Exertional Heat Illness Overview

新光急診張志華醫師 2013/7/23

Objectives

- **Thermoregulation**
- **Heat injuries**
- **Predisposing factors**
- **Return to activity**
- **Prevention**

Sudden Death in Athletes

- #1 overall cause:
  - Cardiovascular conditions
  - Very difficult to prevent
- #1 non-CV cause:
  - Exertional Heat Illness (EHI)
  - More preventable

Thermoregulation

Metabolic Heat

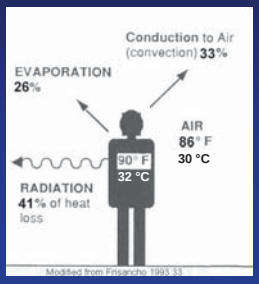
Environmental Heat

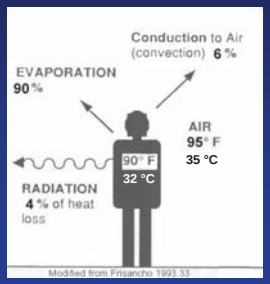
\+ \+

↑ Body Temperature

Thermoregulation (cont.)

Heat exchange mechanisms





Thermoregulation (cont.)

(+) **Heat gain** | (-) **Heat loss**

Metabolic

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Convection
Conduction
Radiation
Evaporation

* **When Environmental tº < Skin tº**

Non EHI Injuries

- Parade Syncope - syncope from standing in the heat
- Dehydration
- Vasovagal reactions
- Heat edema
- Heat rash

Types of EHI

- Heat Cramps - skeletal muscle cramping, usually in abdomen or extremities
- Heat Exhaustion – inability to continue to exercise (+/- collapse), but no lab evidence of organ dysfunction

Types of EHI (cont)

- Rhabdomyolysis – muscle damage causing CPK > 3000 (> 5 x upper limit of normal), possibly leading to AKI
- Heatstroke – CNS dysfunction (mental status changes ranging from confusion to delirium to seizure, coma and death) with lab evidence of organ dysfunction (e.g. renal, hepatic, muscle)

Early Signs and Symptoms

- weakness
- fatigue
- headache
- slowed mentation
- thirst
- muscle cramps
- nausea, vomiting
- diarrhea

Heat Cramps

- Etiology: fatigue > Na+ loss > dehydration
- Symptoms
  - Painful muscle contractions
  - Skeletal muscle only
  - Last 1-3 min usually, up to 8 hours

Exertional Rhabdomyolysis

- Etiology: intense exertion, muscle damage
- S/S
  - Muscle pain, but not cramps
  - Muscle tenderness, +/- swelling
  - May have coke-urine

Heat Exhaustion

- Etiology:
  - widespread peripheral vascular dilation
  - Heat and dehydration usually involved
- S/S
  - VS: high HR, low BP
  - Sweaty, pale, ashen appearance
  - Headache, irritability, n/v, decreased coordination, weakness, dizziness
  - May have muscle cramps
  - Temp < 40 °C

Exertional Heatstroke

- Temp > 40.5°C (105°F)
- S/S of heat exhaustion, PLUS
  - disorientation
  - confusion
  - dizzziness/ataxic gait
  - irrational behavior
  - Inappropriate comments
  - seizures, coma

  } CNS
  - Organ dysfunction: Kidneys, liver, clotting system

Diagnosis of Heat Stroke

- In a previously healthy individual who collapses when exerting in a hot environment for long periods, and whose rectal temperature is above 40.5°C (105°F), the diagnosis of heat stroke is virtually certain

Epstein Y. Am J Med Sports 2:143-152, 2000

BOX 139-5 HEATSTROKE: DIAGNOSIS

Exposure to heat stress, endogenous or exogenous
Signs of severe CNS dysfunction (coma, seizures, delirium)
Core temperature usually above 40.5°C (105°F), but may be lower
Hot skin common, and sweating may persist
Marked elevation of hepatic transaminases

CNS, central nervous system.

