

HYPERTHERMIA GUIDELINES: use in patients with core temp greater than 40°C (104°F)

- ❑ Immediate administration of benzodiazepines in patients with agitation and shivering
- ❑ If *convulsions are refractory to benzodiazepines* and barbiturates should be paralyzed and provided mechanical ventilation with EEG monitoring
- ❑ Begin broad spectrum antibiotics once cultures obtained
- ❑ Call transfer center to arrange for ICU admission or transfer if warranted
- ❑ Active external cooling generally is halted at 39°C

Heat Exhaustion:

- **Symptoms:** fatigue, dizziness, headache, nausea, vomiting, malaise, hypotension, and tachycardia, elevation in body temperature
- Potential for collapse because of an inability to maintain adequate cardiac output
- Can occur with or without exercise in hot environments



Heat Injury:

- Elevation in body temperature +
- Presence of organ or tissue dysfunction that resolves with proper treatment



- Can progress to heatstroke if not properly diagnosed and treated.
- Lack of mental status changes distinguishes heat injury from heat stroke.

Heat Stroke:

- **Severe elevation in body temperature**
 - typically $>40^{\circ}\text{C}$, 104°F
- **CNS dysfunction:**
 - combativeness, delirium, seizures, and coma
- **History of exposure**
 - hot and humid weather or vigorous physical exertion



Heat Stroke:

- Onset may be gradual (over hours or sometimes days)
- Nonspecific symptoms, similar to heat exhaustion
- May also occur rapidly with no warning signs
- Requires immediate medical intervention to prevent permanent damage
- Neurologic damage, injury to the gut, kidney, lung, spleen, liver, and skeletal muscle (specific to exertion) often occurs within days or weeks of clinical presentation.

Classic Heat Stroke:

- Observed in very young or elderly persons
- Occurs at rest during exposure to high environmental temperature
- Present with hot, dry skin caused by failure of the normal sweating response (anhidrosis)
- Up to 60% of patients with classic heat stroke are hospitalized or found dead within 1 day of the reported onset of illness

Exertional Heat Stroke:

- Occurs primarily in young, physically fit individuals who collapse during exercise
- Physical effort unmatched to physical fitness is a significant risk factor
- Anhydrosis is an uncommon finding in these patients
- Highly motivated individuals may ignore the physiologic signs of fatigue that would normally cause them to stop exercising
- EHS may occur in temperate conditions because of high physical demand or clothing that inhibits cooling (e.g., firefighter uniforms)
- Mortality relatively low (~3% to 5%) compared with classic heatstroke (~10% to 65%)

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Prevention:

- **Acclimation**
- **Reduce Exposure time**
- **Reschedule Events**
- **Remove Vulnerable Populations**
- **Adequate hydration**

Must Mimic Climate of Athletic Event or Occupational Setting and Include Adequate Heat Stress

- Heat must be sufficient to cause heavy sweating.
- Use exercise/rest cycles to intensify or diminish the effect of the heat stress on bodily functions.
- Include at least 6 to 14 days of adequate heat stress.
- Exercise daily for at least 90 minutes.

Start with Acclimation and Exercise Training

- Be flexible in scheduling training.
- Build confidence.
- Performance benefits may take longer to achieve than physiologic benefits.

Methods of Heat Acclimation

- Use a climate-controlled room (sauna or heat chamber) or hot weather.
- Incorporate training by including additional acclimation sessions.

Days Leading to Athletic Performance or Event

- Start slowly, and decrease training duration and intensity; limit heat exposure.
- Acclimatize in heat of the day.
- Train in coolest part of the day.
- Use appropriate work/rest cycles.
- Be vigilant of salt and fluid needs, especially during the first week of acclimation.

Field Treatment:

- Have patient lie down-on cool surface if possible
- Expose skin
- Submerge in cold water if possible
- Moisten skin
- Place in breezy area- in the shade
- Give cold fluids to drink



Questions?

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