HYPOTHERMIA MANAGEMENT IN TRAUMA PATIENTS

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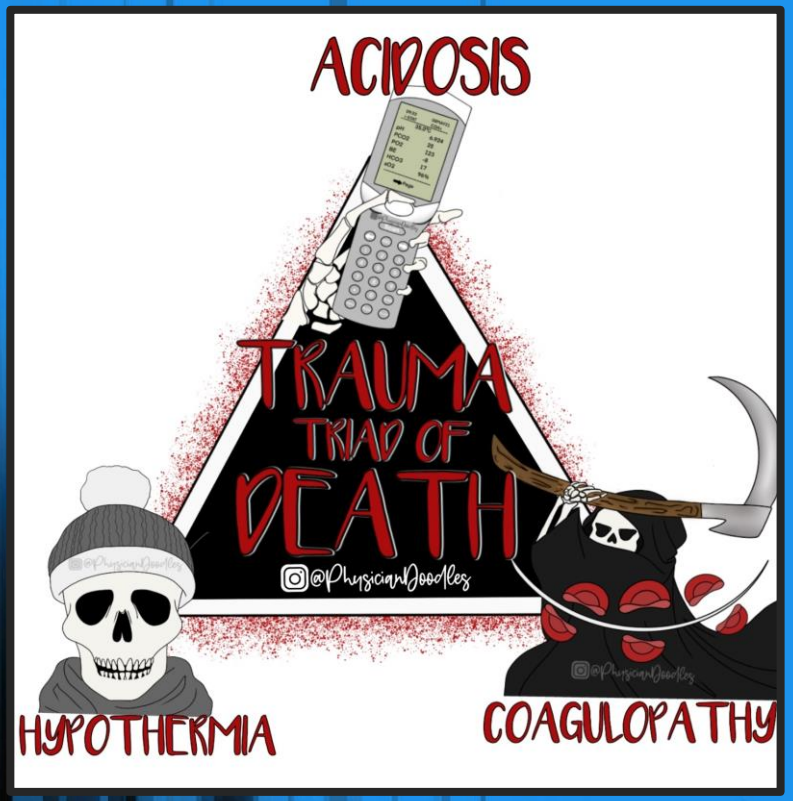
Disclosures

- **No disclosures**

Introduction

- Hypothermia is present in 2/3 of severe trauma patients
- If untreated leads to increased mortality, transfusion requirements and length of stay
- Key contributor to the trauma “Triad of Death”
- New UMC hypothermia guideline
  - Assessment
  - Risk factors
  - Laboratory evaluation
  - Rewarming



Classification of Hypothermia

Classification	Conventional	Trauma patient
Mild hypothermia	35–32 °C (95.0–89.6 °F)	36–34 °C (96.8–93.2 °F)
Moderate hypothermia	32–28 °C (89.6–82.4 °F)	34–32 °C (93.2–89.6 °F)
Severe hypothermia	28–20 °C (82.4–68.0 °F)	32 °C (89.6 °F)
Profound hypothermia	20–14 °C (68.0–57.2 °F)	