Table 139-1 Usual Characteristics of Heatstroke

EXERTIONAL	CLASSIC
Healthy	Predisposing factors/medications
Younger	Older
Exercise	Sedentary
Sporadic	Heat wave occurrence
Diaphoresis	Anhidrosis
Hypoglycemia	Normoglycemia
DIC	Mild coagulopathy
Rhabdomyolysis	Mild CPK elevation
Acute renal failure	Oliguria
Marked lactic acidosis	Mild acidosis
Hypocalcemia	Normocalcemia

CPK, creatinine phosphokinase; DIC, disseminated intravascular coagulation.

AXIOM

A sudden collapse during physical exertion carried out under warm climatic conditions should a priory be diagnosed as heat stroke (unless and until proven otherwise)

Spectrum of Severity

Heat exhaustion → **Heat Stroke**

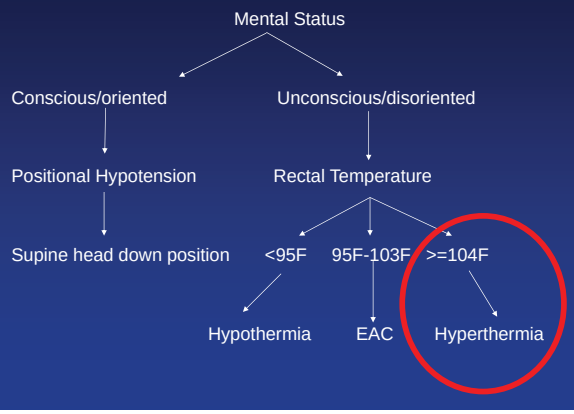
Rhabdomyolysis and cramps can present anywhere on the spectrum

Core Temperature – necessary in assessment but NOT good method of predicting level of severity or outcome.

Core Body Temperature

- MUST assess by rectal thermistor
- Heat exhaustion
  - T usually < 40
- Heat Stroke
  - T > 40
  - T > 40 by itself is NOT diagnostic of heat stroke, need CNS/organ dysfunction also

Exercise Associated Collapse



BOX 139-6 DIFFERENTIAL DIAGNOSIS OF HEATSTROKE

CNS hemorrhage
Toxins/drugs
Seizures
Malignant hyperthermia
Neuroleptic malignant syndrome
Serotonin syndrome
Thyroid storm
High fever/sepsis
Encephalitis/meningitis

CNS, central nervous system.

EHI Initial Eval & Treatment

- Rest
- Shade
- Remove excess clothing/equipment
- Fluid replacement (electrolytes)
- Measure core temperature!
- Cooling (if necessary)

Muscle Cramps

Rest, Massage, Stretch, Oral hydration, Ice
Re-eval in 10-15 minutes

↓

Serum Na+, give 2 liters of IV saline
Re-eval in 10-15 minutes

↓

Transport if poor response

Heat Exhaustion

- Monitor VS
- Cooling if hyperthermic
- Supine, legs up
- Most improve w/ rest, oral hydration
- IV fluids (NS) if slow response
  - No evidence for faster recovery

Heatstroke Treatment: Cool Quickly! (after calling EMS)

External cooling

- Cold ice packs
- Water spraying
- Fans
- Cooling blankets
- Ice bath

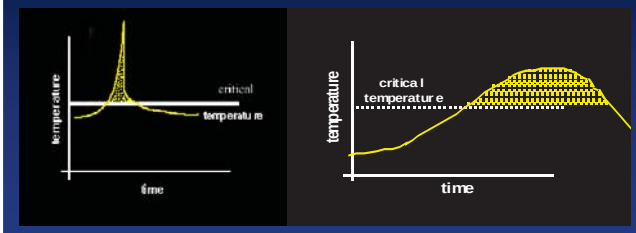
Internal cooling

- Intravenous fluids
- Peritoneal lavage

Antipyretics have no role in the acute treatment of heatstroke

Temperature - duration area

The severity of the illness is a function of the temperature-duration area above a critical temperature (40.6°C), not so much the absolute max temperature



