

Heat Illness

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Elevated Temperature

- Fever
 - Raised hypothalamic set-point
- Hyperthermia
 - Normal hypothalamic set-point
 - Elevated temperature d/t body can't dissipate heat/external factor

Heat Acquisition & Loss

Gains

- Metabolic rate
- Exercise/exertion
- Radiant energy
 - Solar load
 - Radiant heat (earth/surroundings)
- Ambient temp (humidity)

Losses

- Radiation
- Convection
- Conduction
- Evaporation
- Respiration

Heat Acquisition



Heat Loss



Thermoregulation

- If no thermoregulation core temp increases ~ 1°C/hr
- Meaning without thermoregulation you would die in
 - 4hrs doing nothing at all
 - 20-30 mins if working out

Thermoregulation

- Normal heat production ~ 100kcal/hr
- Increases with:
 - Dehydration
 - O.4 degrees increase each 1% BM loss
 - Activity
 - Sedentary 60-70 kcal/M²/hr
 - Walking 250-300 Kcal/M²/hr
 - Max exercise 1000 Kcal/M²/hr
 - Jogging = 1kcal/kg/km

Thermoregulation

- 3 levels of control
 - Skin (sweat & blood flow)
 - Skin temp determines shivering & vasoconstriction
 - Muscle mass (shivering, activity)
 - Central control (hypothalamic set point)

Risk Factors for Heat Illness		
Risks	Examples	
Advanced Age		
Anhydrosis	CNS/PNS Disorders	
Burns		
Brain Damage	Hypothamic Injury (Bleed)	
Chronic Illness	Athrosclerosis Cystic Fibrosis Diabetes	
Clothing	Vapor-Impermeable Clothing	
Dehydration		
High Heat / Humidity		
Inadequate Fluid Intake		
Increased Heat Production	Fever Exercise Hyperthyroid MH NMS Seizures Thyroid Storm	
Obesity		
Peripheral Vascular Disease		
Psychiatric Conditions	Delirium Psychosis	
Physical Activity		
Skin pathology	Ectodermal dysplasia Scleroderma	
Vomiting / Diarrhea	Gastroenteritis	

Alcohol	
Alpha adrenergics	
Amphetamines	
Anticholinergics	
Antihistamines	
Antipsychotics	
Benzodiazepines	
Beta blockers	
Calcium channel blockers	
Clopidogrel	
Cocaine	
Diuretics	
axatives	
Neuroleptics	
Phenothiazines	
Thyroid agonists	
Fricyclic antidepressants	

Heat Illness



Heat Stroke

Defined as Tc >40.5°C

- CNS dysfunction
 - can be quite subtle (behaviour changes, concentration)
 - delirium
 - seizures
 - coma
- Tachycardia, increased respiratory rate, hypotension
- Serious signs
 - rhabdomyolysis
 - bowel infarction
 - hepatic injury
 - thrombocytopenia

- encephalopathy
- MI
- pancreatitis
- arrythmias

renal failurehemorrhageDIC

• Residual brain damage in 20%

Heat Stroke

Heatstroke: Diagnosis Rosen's Box 133.5

- Core temperature > 40.5°C
- CNS dysfunction (Coma/Delirium/Seizure)
- Elevated liver enzymes
- Exposure to heat stress
- Hot skin ± Sweating

Classic vs Exertional Heat Stroke

Factor	Classical	Exertional
Age	Older (>60)	Younger (15-45)
Health	Comorbidities	Healthy
Activity	Sedentary	Exercise
Medications	Many	None
Sweating	May be absent	+
Hypokalemia	Absent	Common
Hypocalcemia	Rare	Frequent
Rhabdomyolysis	Rare	Often severe
Lactic acidosis	Nil	+
Renal failure	<5%	25-30%

Heat Stroke Treatment

- Stop activity
- Cool environment
- Supportive care of ABCs
- Cooling to <39°C
 - Passive
 - *Conductive*
 - Evaporative/convection
- IV/PO hydration
- Evacuation

Heat Stroke Differential

Heat Stroke Differential

- CNS haemorrhage
- Toxins, drugs
- Seizures
- Malignant hyperthermia
- Neuroleptic malignant syndrome
- Serotonin syndrome
- Thyroid storm
- High fever, sepsis
- Encephalitis, meningitis

- Healthy 20-year-old comes to see you after his first day working on a construction site in the middle of a heat wave
- He complains of ++ sweating and sudden pain in his left calf

Diagnosis

- ++ sweating during activity
- Hypotonic fluids during activity
- Cramps of most worked muscles
- Usually post activity

Treatment:

- Mild = ORS
- Severe = IVF

Heat Cramps

- You are working as medical staff for a local Marathon
- It's a warm day with highs of 25°C and humid
- You are stationed at the finish line and see a runner slowly stumbling towards you and then crawling to the finish line
- He makes it across the line and you assess him
 - Temp 39.5⁰, HR 134, glucose 4.5
 - Pt is sweating and vomits

	Heat Exhaustion
 Clinical dehydration 	Normal temp or <40 ^o C
 Fatigue 	Normal mental status
 Headache 	Orthostatic hypotension
 Malaise 	Tachycardia
 Muscle cramps 	Sweating
 Nausea/vomiting 	
 Syncope 	
 No other medical cause 	

Heat Exhaustion

Treatment:

- Cool environment
- Fluid replacement
- Rest
- Admit if electrolyte abnormalities

- It's a suddenly warm 25^oC day in Moose Factory hospital
 - The heat is on high because it was cold 3 days ago, everyone is complaining about the heat
 - You are treating a COVID + patient
- You hear a crash and turn around to find one of the nurses on the floor

Heat Syncope

- Associated with prolonged standing
- More common in older adults
- Temporary LOC d/t decreased cerebral perfusion

Treatment:

- Supine positioning
- Remove from hot environment

- 35-year-old presents to see you complaining of a rash
 - Rash itchy red vesicular rash
 - Isn't sweating over the rash



Prickly Heat Rash

- Blocked sweat glands
- Itchy

Treatment:

- Chlorhexadine lotion/crème
- Salicyclic Acid 1% lotion



- A 50-year-old woman comes to see you after spending a week in Toronto during a heat wave
 - Complains that her ankles have been swollen for the last 3 days

Heat Edema

Consider/rule out other causes

Treatment:

- Limb elevation
- Compression stockings



- A 26-year-old female comes to see you with painful skin
- She was outside yesterday in shorts & a tank-top as it was a nice day, although overcast

Sunburn

- Inflammatory reaction to UV radiation damage
- Accelerates skin aging
- Is the leading cause of skin cancer
 - 5 or more sunburns DOUBLES your risk of melanoma
 - Even 1 blistering sunburn in childhood/adolescence DOUBLES your risk of melanoma

Treatment:

- Cool bath/shower
- Moisturize
- NSAIDS
- Hydrate
- Let blisters heal
- Protect your skin
 - Babies <6months should never be exposed to sun
 - Everyone >6months should protect from sun with broad-spectrum sunscreen, protective clothing, UVblocking sunglasses



Figure 1. Heat illness treatment algorithm.



References

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