Environmental Core Content
Keith Conover, M.D., FACEP

Hypothermia

Definition: <35°C (95°F)

Research limitations

Pathophys:
- Measuring temperature
  - oral
  - axillary
  - forehead
  - rectal
  - esophageal
  - ear
  - EKG
- Heat debt:
  - incipient hypothermia,
  - massive cooling without hypothermia (500-2000 kcal)
- Hypothermia and mental functioning:
  - mild: 34-35°C = 93-95°F
    - memory recall normal
    - new memory only 70%
    - 1.5x mental functioning
  - severe:
    - paradoxical undressing
    - contributor to other deaths
- Predisposing factors:
  - immature thermoregulation
- disease
- drugs
- debilitation
  - cardiovascular
    - ventricular fibrillation threshold
      and Geisinger study
    - cold diuresis
      - dehydration
      - level/seizures
    - other arrhythmias
      - pacing/atropine
      - “they all get better”

- Hypothermia Etiology
  - Primary/secondary
  - Acute/Subacute/Chronic
  - Third-spacing and elderly vs. rewarming

- Treatment
  - active/passive
  - internal/external
  - “afterdrop” “rewarming shock”
  - rapid rewarming
  - fluid if very rapid
  - core first
  - food
  - thoracotomy
  - NG and rectal and bladder lavage
  - Bair hugger
  - bypassks
  - rewarming rates:
◆ warm IVs: lactate metabolism
◆ charcoal vest
◆ warm water immersion

- **BCLS:**
  - “warm but not yet dead”
  - “pink is good, blue is bad, air must go in and out”
  - one or three minutes for pulse?
  - hypocapnia protective
  - long pauses: “metabolic icebox”
  - CPR vs. bradycardia circulation to coronaries
  - half-speed CPR?

- **ACLS:**
  - defibrillation below 86°F (30°C)
  - bretylium, lidocaine, procainamide

- **Complications**
  - pneumonia
  - pancreatitis
  - coagulopathy
  - DIC unresponsive to heparin/dextran (may cause precipitation of cryofibrinogen in elderly)

- **Local Cold Injury**
  - Chilblain (pernio)
    - Prolonged cold exposure
    - Cheek and back of hand
    - acute vs. chronic
- association with Raynaud's + smoking
- Calcium channel blockers
- Trench foot (immersion foot)
  - Patton, 1944: more casualties from trench foot than from the Germans
  - cold and wet, but above freezing
  - swelling + tight boots?
  - Three phases:
    - cold exposure and vasospasm; cold, pale, wooden (later swelling)
    - inflammation (Wholey's story)
    - healing
  - Treatment: as for frostbite minus rewarming
- Frostnip: pale, still soft
- Deep Frostbite
  - Pathophys
    - Freezing of interstitial fluid > dehydration (rubbing with snow?)
    - Visible evidence of damage delayed until rewarmed
    - Platelet aggregation
    - inflammation (ibuprofen)
    - individual (genetic) and racial difference in susceptibility, also nutritional state, hypothermia, smoking.
- Natural History
  - blisters, red
Grading: I-IV (same as burns) – but delayed grading

Field diagnosis: palpation

Prevention:
- non-cotton socks
- properly-fitting boots
- “two-sock frostbite”
- role of hypothermia and debilitation
- rapid cooling but subfreezing fluids
- wind-chill equivalent temperature

Treatment
- rapid rewarming in 105-110°F (41-43°C) water.
  - Despite Hippocrates, Baron Larrey, and many others
  - numb, avoid fires, heat packs (Hippocrates and Larrey right about that)
  - and hypothermia:
    - litter
    - Hubbard tank
  - not “prevent slow rewarming”: Mt. Hood treatment (not!)
  - “can walk on frostbitten feet” (not!)
  - avoid refreezing
- Ibuprofen?
- Dextran?
- IV reserpine?
- Sympathectomy?
- Aloe Vera?
- Surgical resection (not!)
- Treat infections
- Supportive care

- Submersion
  - Cold water submersion
    - Mammalian diving reflex
    - Hypoxia
    - Protective hypothermia
  - Warm water submersion
    - “Breaking” + Heimlich maneuver
    - “Dry drowning”
    - Delayed pulmonary edema
    - Delayed renal failure