AAP News™

Is a temperature ever normal?

March 28, 2019

H. Cody Meissner, M.D., FAAP

Article type: ID Snapshot

Editor's note: *This is the second of three articles on fever. Read the first article at http://bit.ly/2HiliqL.*

The body's thermoregulatory center is in the hypothalamus where neurons receive input from temperature receptors in the skin and from neurons assessing the temperature of blood flow in the hypothalamus. The body maintains a fairly steady core temperature by balancing heat production from metabolic activity such as in muscle and the liver with loss of heat from the skin and lungs.

When the thermoregulatory center is reset at a higher temperature, neurons stimulate vasoconstriction in the extremities and heat is conserved. Shivering increases heat production from muscles but may not be necessary if vasoconstriction sufficiently raises the temperature of the blood supplying the hypothalamus. When the hypothalamic set point is reset at a normal temperature because of a reduction in pyrogen concentration or the use of antipyretics, heat loss occurs by sweating and vasodilation.

Core temperature is relatively constant despite fluctuations in the surrounding environment. Temperature recordings from a central site such as rectum, bladder urine, esophagus or blood in a pulmonary artery catheter provide the most accurate readings of core temperature. However, access is difficult at these sites, making measurements more invasive and less practical.

In contrast to the core temperature, the periphery such as the skin and superficial tissues is influenced by environmental temperatures and seldom is constant.

Temperature often is monitored at a peripheral site such as the tympanic membrane, oral cavity or axilla. The speed and ease with which the tympanic membrane temperature can be measured with an infrared thermometer has made this a frequent anatomic site for measurements. A tributary of the artery that perfuses the thermoregulatory center perfuses the tympanic membrane, theoretically producing a close approximation to core temperature.

However, studies have shown a limited correlation between simultaneous otic temperature (measurement of radiant heat from tympanic membrane and ear canal) and rectal temperature measurements. When measurements are made in both ears, differences often are found. One study reported a temperature difference of 1.2 degrees Celsius (2.16 degrees Fahrenheit) between right and left ears of febrile children using an infrared thermometer. The temperature of the tympanic membrane can be less reliable in patients with otitis media. Tympanic thermometers and reliance on axillary temperatures generally are not recommended for neonates and young children when an accurate temperature reading is required.

Plastic strip type thermometers held against the forehead tend to be unreliable because they record the temperature of the periphery (skin) rather than the core temperature.

Oral temperature measurements generally differ from a core temperature as measured rectally. Oral temperature measurements are influenced by ambient temperature (breathing), probe placement and ingestion of hot or cold liquids. One study described a difference of as much as 2 C (3.6 F) with simultaneous readings in the oral cavity and the rectum among exercising adolescents.

A rectal temperature is recognized to be a reasonable approximation of core temperature. Rectal temperatures generally are 0.4 C (0.7 F) higher than oral readings. However, a rectal reading may reflect heat generated by metabolic activity of colonic bacteria, or the stool in the rectum may act as a heat skink that does not reflect changes in core temperature. In addition, blood from the lower extremities flows through the internal iliac vein, passing near the anorectal canal, potentially resulting in a cooler reading, particularly among patients in shock.

Which of the following are false?

a) Anticytokine therapy may mask infection by preventing fever.

b) Fever and hyperthermia are the same.

c) Hyperpyrexia can be managed with antipyretics alone.

d) Pyrogens may be either exogenous or endogenous.

Answer: b and c are false

Hyperthermia refers to an uncontrolled increase of body temperature in a fashion that overrides the ability to lose heat. The thermal regulatory center remains unchanged, but exogenous heat exposure or endogenous heat production result in high internal temperatures. Hyperthermia may occur when a person works in a hot environment and produces heat faster than dissipation can occur at the periphery.

Hyperpyrexia refers to a fever greater than 41.5 C (106.7 F) that can occur with severe infections or in patients with central nervous system hemorrhages. Antipyretic therapy helps to reduce the body temperature, and peripheral cooling (such as cooling blankets) may accelerate peripheral heat losses. However peripheral cooling without the use of antipyretic therapy can cause vasoconstriction and reduce heat loss.

A pyrogen is a substance that causes fever. Endogenous pyrogens belong to the class of proteins called cytokines. Exogenous pyrogens refer to microbial toxins. The best-known example of an exogenous pyrogen is the lipopolysaccharide (endotoxin) produced by gram-negative bacteria. As little as 2 to 3 ng/kg of endotoxin produces fever and malaise in volunteers. Enterotoxins from *Staphylococcus aureus* and exotoxins from group A streptococci (gram-positive bacteria) act as exogenous pyrogens (superantigens) causing release of pyrogenic cytokines.

Dr. Meissner is professor of pediatrics at Floating Hospital for Children, Tufts Medical Center. He also is an ex officio member of the AAP Committee on Infectious Diseases and associate editor of the AAP Visual Red Book.

Related Content

- Additional ID Snapshot columns