EM Basic- Hyperthermia

Normal core body temperature – 37°C +/- 0.5°C (98.6°F +/- 0.9°F)
Heat stroke – core temperature > 40°C (104°F)

- **Exertional** – occurs in athletes/military during strenuous activity
- **Non-exertional (classic)** – occurs in elderly and poor

Mechanism – heat load becomes so great that the body's regulatory mechanisms (ex. evaporation, decreased ability to deliver heat to skin, and impaired vasodilation in elderly) are overwhelmed and can no longer dissipate heat effectively

History
HPI
Dizziness? Weakness? Nausea/vomiting? Diarrhea? Increased thirst? Profuse sweating? Collapse during strenuous activity?
Medications – Pt. on diuretics, antihypertensives, neuroleptics, anticholinergics, dietary supplements?
PMH – hx of alcoholism, schizophrenia, or CV disease?
Setting suggesting alternative dx– symptoms start after general anesthesia? Pt. on antidepressant or antipsychotic medications? History of a thyroid disorder?
Social – does pt. use illicit drugs?

PEARL – Pts. will often be delirious on arrival to hospital so best history will often be from pre-hospital providers

Physical Exam
Vitals – tachycardia, tachypnea, hypotension, T > 40°C (104°F)
Temp. Measurement – use rectal or esophageal probe
General – evaluate muscle compartments for signs of acute compartment syndrome, examine all orifices for bleeding
Early stages – neuro signs including delirium, coma, convulsions, hallucinations
Other signs – cutenaeous vasodilation, crackles (pulmonary edema), jaundice (hepatic injury), muscle flaccidity, diaphoresis may/may not be present

PEARL – A patient with severe exertional heat stroke will usually have musc flaccidity. If muscle rigidity is instead present, this suggests an alternative diagnosis such as malignant hyperthermia or neuroleptic malignant syndron

Workup
CBC (baseline)
CMP (hypoglycemia, hyponatremia, ↑ transaminases, ↑ BUN/creatir in exertional→hypocalcemia, hyperphosphatemia)
Serum CK/urine myoglobin (rhabdomyolysis, esp. in exertional)
Lactate level (lactic acidosis in exertional)
ABG/VBG (metabolic acidosis and respiratory alkalosis common in classic)
EKG (dysrhythmias, conduction abnormalities, non-specific ST-T wave changes, heat-related ischemia/infarction)
Tox screen (if you suspect medication effect)

Imaging
CXR (pulmonary edema)
Head CT/LP (if you suspect CNS cause of AMS)

Differential Diagnosis
Meningitis/encephalitis – shaking chills
Thyroid storm – enlarged or nodular thyroid gland; order TFTs
Anticholingeric poisoning – dilated pupils (constricted in heat stroke)
Neuroleptic malignant syndrome – pt. on antipsychotics and p/w hyperthermia, muscle RIGIDITY, AMS, labile blood pressure, tremors, choreoathetosis
Serotonin syndrome – pt. on MAOi + SSRI/TCA/opioid; triad of cognit changes (HA/convulsions), autonomic hyperactivity (tachycardia/diaphoresis), neuromuscular abnormalities (hyperreflexia/myoclonus)
Malignant hyperthermia - ↑ core temp. (often > 45°C) after tx w/anesthetic agents, muscle RIGIDITY, sinus tachycardia, skin cyanosi w/mottling

PEARL – if there is any diagnostic uncertainty, then sepsis must be considere in differential and empiric broad-spectrum antibiotics should be started

Management
ABCs – intubation, O2, and fluids as necessary

Monitoring
Vitals – frequently, rectal/esophageal probe for temp.
Fluid status/renal function – Foley catheter
Other – cardiac monitor, continuous pulse oximetry

Cooling (stop when Temp. 38-39°C = 100.4-102.2°F)
Ice water immersion (exertional, avoid in elderly/classic heat stroke)
Place pt. in tub with 2-15°C (35-60°F) cold water
Keep water cool during process and frequently stir
Evaporative cooling (classic or exertional)
Removal all of pt.'s clothes and spray pt. with lukewarm water
Position fan towards pt. to blow air over skin and evaporate water
Water Ice Therapy (alternative to immersion)
Place patient on a porous stretcher and position over tub of ice water
Ice water taken from bath and continuously poured on patient
Ice packs to massage major muscle groups and ↑ skin vasodilation
If no tub available, can place a few sheets under pt., cover pt. completely with ice, then wrap him/her with a sheet
Ice packs (if ice water techniques or evaporative cooling not possible)
Apply to pt.'s neck, groin, and axillae
Cold fluid thoracic and peritoneal lavage (last resort)
Invasive, should never be used in pregnant pt or those with prior abdominal surgery
Adjunctive cooling measures
Cooled O2, cooling blankets, IV fluids cooled to 22°C (71.6°F)

Disposition
Healthy atheletes – if recover rapidly w/cooling and have no complications – d/c after period of observation
Multiorgan dysfunction – admit to ICU
All others – admit for observation and monitoring

Returning an athlete to play- General Advice
Avoid significant physical exertion until complete recovery and all blood tests WNL
Gradual reintroduction of physical activity
May resume full competition after participating in full training in heat for 2-4 wks w/o adverse effects. NEVER clear an athlete to return to play fr the ED- have them followup with another provider as an outpatient.

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