Environmental Core Content
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- 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 $86^\circ F (30^\circ C)$
- 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