Exercise and Collapse: Differential Diagnosis

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Diff Dx: Collapse during/after an endurance event

- EAC
- EAH
- Heat exhaustion/Stroke
- Dehydration
- Exercise associated hypoglycemia
- CVD: MI or Arrhythmia

In the majority of cases no clear cut diagnosis is apparent
Exercise Associated Collapse

- Most common disorders in MASH tent
- EAC is not a diagnosis
- Inability to stand or walk unaided as a result of
  - Light-headedness
  - Dizziness
  - Syncope
- Most symptoms resolve in the recumbent position!
Exercise Associated Collapse

Epidemiology of EAC
- 85% of collapse after finish line
  - Why is cessation of exercise an essential factor in EAC?
- EAC: Rate of identifiable medical condition before finish line vs. after?
  - 100% vs. 34%

Etiology of EAC
- Transient postural hypotension
  - Cardiac Output
    - Blood pooling in legs
    - Low peripheral resistance from compliant leg veins
    - Cessation muscle pump venous return
  - Forgotten Barcroft/Edholm reflex
    - Drop Right Atrial Pressure → Drop peripheral resistance w/o increase HR → orthostatic hypotension
- Postural hypotension often severe
  - Ultra marathon/endurance
  - Unrelated to dehydration
Therapy of EAC

- IV therapy not rational
  - May induce iatrogenic hyponatremia and hypoglycemia
  - Can be life threatening!
- Therapy aims to return blood from periphery
  - Keep walking after finish line!
  - Elevate pelvis and legs
  - Anti-histamines for recurrent EAC?
- Failure to respond may indicate (order of incidence)
  - Hyponatremia
  - Dehydration
  - Heat Illness
  - MI=incidence 1.2/100,000 marathon runners
Heat Illness Spectrums

Heat Exhaustion
- Patients with EAC in extreme heat
- Poorly defined syndrome which limits the ability to sustain exercise
- Easily treated and resolves without sequelae
- Presumed etiology
  - ↓ fluids/electrolytes
- Associated with moderate hyperthermia

Heat Stroke
- CNS dysfunction
- Severe illness which may result in death despite aggressive Rx
- End organ damage and mental status changes
Definition of Exercise Associated Hyponatremia

- Hyponatremia during or after exercise
  - Moderate < 135mmol/L
  - Severe < 130 mmol/L (<125)
History-EAH

- **1981**
  - 1st case: 2 runners participating in a 90-km race in South Africa.

- **1985 Hawaiian Ironman**
  - 29%

- Shorter events?
  - hikers in the Grand Canyon
    - 1999
      - Marathon runners

- Dogs

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Symptoms with EAH?

- Asymptomatic in many disease states

- The severity of neurologic symptoms
  - correlates with rapidity & severity of the drop in Na
  - A gradual drop over days to weeks, even to very low levels, may be tolerated, because of neuronal adaptation
Incidence of Exercise Associated Hyponatremia

- 1985 Hawaiian Ironman
  - 29% of race finishers

- 1996 New Zealand Ironman
  - 9% of athletes requiring medical care

- 1997 New Zealand Ironman
  - 18% of race finishers

- 1997 Grand Canyon Study
  - 6% of hikers requesting medical assistance had Na <130

- 2005 Boston Marathon
  - > 13% of finishers had a Na <135

- 2006 London Marathon
  - 12.5% Asx Hyponatremic Racers: drank more (almost double) & gained more weight than non-hyponatremic racers
Questions?

- Are there particular symptoms that help to differentiate hyponatremia vs heat illness?
- Common symptoms
  - N & V, Headache, dizziness?
  - No difference!
Distinguishing Hyponatremia vs Heat Exhaustion

**Hyponatremia**
- Tight watch
- Desire to urinate
- Weight gain
  - Should lose 1Kg+ body weight in standard Marathon
- **Seizures and change of mental status** distinguished hyponatremia (P= 0.0002)
- Seizures, combativeness or major confusion (71%)  
- Mild degrees of confusion and ↓coordination (100%)

**Hyperthermia**
- Tachycardia, hypotension & orthostatic vital signs
  - >50% of Heat exhaustion pts were orthostatic
  - 0% hyponatremia patients
- **Syncope**
  - 23% of heat exhaustion
  - 0% of hyponatremic pts
Hyponatremia among Runners in the Boston Marathon NEJM April 2005

488 runners /13% Na <135 / 0.6% Na <120

+ univariate analyses
  - substantial weight gain
  - consumption of more than 3 liters of fluids during the race
  - consumption of fluids every mile
  - a racing time of >4:00 hours
  - female sex
  - low body-mass index.

+ multivariate analysis
  - weight gain (odds ratio, 4.2; 95 percent confidence interval, 2.2 to 8.2)
  - a racing time of >4:00 hours (odds ratio for the comparison with a time of <3:30 hours, 7.4; 95 percent confidence interval, 2.9 to 23.1)
  - body-mass-index extremes
Summary: Risk Factors

- Exercise duration >4 h or slow running/exercise pace
- Female gender (partly explained by lower body weight)
- Low body weight (also extremes of BMI)
- Excessive drinking (>1.5 L/h) during the event
- Pre-exercise over-hydration
- Post-exercise over-hydration
- Abundant availability of drinking fluids at the event
- Nonsteroidal anti-inflammatory drugs (not all studies)
- Extreme hot or cold environment
2005 Consensus panel treatment

- Mild 130-135: fluid restriction and observe
- Severe <120 or symptomatic <130
  - Hypertonic saline
  - Rapid correction, 100ml of 3% saline over 10min
References