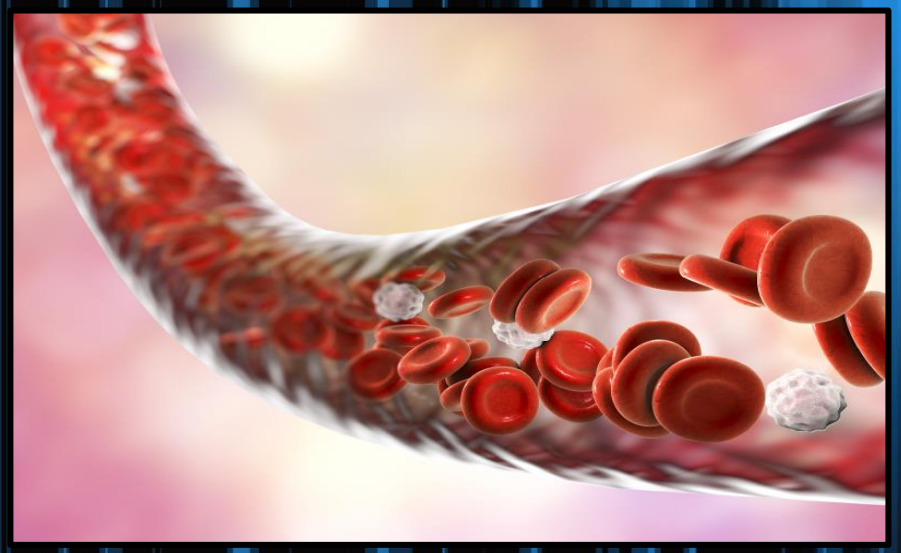
Physiological Effects of Hypothermia

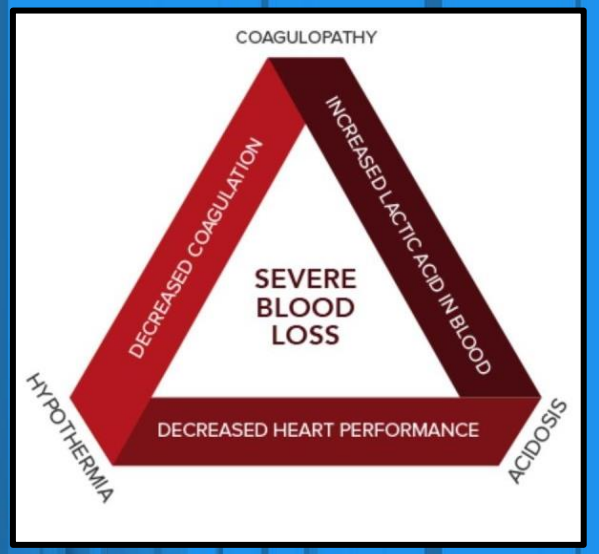
- **Neurological**
  - Cerebral metabolism ↓7% per °C of heat loss
  - Confusion, discoordination, somnolence
  - Comatose ~ 30 °C
  - Loss of deep tendon and brainstem reflexes < 27 °C
    - Patient must be re-warmed to 34 °C to diagnose brain death
- **Cardiovascular**
  - Increased sympathetic tone, HR, BP, CO at 34-36 °C
  - Depressed cardiac activity, impaired diastolic relaxation at 28-34 °C
  - Bradycardia, prolonged PR, Osborne waves, T-wave inversions at 25-28 °C
  - Ventricular fibrillation < 25 °C

Physiological Effects of Hypothermia

- Respiratory
  - Increased respiratory rate at 36 °C
  - Decreased airway reflexes, increasing aspiration risk at 34 °C
  - Medullary center depression, ↓minute ventilation, ↑ secretions, atelectasis at < 32 °C
- Renal
  - Initially ↑ renal blood flow and cold induced diuresis
  - Later ↓GFR, at 30 °C GFR 50% of normal
  - Urine output decreases at 20 °C

Physiological Effects of Hypothermia

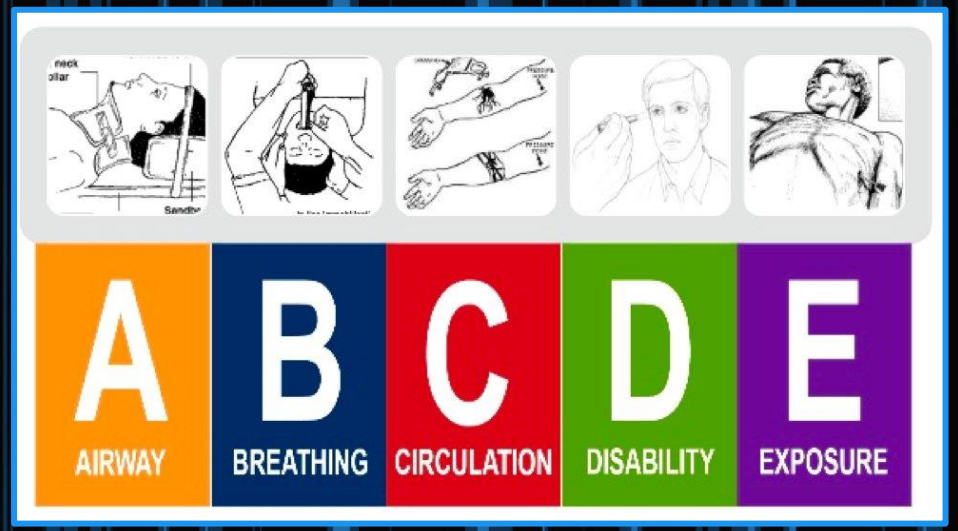


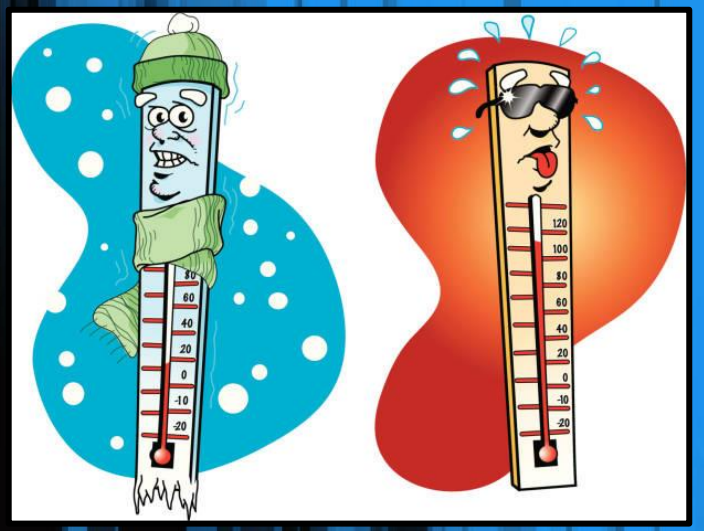


- Hematological
  - Clotting factor enzymes & platelets work best ~ 37 °C
  - Impaired platelet function 33-36 °C
  - Impaired clotting factors, fibrinogen synthesis, thrombin, glycoprotein complexes, platelet aggregation, thromboxane B2 production < 33 °C

