Hot Weather Medicine
PFN: SOMOML07

Terminal Learning Objective

- Action: Communicate knowledge of “Hot Weather Medicine”
- Condition: Given a lecture in a classroom environment
- Standard: Received a minimum score of 75% on the written exam IAW course standards

References

- Current Medical Diagnosis and Treatment (51st edition; 2012; McPhee; Papadakis)
- The Merck Manual (17th edition; Beers; Berkow)
- Special Operations Forces Medical Handbook (2001)
- Pathophysiology for the Health Professions (4th edition; 2011; Gould; Dyer)
Reason

As a Special Operations medic you are expected to have expertise in “Operational Medicine.” Mission requirements that push team members to the limits of physical endurance, combined with extremes in terrain and climate, greatly increase the risk for heat injuries. Your knowledge of the medical aspects of hot weather operations could be the difference between mission success or mission failure.

Agenda

- Communicate the pathophysiology and contributing factors related to heat injuries
- Communicate the physiology, signs and symptoms, differential diagnosis, and management of heat related injuries, to include prickly heat, heat syncope, heat cramps, heat exhaustion, and heat stroke

Agenda

- Identify other heat related injuries, to include sunburn and exertional hyponatremia
- Identify prevention methods of heat injuries
The Pathophysiology and Contributing Factors Related to Heat Injuries

Pathophysiology

- The basics of heat injury risk
- What is thermoregulation?
  - Normothermia
  - Hyperthermia
- Check core temperature

Pathophysiology

- Thermoregulation
  - Conduction - direct physical contact
  - Convection - transfer of heat from the body to air and water vapor surrounding the body
  - Radiation - transfer of heat electromagnetic waves
  - Evaporation - transfer of heat by transformation of liquid into a gaseous phase
Pathophysiology

- Thermoregulation
  - The body's dominant form of heat loss in a hot environment are radiation and evaporation
  - When air temperature exceeds 95°F, radiation heat loss ceases and evaporation becomes the only means of heat loss

Pathophysiology

- Heat stress
  - When heat is generated or gained by the body faster than it can be dissipated
  - Initially the body attempts to compensate by shunting blood away from the body's core through peripheral dilation and evaporation

Pathophysiology

- Cardiac output reaches its limits
  - As the heat places more demands on the thermoregulatory mechanisms of the body, it's ability to regulate temperature is decreased and sweating diminishes
Pathophysiology

- Less heat is moved away from the core
- Development of hyperthermia accelerates
- End organ failure
- System failure

Contributing Factors

- Increased heat load
- Water requirements
- Dehydration
- Salt
- Acclimatization
- Physical conditioning
- Use of supplements
- Environment

Contributing Factors

- Increased heat load
  - External (a hot day)
  - Internal (a road march with 50 lbs)
  - Or both (a road march in the desert sun)

  Note: Increased heat load can lead to heat injury!
Contributing Factors

• Water
  ➢ The body is absolutely dependent on water in hot environments
  ➢ In severe heat a person can lose one liter or more per hour
  ➢ Water must be replaced
    • 1200 ml per hour is maximum absorbed by the gut
    • Activity will determine the amount needed

Contributing Factors

• Water requirements
  ➢ Fact or fiction: The human body can be conditioned to require less water over an expanded period of time?
    • “Water discipline”
  ➢ If water is in short supply, activity should be limited to the coolest part of the day or the night
  ➢ What is the best hydration solution?

Contributing Factors

• Dehydration
  ➢ Results from inadequate replacement of lost body fluids
  ➢ Decreases your ability to maintain body temperature in the heat
  ➢ If injured, increases your susceptibility to severe shock
  ➢ Mild dehydration (2% to 3% of body weight) reduces physical capacity and heat tolerance
Contributing Factors

- Dehydration (cont.)
  - Signs and symptoms
    - Dark urine with a very strong odor
    - Low urine output
    - Dark and sunken eyes
    - Fatigue
    - Emotional instability
    - Loss of skin elasticity
    - Thirst is a poor indicator of adequate hydration

Contributing Factors

- Salt
  - Normal food intake will provide adequate salt
  - If heat temperature goes up what happens to appetite?
  - If heat stress increases - salt requirements will also*
    - Salt tablets should not be used as an oral salt source, use 0.1% salt solution (see ORS recipe in the SOF handbook, page 7-27)*

Acclimatization
Contributing Factors

- Acclimatization
  - Very important way to prevent heat illness
  - Is dependent on the degree of heat stress to which the individual has been exposed
  - Requires up to 14 days, regardless of physical conditioning

Contributing Factors (cont.)

