Heat Related Emergencies

Objectives

- **State how many people are affected by heat emergencies**
- **Name three methods the body uses to rid itself of excess heat**
- **List four symptoms of constricted blood flow to the brain**
- **List three heat-related medical problems**

Objectives cont.

- **Describe the signs and symptoms of heat exhaustion**
- **List the patients who are more susceptible to heat stroke**
- **Describe the signs and symptoms of heat stroke**
- **Explain the treatment of heat stroke**

Glossary

- **Anterior Hypothalamus:** the portion of the brain responsible for regulating body temperature
- **Conduction:** the dispersal of heat into a solid or liquid
- **Convection:** the loss of heat that occurs when air passes by a surface
- **Dehydration:** the excess loss of body fluids leading to hypoperfusion of shock
- **Evaporation:** the cooling effect which occurs through drying of sweat on the surface of the body
- **Radiation:** heat that is emitted out/off an object
- **Anhidrosis**: lack of sweating

Epidemiology

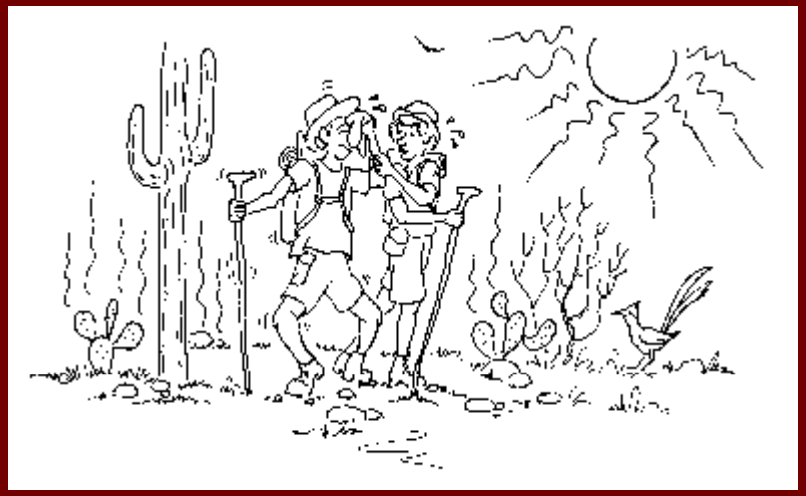
- **4,000 heat related deaths yearly**
- **80% of the fatalities are elderly**
  - Occurs in 5 per million over age 85 compared to 1 per million in the 5-44 age group
- **2nd leading cause of death among young athletes**
- **Very young (<4yo) also at increased risk**
  - Occurs in 0.3 per million compared to 0.05 per million in patients > 4yo.

Epidemiology

- High heat or humidity requires ~2 weeks of acclimatization.
- Individuals with heat exposure can require from 5-13 quarts of water per day depending upon the type of work they do.
- Salt consumption should be slightly increased to compensate for loses due to sweating.
  - (LCDR A. Johnson, MC, USN and LCDR L. Schenden, MC, USNR, Department of Emergency Medicine, Naval Medical Center San Diego, San Diego, CA (1999).)

Pathophysiology

- **Heat Balance**
  - **Conduction**
  - **Convection**
  - **Radiation**
  - **Evaporation**



<u>Heat Balance equation</u>

Body Heat = Metabolism

+ [+conduction + radiation]

+ convection – evaporation

Body Heat = M + [+ K + R + C – E]

Pathophysiology **(cont.)**

- **Physiologic Response to Heat**
  - Anterior hypothalamus
    - ANS stimulation
    - ↑ vasomotor tone and ↑ cutaneous blood flow.

      Results in ↑ heart rate and cardiac output. Pt with cardiac disease at increased risk for heat injury.
  - Parasympathetic stimulation
    - Sweating

      Dehydration can predispose individual to heat injury
  - Acclimatization
    - Results from repeated exposure (exercise)

Pathophysiology (cont.)

- **Heat Injury Predisposition**
  - **3 Factors Influencing Heat Production**

1. Increased Internal Heat Production.
   - *Physical Activity*
   - *Febrile illness*
   - *Pharmacologic agents*

2. Increased External Heat Gain
   - *Exposure to high ambient temperature*
   - *See table 1*

3. Decreased Ability to Disperse Heat
   - *See table 2*

Heat Index (Apparent Temperature)

Relative Humidity (%)