Assessment

- Airway, Breathing, Circulation, Disability, Exposure
- Measure core body temperature (esophageal, bladder or rectal)
- Assess for hypothermia risk factors
- Initiate appropriate rewarming measures
- Continue temperature reassessment at least hourly while hypothermic
- Cessation of warming measures when 37 °C is reached



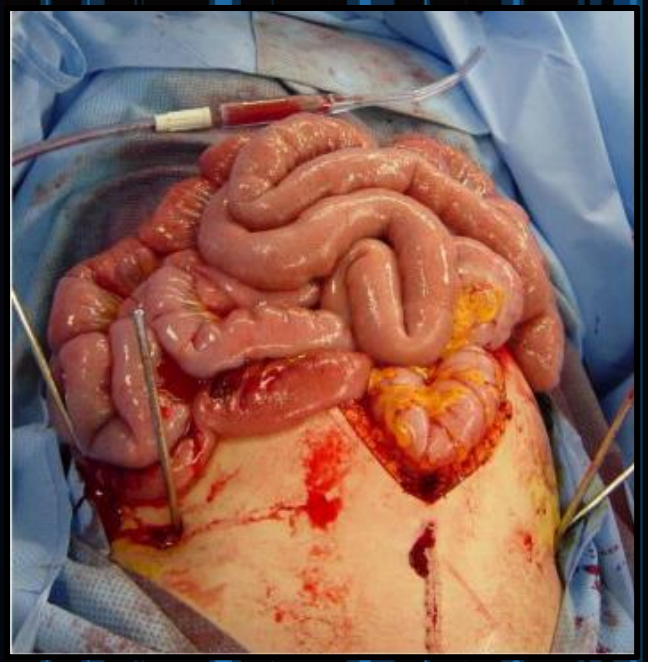


Hypothermia risk factors
Prehospital

- Severe injuries
  - Head injury, spinal cord injury, shock, burns, large open wounds
- Suspected medical conditions
  - Thyroid, adrenal, cardiac, malnutrition, autonomic nervous system dysfunction
- Extremes of age
- Cold clothing and/or environment
- Prehospital intubation

Hypothermia risk factors
Hospital

- Cold IV fluids
- Cold blood products
- Surgery with general anesthesia > 3 hours
- Exposure



Laboratory Evaluation

- Glucose
- CBC
- CMP
- Blood gas
- Urinalysis
- Procalcitonin
- Creatinine kinase
- Serum myoglobin
- Toxicology screening
- Coagulation studies (INR, PT, aPTT, Quantra/ROTEM)
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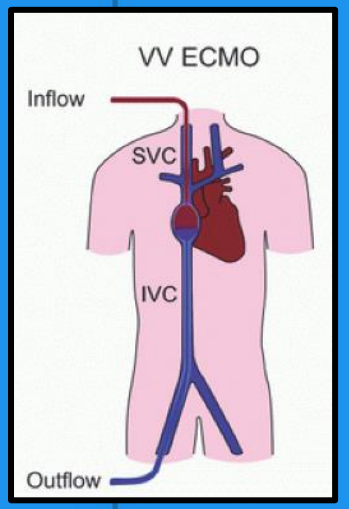
Rewarming
Mild Hypothermia
34.0 – 36.9 °C

- Passive rewarming
  - Removal of cold clothing
  - Increase room temperature
  - Apply warm blankets

Rewarming
Moderate Hypothermia
32.0-33.9°C
(with no cardiac comorbidities)

- Passive rewarming
- Active external rewarming
  - Radiant warmer
  - Bair hugger (forced warm air blanket)
  - Heating pads (not in high pressure areas)

Rewarming
Moderate Hypothermia with cardiac comorbidities
or
Severe hypothermia< 32.0°C



- Passive rewarming
- Active external rewarming
- Active external and internal rewarming
  - Warm humidified oxygen (nasal cannula or mechanical ventilation) 40 °C
  - Warm IV fluids 38-42 °C
  - Artic Sun
  - Peritoneal lavage
  - Hemodialysis
  - Targeted temperature management via Altrix device
  - VV ECMO

Conclusions

- Prompt recognition and management of hypothermia is vital
- Continued awareness of hypothermia risk factors
- Initiate passive and active rewarming methods as indicated
- Frequent reassessment of temperature until normothermia is reached

References

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