- Reduced salt content of sweat, also helps conserve plasma volume
- Slowly expose to progressive increase in temperatures and physical exertion
  - About 1 to 2 hours per day
- Maintain lower body temperatures for any amount of heat stress

Contributing Factors

- Physical conditioning
  - Provides the cardiovascular reserves required to sustain thermoregulation
- Prior heat casualty?
- Overweight increases the likelihood of injury
- Debilitating diseases increase the incidence
Contributing Factors

- Use of supplements
  - Creatine and amino acids
    - Increase the requirement for water
    - Dehydration and kidney damage
    - Increased risk of heat injury

Environment

- Environment
  - Heat injuries can occur at any temperature or any environment
  - Most heat type injuries occur with high ambient temperatures and high humidity
Contributing Factors

- Environment (cont.)
  - Consider the type of environmental heat stress you will be exposed to during operations
  - Heat injuries are preventable by decreasing physical activity during high heat stress time periods

The Physiology, Signs and Symptoms, Differential Diagnosis, and Management of Heat Related Injuries, to include prickly heat, heat syncope, heat cramps, heat exhaustion, and heat stroke
Heat Related Injuries

- Prickly heat
  - Miliaria rubra
- Heat syncope
- Heat cramps
- Heat exhaustion
- Heat stroke

Prickly Heat - Miliaria Rubra

- Signs and symptoms
  - Erythematous, papular, and pruritic rash developing on actively sweating skin
  - In dry climates, rash confined to skin occluded by clothing to produce humidity
  - Skin does not sweat effectively, predisposing to heat exhaustion and heatstroke
Prickly Heat - Miliaria Rubra

- Management
  - Prevention is priority
  - Clean, light, and loose fitting clothing
  - Does powder help?
  - Treatment
    - Antihistamines
    - Chlorhexidine cream (Hibiclens)
    - If rash progresses
      - Dicloxacillin or E-mycin

Heat Syncope

- Signs and symptoms
  - Syncope after prolonged standing in a hot environment
- Management
  - Perform a secondary assessment after primary survey to assess for any trauma after fall
  - Trendelenburg
  - Cool victim and give oral fluids
    - 0.1% salt solution to correct salt deficit and correct electrolyte imbalance
Heat Cramps

- Signs and symptoms
  - Painful and spasmodic muscle cramps
    - Cramps may be precipitated by manipulation of the muscle
  - Nausea and vomiting
  - Onset during exercise or after the work effort

- Management
  - Administer an oral rehydration solution in 1 liter of drinking water
  - Allow the victim to rest in a cool place

Heat Exhaustion

- The most common heat illness
  - May develop over several days
  - Manifestation of strain on the cardiovascular system
  - Occurs when the demands for blood flow exceed cardiac output*
    - To the skin for temperature control, to muscles for work, and to the vital organs*
Heat Exhaustion

- Signs and symptoms
  - Flu-like symptoms
  - Malaise, headache, weakness, nausea, and anorexia
  - Vomiting
  - Orthostatic hypotension and tachycardia
  - Rectal temperature ranges between 97°F and 104°F with profuse sweating
  - Normal mental status and neurologic exam

Heat Exhaustion

- Management
  - Stop all exertion and move to cool shaded area
  - Remove restrictive clothing
  - Administer an oral rehydration solution or IV
  - Place ice or cold packs on the neck, chest, axillae, and groin
  - Fanning while soaking the patient is effective

Heat Stroke

- Breakdown of the body’s heat regulating mechanism
  - A true medical emergency!
- Distinguished from heat exhaustion by the presence of neurological symptoms
- If heat stroke is suspected and body temperature is elevated, start cooling immediately
  - Do not delay!
Heat Stroke

- Signs and symptoms
  - Elevated core temp, above 104° F
  - Altered neurologic state
    - Mental status, ataxia, seizures, and coma
  - Tachycardia
  - Hypotension
  - Tachypnea
  - Sweating present or absent
    - 50%