Methods of rapid field cooling

- Mist spray and fanning
- Ice in axillae, groin, neck
- Ice water bath immersion

BOX 139-7 COOLING MODALITIES TO LOWER BODY TEMPERATURE IN HEATSTROKE

Preferred

Evaporative cooling using large circulating fans and skin wetting
Ice water immersion

Adjuncts

Ice packs to axillae and groin
Cooling blanket
Peritoneal lavage (unproven efficacy in humans)
Rectal lavage
Gastric lavage
Cardiopulmonary bypass

Monitoring Response to Cooling

- Monitor mental status
- Temp will drop rapidly, 10~30 minutes
- When 39°C reached, STOP ice bags/ice bath
- Continue cooling w/ mist/fan until about 38°C
- If prolonged temp elevation, think fever
- Transport ASAP!

Return to activity

- Heat Cramps: maybe same day
- Heat Exhaustion: 1~3 days
- Heatstroke: 2~3 weeks at least

Prevention is the Best Treatment

Predisposing factors

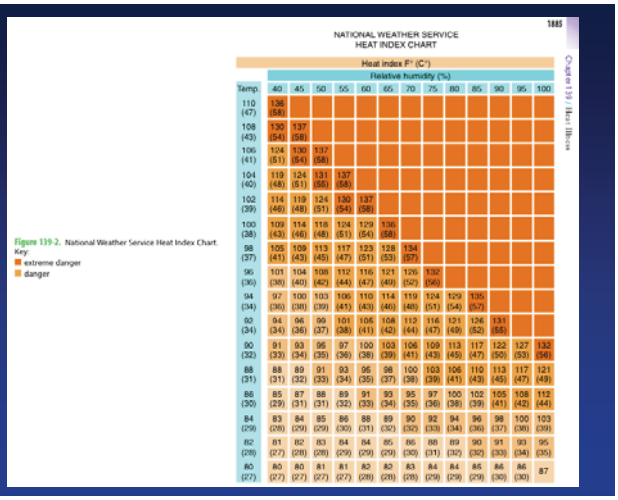
- **Previous Hx of heat stroke**
- **Medications**
- **Sweat gland dysfunction**
- **Upper respiratory illness**
- **Gastrointestinal illness**
- **Overmotivation**
- **Genetic predisposition**
- **Lack of acclimatization**
- **Hot and humid climate**
- **Dehydration**
- **Obesity**
- **Excessive clothing**
- **Low physical fitness**
- **Sleep deprivation**

Heat Acclimatization

- Exercise in the heat
- Improves response to heat in a few days, most gains within 10 days
  - Increase blood volume
  - Increase stroke volume
  - Decrease resting heart rate
  - Decrease metabolic heat production
  - Sweat sooner, more, and with less sodium
  - Skin vasodilates more quickly

Prevention

- Avoid working in high heat load
- Plan work rest cycles
- Avoid the sun (work at night)
- Calculate heat index
- Sleep at list 6 hours a day
- Drink (cool and flavored water)
- Consider salt intake (food)
- Acclimatize (>2 weeks)
- Understand the cumulative effects of heat
- Educate athletes, coaches



Wet Bulb Globe Temp (WBGT)

- Used to determine risk of heat illness
  - Depends on athletes' risk
  - Depends on activity type

綜合溫度熱指數

一、戶內或戶外無日曬時

綜合溫度熱指數= 0.7 ×自然濕球溫度+ 0.3 ×黑球溫度。

二、戶外有日曬時

綜合溫度熱指數= 0.7 ×自然濕球溫度+ 0.2 ×黑球溫度+ 0.1 ×乾球溫度

Points to Remember

- Assume heatstroke in any collapsed athlete in hot conditions; COOL FAST!
- Assess core temp ASAP, but it alone doesn't define heat stroke
- Heatstroke = T >40 + CNS dysfxn + organ damage
- Cooling: ice bath ; mist/fan + ice bags

Thank you