SAEMS

HYPERTHERMIA STANDING ORDER

Self-Learning Module

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November 2013

PURPOSE

This SAEMS Standing Order Training Module has been developed to serve as a template for EMS provider training. The intent is to provide consistent and concise information to all providers practicing within the SAEMS Region. The content of the Training Module has been reviewed by the Protocol Development and Review Sub-Committee, and includes the specific standing order, resource and reference material, and instructions for completing the Training Module to obtain continuing education credit. One hour of SAEMS continuing education credit may be issued following successful completion of the module.

OBJECTIVES

Upon completion of this learning module the participant will be able to:

1. Differentiate between heat exhaustion and heat stroke
2. Identify and establish priorities of treatment
3. Identify those patients who qualify for the SAEMS Hyperthermia Standing Order

INSTRUCTIONS

1. Read the self-learning module and any additional reference material as necessary.
2. Complete the attached posttest and return it to your supervisor or base hospital manager for continuing education credit.

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INTRODUCTION

Hyperthermia is the elevation of the body's core temperature above its normal range of 36.0-37.5^{o}C (96.8-99.5^{o}F) resulting from failure of the body's mechanisms of thermoregulation (Mechem, 2013). This is different from fever, which is a response to inflammation and is caused by cytokine release and regulated by the hypothalamus. Several months of the year the southern Arizona daytime temperature is at or above the body's core temperature, putting even healthy, normally well-hydrated people at risk for heat-related illness.

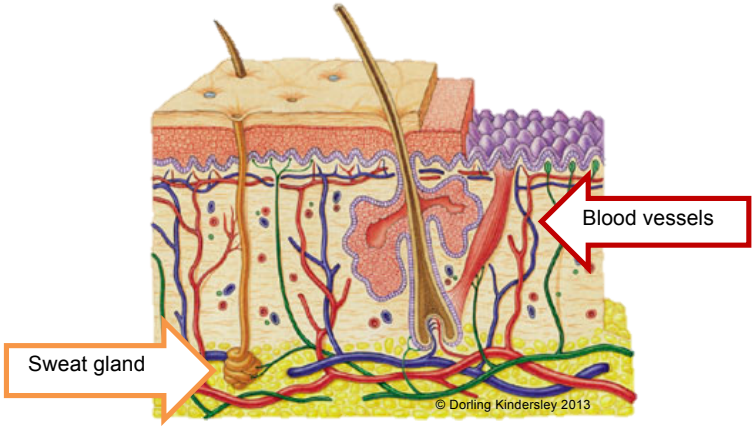
GENERAL

Incidence

Each year an average of 688 people across the United States die from exposure to extreme heat. 66% of those are males, with the largest segment (53%) aged 15-64 years, and 40% aged 65 or older. Arizona holds the dubious distinction of having the highest annual death rate from heat exposure at 1.7 deaths per 100,000 population. The next highest state, Nevada, has a rate less than half of Arizona's at 0.8 per 100,000 (Luber, Sanchez, & Conklin, 2006).

Anatomy and Physiology

Human beings are *homeothermic*, which means we maintain a core body temperature within a fairly narrow range. We generate heat as a result of our metabolic processes and activity, and we can gain heat from or lose heat to our environment. We possess adaptive mechanisms that generally allow us to maintain a stable core temperature in a fairly wide range of external temperatures and conditions. In addition to such behavioral adaptations as adding or removing clothing, moving into or out of sun or shade, or constructing and using shelter, we have physiologic adaptive mechanisms that include our skin, respiratory system and circulatory system and are regulated by the hypothalamus. As body temperature begins to rise, this temperature change is sensed in the hypothalamus, which triggers dilation of the blood vessels in the skin, release of perspiration from sweat glands, and an increase in the heart and respiratory rates. Evaporation of perspiration is the body's primary means of heat dissipation, with radiation of heat from dilated blood vessels playing a smaller role. The rise in heart rate increases cardiac output to maintain blood pressure with the increase in vascular volume. The resulting increased oxygen demand increases respiratory rate, which augments evaporative heat loss (Bledsoe & Sempsrott, 2013).



Pathology

Heat-related injury occurs when heat absorbed from the environment overwhelms the body's ability to dissipate it. Several factors may influence an individual's ability to respond to the environment, predisposing that individual to hyperthermia. Children and the elderly, for example, have less effective temperature regulating mechanisms and are less able to adapt to temperature extremes. Some medical conditions also interfere with temperature regulation. Diabetes mellitus can damage the autonomic nervous system, which controls vasodilation and perspiration, the two main means by which the body gets rid of excess heat. Even if the medical condition itself does not interfere with temperature regulation, medications taken to treat the condition may. Psychotropic medications can interfere directly with the thermoregulatory center; while beta blockers limit vasodilation and heart rate, and diuretics predispose the patient to dehydration. Acclimatization may also play a significant role: as individuals become accustomed to warmer environs, they retain more water and increase production of perspiration with a lower concentration of salt. Length of exposure, intensity of exposure and environmental factors such as wind and humidity directly impact the risk for hyperthermia and its severity.