Heat Stroke

- Management
  - Provide rapid cooling
  - Protect airway
  - Administer IV fluid
    - NS 1 to 2 liters
  - Treat for shock, oxygen if available
Heat Stroke

- Management (cont.)
  - Treat seizures and combative behavior with IV benzodiazepine
    - diazepam 2 to 5 mg IV
  - Suppress shivering with benzodiazepine and evacuate the victim immediately
  - Discontinue cooling after temperature reaches ≈ 101°F to 102°F (avoid over-cooling)

Heat Stroke

- Do
  - Treat any heat injury with neurologic or mental status abnormalities as heat stroke
  - Initiate immediate cooling measures to any heat stroke casualty
  - Obtain a rectal temperature as soon as possible after collapse
  - Inform the leadership so they may implement appropriate measures to prevent further heat injuries

Heat Stroke

- Do not
  - Delay cooling measures awaiting a definitive diagnosis
  - Assume that a casualty with or without profuse sweating does not have heat stroke
  - Give any medications that will increase heart rate or metabolic rate, decrease blood pressure, or impede sweating
  - Take this condition lightly, EHS can kill
Other Heat Related Injuries, to Include Sunburn and Exertional Hyponatremia

Other Heat Related Illnesses

- Sunburn reduces the thermoregulatory capacity of skin
  - As any injury, has systemic effects including fever
  - “sun sickness” can be debilitating
  - Tx 2nd degree burn as 2nd degree thermal burn

Other Heat Related Illnesses

- Exertional hyponatremia
  - Caused by a loss of salt from sweating and hemodilution of sodium from drinking more than adequate amounts of water
    - i.e., H₂O intoxication
  - Signs and symptoms
    - Similar to heat stroke with neurological symptoms (differentiated by non-elevated temp)
  - Management
    - Replace sodium with NS IV (slowly)
    - Evacuation
Don’t Forget About TMEPS

Prevention Methods of Heat Injuries

Prevention

- Methods
  - Hydration is the most important element in a plan to prevent heat casualties
  - Dissipate heat by wearing loose clothing
  - Avoid direct sunlight if possible
  - Reverse work/rest cycles
  - Acclimatization
Wet Bulb Globe Temperature

Prevention

- Points to remember
  - Successful prevention of heat injuries is more important to the unit than their treatment
  - Education and training will help prevent heat related illness
  - Be involved in planning operations and training, by doing a thorough medical analysis of the environmental risks, and counter measures
  - Treat heat illness aggressively!

Questions?
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Check on Learning

Why is the absence of thirst a poor indicator of adequate hydration?

A. It is not stimulated until you are dehydrated
B. It is only stimulated when kidneys shut down
C. It is not stimulated until water shifts extracellularly
D. It is only stimulated when rehydration is taking place
Check on Learning

In a hot environment, which of the following factors of thermoregulation becomes the #1 method of heat loss?

A. Conduction
B. Radiation
C. Convection
D. Evaporation

Check on Learning

T/F: Acclimatization requires up to 14 days of progressive exposure to heat and activity level regardless of physical conditioning.

A. True
B. False

Check on Learning

T/F: Most heat type injuries occur in an environment with high ambient temperatures and high humidity.

A. True
B. False
Check on Learning

T/F: By definition heat injuries only occur in temperatures above freezing.

A. True  
B. False

Check on Learning

Heat stroke is a medical emergency. What signs help to differentiate from heat exhaustion?

A. Temperature > 104°F  
B. CNS involvement (delirium and coma)  
C. Anhydrosis (absence of sweating)  
D. All of these are correct  
E. A and B only

Check on Learning

Exertional Hyponatremia (water intoxication) is caused by a loss of salt from excessive sweating and hemodilution from more than adequate water consumption. Signs and symptoms are similar to , only the core temperature is < 104°F.

A. Heat exhaustion  
B. Prickly heat  
C. Heat stroke  
D. Heat cramps
Check on Learning

Which of the following best describes why prickly heat can be a potential mission stopper?

A. Secondary infection of skin is possible
B. Interferes with efficient sweating
C. Predisposes soldier to heat exhaustion or heat stroke
D. All of these are correct