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Hypothermia: Diagnosis and Treatment

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ABSTRACT

Hypothermia is defined as a so-called central vital sign below 35°C (95°F). Impaired thermoregulation may contribute to accidental hypothermia. Hypothermia is evaluated as mild, moderate, or severe central blood warmth and clinical features ranging from shivering to progressive bradycardia, coma, and circulatory collapse. During the diagnostic evaluation, the patient's core temperature should first be determined, followed by an ECG. Additional tests evaluate comorbidities and complications. Treatment consists of rewarming and supportive care. Cardiac arrhythmias are the main common explanation for death from hypothermia.

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INTRODUCTION

The definition of hypothermia is an involuntary visit temperature below 35C. Accidental hypothermia isn't limited to regions or times of severe cold and may occur in milder climates.[1] Symptoms will vary betting on the severity of hypothermia. Severity is defined supported core temperature as mild (32 to 35 C), moderate (28 to 32 C), and severe (under 28 C), with some experts also categorizing certain individuals with profound (less than 24 C) hypothermia. More severe symptoms, morbidity, and mortality are related to worsening degrees of hypothermia. [1,2,3]

Etiology

Primary etiologies are those in which you are exposed to extreme or secondary climates, that is, a condition that leads to a dysregulation of temperature that results in:

Increased heat loss: drugs (induced vasodilation), erythroderma (burns, psoriasis), surgery, sepsis, multiple trauma. [4,5]

Decreased heat production: endocrine disorders (hypopituitarism, hypoadrenalism, and hypothyroidism), severe malnutrition, hypoglycemia, damage to posterior hypothalamic nucleus, and neuromuscular inefficiencies. [6,7]

Mechanisms of heat loss		
Mode of heat transfer	Definition	Comments
Evaporation	• Loss of energy due to a phase transition of water on the surface of the skin or mucous membranes from the liquid phase to the gaseous phase	• Evaporation is the most effective mechanism for dissipating heating from the body during intense exercise and in hot and dry environments • Evaporative heat loss cannot occur if the ambient relative humidity is 100%
Conduction	• Heat transfer that occurs as a result of a transfer of kinetic energy between molecules	• Most prominent when a person lies on a cold surface
Convection	• Heat transfer that occurs as a result of the macroscopic movement of a fluid	• Occurs when an individual is immersed in flowing water or when the air is continuously circulated (e.g., air-conditioned room)
Radiation	• Energy transfer in the form of electromagnetic waves (e.g., infrared waves)	• Radiation is the only mode of heat transfer in a vacuum • Radiation is the main mode of heat loss in a cool environment (< 20°C) with no wind

Impaired thermoregulation: damage to the preoptic nucleus of the hypothalamus because of CNS trauma, strokes, toxicologic and metabolic derangements, intracranial bleeding, Parkinson disease, CNS tumors, Wernicke disease, or degenerative disorder. [8]

Risk factors: Substance use, increasing age, homelessness, psychiatric disease. [9]

Pathophysiology

The body loses heat through radiation (most significant means of warmth loss), conduction, convection, and direct contact with cold surfaces. The hypothalamus attempts to keep up a temperature of roughly 36.5°C (97.7°F) to 37.5°C (99.5°F) by: 10

Conserving heat (peripheral vasoconstriction – direct and sympathetic). [10]

Cold-induced thermogenesis (increasing heat production). [10]

Shivering thermogenesis10

• Involuntary, rapid oscillations of skeletal muscles that use Adesnosin Triphosfate and generate heat.
• Shivering can increase heat production four times.
• Primary means of maintaining core temperature in cold environments.
• Does not occur in infants (due to musculus immaturity).
• Cannot be sustained indefinitely thanks to discomfort and fatigue.

Non-shivering thermogenesis[10]

• Increased heat production by brown fat.
• Increases heat production by 10–30% following acute cold exposure.
• Primary means of maintaining core blood heat among infants.

Hypothermia affects all organ systems[10]

• General tissue oxygen demand decreases by ~ 6% per degree Celsius below 35°C.
• Weakened cellular reaction.
• Cardiovascular effects: ↓ depolarization of cardiac cells → ↓ rate of flow and ↓ mean blood pressure.
• CNS effects: ↓ CNS metabolism.

Hypothermia[11]

Accidental hypothermia is an involuntary call core blood heat below 35°C (95°F)

Clinical features of hypothermia:

Including level of consciousness (LOC), correlate with core temperature, and together may be accustomed define stages of hypothermia.

Mild hypothermia (32–35°C/ 89.6–95.0°F) [11]
• Alert, impaired judgment
• Amnesia, dysarthria, ataxia
• Tachycardia, tachypnea
• Shivering
• Bleeding diathesis

Moderate hypothermia (28–32°C/ 82.4–89.6°F) [11]
• Worsening CNS depression, e.g. lethargy, stupor
• Hypoventilation
• Bradycardia, cardiac arrhythmias
• Hyporeflexia
• Dilated pupils
• Loss of shivering typically occurs[6]
• Cold diuresis: Peripheral vasoconstriction in hypothermia increases central and renal blood flow, which causes Pitressin suppression, leading to diluted urine.
• Paradoxical undressing: the abnormal removal of clothing by patients despite low ambient temperature
• Ileus, pancreatitis

Severe hypothermia (< 28°C/ < 82.4°F) 11
• Coma, areflexia
• Fixed and dilated pupils
• Ventricular fibrillation

• Hypotension
• Pulmonary edema, apnea
• Oliguria
• Rigidity (pseudo-rigor mortis)
• Pulselessness

Diagnostics[12]

ECG is that the best initial test to watch for arrhythmias, with some common findings like heart blocks and dysrhythmias: variable; depends on core temperature, J wave (Osborn wave): elevated J point, prolongation of all ECG intervals.

Management of hypothermia [13]

• Initial resuscitation: ABCDE approach
• If the patient does not have a pulse in the next 60 seconds, cardiopulmonary resuscitation should be started.
• Provide supplemental oxygen.
• Begin IV fluid resuscitation.
• Remove wet clothing and ensure a warm environment.
• Monitoring of core temperature during resuscitation.
• Start rewarming techniques supported in the hypothermic stage.

Rewarming techniques:

Passive rewarming

Patients with mild hypothermia may only require passive rewarming, Insulation (e.g., with blankets) allows patients to retain body heat, active movement can increase heat generation, active rewarming. [14]

Indications: Moderate to severe hypothermia, unsuccessful passive rewarming, active external rewarming, methods include warming blankets, radiant heat, and made warm air, rewarm the torso before the extremities. [15]

Active internal rewarming: Warmed IV fluids, extracorporeal blood rewarming

Indications include: Hypothermic asystole, unsuccessful rewarming with other techniques, options include venovenous rewarming, hemodialysis, and extracorporeal life support (ECLS). [16]

CONCLUSION

Hypothermia exerts multiple effects at the cellular level, which impair innate immune function, and are related to increased septic complications and mortality. These findings provide a physiological basis for perioperative temperature monitoring, which may be a valid surgical performance measure which will be accustomed reduce surgical complications related to avoidable hypothermia.

Although the protective effects of fever are recognized for several decades now, evidence regarding the converse detrimental effects of hypothermia in surgical patients remains relatively novel and continues to emerge. Early recognition of this entity additionally as early treatment is essential to patient survival.

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