HYPERTHERMIA ASSESSMENT

In the early, less severe stage of hyperthermia known as heat exhaustion, the body has been attempting to use compensatory mechanisms to dissipate the excess heat and continues to do so. As a result, the patient appears flushed, with moist skin. The combination of vasodilation and hypovolemia from sweat production will likely result in relatively low blood pressure and an elevated heart rate, with complaints of headache, weakness, and fatigue. The patient may also have muscle cramps as a result of electrolyte depletion through perspiration. As blood pressure falls, the patient may show signs of increased anxiety or, in more serious cases, confusion (Bledsoe & Sempsrott, 2013).

As temperature continues to rise and hypovolemia worsens, blood pressure continues to fall and the body loses the ability to perspire. The patient's skin remains red as a result of vasodilation, but becomes dry and hot to the touch. Heart and respiratory rates continue to rise and blood pressure continues to fall. The anxiety and confusion of severe heat exhaustion progress to delirium and coma, with the possibility of seizures. While there is no single core temperature that has been agreed on, patients exhibiting these signs have moved from heat exhaustion to heat stroke, a potentially life-threatening condition (Bledsoe & Sempsrott, 2013). The cascade of events that occurs with heat stroke is further complicated by the fact that proteins begin to denature at 105°F. Denaturation changes the structure of protein, interfering with its function. Initially reversible, denaturation becomes irreversible as temperature increases. A fairly graphic example of irreversible denaturation can be seen when an egg is cooked and the proteins in the yolk and albumin solidify. Enzymes are almost totally protein and are crucial to all the biochemical processes that are involved with living. Prompt recognition of hyperthermia and early intervention are crucial to improving the patient's chance of survival.

HYPERTHERMIA MANAGEMENT

After the ABCs, care of the hyperthermic patient is focused on reducing core temperature and replacing lost fluid. Move the patient into a cooler environment, and if possible, use fans or other air flow across damp clothing or sheets to increase evaporative heat loss. Beware of shivering, which increases the body's heat production. Dial back the cooling efforts if shivering does occur. While some sources recommend PO fluids for patients who are conscious and able to tolerate them, the regional standing order recommends keeping all patients with hyperthermia NPO to minimize the risk of vomiting. A crystalloid IV bolus, preferably with cool fluids to help lower body temperature, is the most immediate means for replacing the fluid and electrolytes that have been lost. Any patient with a history of heat exposure and symptoms of heat exhaustion or heat stroke should have an IV initiated and should be given an *initial* 20 mg/kg bolus. Assess the patient's pulmonary and hemodynamic status after each 500mls infused. Discontinue boluses if patient shows evidence of fluid volume overload. Repeat the bolus if patient remains symptomatic and shows no evidence of fluid volume overload. Also, ondansetron may be given to treat nausea and vomiting, which can worsen dehydration.

Like shivering, seizure activity increases heat production and oxygen demand. Seizures should be treated with a benzodiazepine as outlined in the Seizure Standing Order. Cardiac dysrhythmias, hypoxia and cardiac ischemia are all possibilities in hyperthermic patients and ALS monitoring should be utilized.

IMPLEMENTING THE HYPERTHERMIA STANDING ORDER

HYPERTHERMIA STANDING ORDER

Initiate immediate supportive care:

- Maintain airway
- Oxygen to keep O_2 sat > 90%
- Cardiac monitor
- Obtain fingerstick blood glucose
- Obtain temperature reading (if available)
- Move patient to cooler environment and begin cooling measures

INCLUSION

Use standing order on patients with history of heat exposure:

HEAT EXHAUSTION

- Painful muscle cramps
- Nausea and vomiting
- Abdominal pain

HEAT STROKE

- Loss of consciousness
- Altered mental status: confusion, combativeness, or seizure

ORDERS

HEAT EXHAUSTION /STROKE

1. Initiate cooling measures
2. Establish IV NS/LR to maintain adequate peripheral perfusion:
   - 20ml/kg bolus, may repeat once. Reassess hemodynamic and pulmonary status at 500 ml intervals.
3. Keep patient NPO
4. If shivers develop stop rapid cooling
5. For seizures, administer benzodiazepine per Seizure Standing Order
6. For nausea or vomiting, administer Ondansetron per N/V Standing Order
7. Monitor for other complications:
   - AMI or heart failure
   - Weakness or paralysis
   - Electrolyte abnormalities may result in dysrhythmia; treat per standard resuscitative measures

Contact Medical Direction for deterioration in patient condition

Approved 10/07; revised 10/2008; 6-09; 10-15-13

SUMMARY

Hyperthermia is a spectrum of illness that ranges from mild heat exhaustion and cramps to potentially life-threatening heat stroke. The line that separates one from the other is not always easy to distinguish in the field. All symptomatic heat exposure patients should receive vigorous fluid resuscitation and cooling measures. The sooner the patient's temperature stops rising, the lower the odds of serious illness.