Air Temperature °F	40	45	50	55	60	65	70	75	80	85	90	95	100
110	136												
108	130	137											
106	124	130	137										
104	119	124	131	137									
102	114	119	124	130	137								
100	109	114	118	124	129	136							
98	105	109	113	117	123	128	134						
96	101	104	108	112	116	121	126	132					
94	97	100	103	106	110	114	119	124	129	135			
92	94	96	99	101	105	108	112	116	121	126	131		
90	91	93	95	97	100	103	106	109	113	117	122	127	132
88	88	89	91	93	95	98	100	103	106	110	113	117	121
86	85	87	88	89	91	93	95	97	100	102	105	108	112
84	83	84	85	86	88	89	90	92	94	96	98	100	103
82	81	82	83	84	84	85	86	88	89	90	91	93	95
80	80	80	81	81	82	82	83	84	84	85	86	86	87

With Prolonged Exposure and/or Physical Activity

Extreme Danger

Heat stroke or sunstroke highly likely

Danger

Sunstroke, muscle cramps, and/or heat exhaustion likely

Extreme Caution

Sunstroke, muscle cramps, and/or heat exhaustion possible

Caution

Fatigue possible

Role of Dehydration in Heat Disorders

- Close Relationship to Heat Disorders
  - Dehydration prevents thermolysis.
- Signs & Symptoms
  - Nausea, vomiting, and abdominal distress
  - Vision disturbances, decreased urine output
  - Poor skin turgor and signs of hypovolemic shock
- Treatment
  - Oral fluids if the patient is alert and oriented
  - IV fluids if the patient has an altered mental status or is nauseated

Pathophysiology (cont.)

- Dehydration
- Obesity
- Heavy/Impermeable Clothing
- Poor Physical Fitness
- Lack of Acclimatization
- Cardiovascular Diseases
- Skin Diseases
  - –Burns
  - –Scleroderma
  - –Eczema/Psoriasis
  - –Glandular disorders
- Extremes of Age
- Lack of Mobility
- Febrile Illnesses
- Hyperthyroidism
- Alcoholism
- Drug Use
  - –Cocaine
  - –Amphetamines
  - –Opiates
  - –LSD/PCP
- Poor Socioeconomic
  - — No air-conditioning
  - – multistory building living
- Prolonged Exertion in Heat
- Medications
  - –Antipsychotics
  - –Anticholinergics
  - –CA channel, β, blocker
  - –Diuretics
  - –α agonists/Sympathomimetics

Table 2 Causes for Decreased Heat Dispersal

Clinical Features

- **Heat Edema**
  - Due to cutaneous vasodilatation and orthostatic pooling of interstitial fluid in extremities
  - Most often found in elderly, non-acclimated travelers
  - Usually self limiting

Clinical Features

- Hyperpyrexia
  - Pyrogens
  - Differentiating Fever from Heatstroke
  - Cooling the Fever Patient
    - Consider antipyretic medication.
      - Acetaminophen or ibuprofen
    - Avoid sponge baths.

Clinical Features

- **Prickly Heat** (aka lichen tropicus, miliaria rubra, heat rash)
  - Erythematous rash caused by acute inflammation of sweat ducts
  - Presentation includes itching, pruritic rash in warm environment (itching usually responds to antihistamines)
  - If prolonged can develop into chronic dermatitis

Clinical Features **(cont.)**

- **Heat Syncope**
  - Results from cumulative effect of peripheral vasodilatation, decreased vasomotor tone and relative volume depletion.
  - Usually occurs in non acclimated pt's in early stage of exposure.
  - Dx includes excluding more serious causes of syncope
  - Tx includes rehydration, removal from heat, and rest

Clinical Features **(cont.)**

- **Heat Cramps**
  - Painful spasmodic contractions of skeletal muscle.
  - Usually occur after exercise or after a latent period. Unconditioned, non acclimated individuals at high risk
  - Pathogenesis thought to be deficiency of Na, K+, and H_2O at cellular level.
  - Tx includes rest/rehydration

Clinical Features **(cont.)**

- **Heat Tetany**
  - Hyperventilation resulting in respiratory alkalosis, paresthesia, and carpopedal spasm
  - Usually associated with short periods of intense heat stress
  - Tx includes removal from heat and decreasing respirations.

Clinical Features **(cont.)**

- **Heat Exhaustion**
  - Sx non-specific (WDAO, n/v, HA, myalgias, etc.)
  - May also include
    - Syncope
    - Orthostatic hypotension
    - ST, tachypnea
    - Diaphoresis
    - Hyperthermia
  - Diagnosis of exclusion
  - Tx includes rest, volume and electrolyte replacement

Clinical Features **(cont.)**

- **Heatstroke**
  - Triad
    - Temp > 40.5^0 C (104.9^0)
    - CNS dysfunction
    - Anhidrosis
  - **Anyone with hyperpyrexia and AMS is considered heatstroke until proven otherwise.**
  - Any neurological disturbance can occur with heatstroke

Clinical Features **(cont.)**

- **Heatstroke**
  - **Effect on Organ Systems**
    - CNS
      - Irritability, bizarre behavior
      - Combativeness
    - Cerebellum
      - Highly sensitive to heat
      - Ataxia common
    - Cerebral edema
    - Anhidrosis may be later finding due to volume depletion and sweat gland dysfunction
  - **Total breakdown of thermoregulation**

Clinical Features (cont.)