GLOSSARY

Crystalloid: liquid that contains dissolved substances that form crystals when evaporated. Normal saline, lactated Ringer's, and D5W are all crystalloids.

Hypothalamus: portion of the brain located inferior to the cerebrum and the thalamus, but above the brainstem, secretes substances that help control homeostasis, including thermoregulation.

Thermoregulation: regulation of body temperature.

REFERENCES

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POSTTEST

NAME:_____ DATE:_____

1) Patients with heat exhaustion may feel weak, anxious or mildly confused, while those with heat stroke range from confused to comatose.
   a) True
   b) False

2) What is the first priority after the ABCs?
   a) Give PO fluids
   b) Get a thorough history
   c) Move the patient to a cooler environment
   d) Remove the patient's clothing

3) Who is excluded from the Hyperthermia Standing Order?
   a) Children under the age of 6
   b) Pregnant women
   c) Patients under the age of 16
   d) All of the above
   e) None of the above

4) Which of the following factors is NOT known to predispose an individual to hyperthermia?
   a) Certain medications
   b) Gender
   c) Extremes of age
   d) Medical condition

5) Even mild increases in core temperature (101°F) can cause protein denaturation.
   a) True
   b) False

6) Prehospital treatment priorities for patients with hyperthermia are normalizing body temperature and correcting dehydration.
   a) True
   b) False

7) Gatorade is a good treatment option for hyperthermic patients.
   a) True
   b) False

8) Nevada has the highest per capita death rate in the nation, followed closely by Arizona.
   a) True
   b) False

9) Shivering means the patient is being adequately cooled and should be encouraged.
   a) True
   b) False

10) Your patient is a 40 y/o male weighing about 220 lbs. He is sweating profusely; his BP is 92/36 with a heart rate of 138. He complains of a headache, with weakness, dizziness and some nausea, and appears anxious. After moving him into your air-conditioned ambulance what is your next treatment?
   a) As much Gatorade as he can chug
   b) 500 ml crystalloid IV over one hour
   c) 1 liter crystalloid IV bolus
   d) 2 liter crystalloid IV bolus
   e) None of the above

11) Your patient is a 40 y/o male weighing about 220 lbs. He is red, hot and dry; his BP is 82/30 with a heart rate of 166. He opens his eyes to sternal rub and reaches for your hand, but makes incomprehensible sounds. After moving him into your air-conditioned ambulance, removing his clothing and covering him with a damp sheet, what is your next treatment?
   a) 500 ml crystalloid IV bolus
   b) 1 liter crystalloid IV bolus
   c) 2 liter crystalloid IV bolus
   d) None of the above

12) The patient in question 11 shows minimal improvement of vital signs after your treatment, with no change in mental status. What do you do next?
   a) 500 ml crystalloid IV bolus
   b) 1 liter crystalloid IV bolus
   c) 2 liter crystalloid IV bolus
   d) None of the above

13) You respond to the home of an 18 y/o patient who you find in bed covered with a blanket but shivering, c/o abdominal pain with nausea and vomiting. Family tells you his temperature is 102°F. All other vital signs are within normal limits. What would be appropriate to do next?

a) Initiate cooling measures and start an IV of crystalloid per the Hyperthermia Standing Order
b) Start an IV of crystalloid and give ondansetron per the Abdominal Pain Standing Order
c) Call medical direction for an order for midazolam to treat the shivering
d) None of the above

14) Protein denaturation as a result of hyperthermia interferes with the functioning of enzymes that are crucial to basic biochemical processes.
a) True
b) False

15) Patients with heat exhaustion commonly have hot dry skin, delirium, tachycardia, and hypotension.
a) True
b) False

EVALUATION

Please answer the following questions by marking the appropriate response:

		Lowest Worst Least				Highest Best Most
1.	To what end did this module meet your needs?	1	2	3	4	5
2.	There was a balance between theoretical and practical information.	1	2	3	4	5
3.	The time required was appropriate to the content.	1	2	3	4	5
4.	The module increased my knowledge and understanding of the topic.	1	2	3	4	5
5.	References or audiovisuals were adequate.	1	2	3	4	5
6.	Overall, this program was worthwhile.	1	2	3	4	5

7. Additional comments:

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