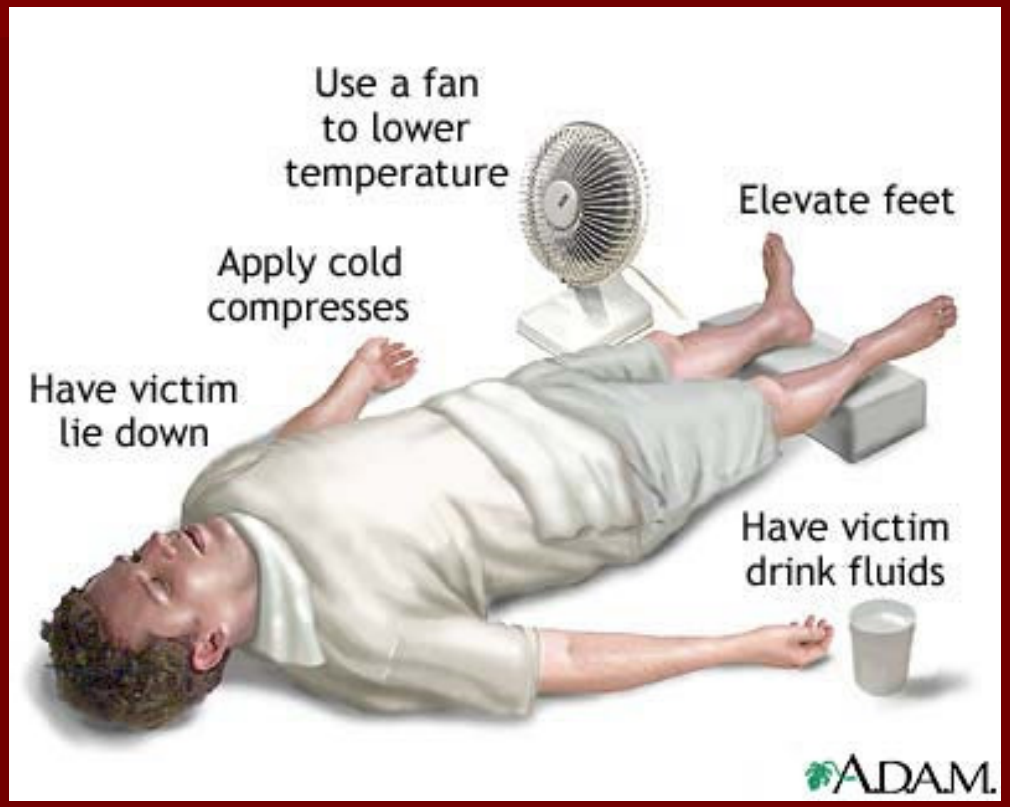
- **Heatstroke**
  - Non-exertional
    - Slow evolution, onset insidious
    - Increases exogenous heat gain with decreased heat dispersal
    - Elderly, poor, infants, and chronically ill at greatest risk.
    - Increased risk with
      - Lack of AC
      - CV disease
      - Older age
      - Cardiovascular/anticholinergic drugs
  - Exertional
    - Due to vigorous activity
    - Sx same as for non-exertional

Clinical Features **(cont.)**

- **Heatstroke**
  - **Treatment**
    - Initial ABC's, high flow O_2
    - Continuous pulse oximetry
    - EKG, IV access, volume replacement
    - Temperature

Clinical Features **(cont.)**

- **Heatstroke**
  - Cooling Techniques
    - Evaporative
    - Immersion
    - Ice packing
    - Strategic ice packs
    - Gastric lavage
    - Peritoneal lavage
    - Cardiac bypass



Clinical Features **(cont.)**

- **Complications of heatstroke**
  - Heart failure, pulmonary edema, cardiovascular collapse
  - Hepatic injury (thermal)
  - Renal injury
    - 2^0 rhabdomyolysis, myoglobinuria, and renal failure
  - Hematological insult
    - Micro-hemorrhages
    - Thrombocytopenia
    - Increased platelet aggregation (thermal)
  - Fluid/Electrolyte disturbances

Precautions for Heat Stroke

- Heat stroke is a medical emergency, be aware that heat exhaustion can progress to heat stroke
- Wet sheets over a patient, <u>without good air flow</u>, will tend to increase temperature and should be avoided
- Do not let cooling in the field delay your transport. Cool patient if possible while en-route