Out-of-Hospital Evaluation and Treatment of Accidental Hypothermia

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KEYWORDS

- Hypothermia • Accidental hypothermia • Afterdrop • Thermoregulation
- Cardiac arrest • Avalanche • Rewarming • Circumrescue collapse

KEY POINTS

- Hypothermia can be life-threatening. Rescuers should attempt to minimize further heat loss and begin rewarming of hypothermic patients in the field while minimizing afterdrop and preventing circumrescue collapse.
- Some patients are cold and dead but other cold patients who are apparently dead can be resuscitated with full neurologic recovery.
- Unless there are definite contraindications, rescuers should do their best to resuscitate hypothermia patients, even if they appear to be beyond hope.

INTRODUCTION

Definition

Accidental hypothermia is an unintentional drop in core temperature, which is the temperature of the heart and central circulation, to 35°C or below. Accidental hypothermia can be caused by environmental exposure and by diseases or conditions that decrease thermoregulatory responses. Iatrogenic accidental hypothermia can occur during resuscitation in emergency settings. Accidental hypothermia is a disease of wars and other disasters, as well as a condition that can affect people who are outdoors for work or recreation or because they are homeless. Accidental hypothermia can occur during any season and in any climate, including subtropical or tropical. Accidental hypothermia can also be caused by trauma, sepsis, or other diseases that decrease metabolic heat production or affect thermoregulation.

The author has nothing to disclose.

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Therapeutic hypothermia, a form of targeted temperature management, can be induced to protect the brain in resuscitated cardiac arrest patients who remain unconscious after return of spontaneous circulation (ROSC). Hypothermia for neuroprotection may also be induced for cardiac surgery. Induced hypothermia is not discussed in this article.

Physiology

In normal conditions, the human body maintains a core temperature of 37° plus or minus 0.5°C. In response to input from peripheral and, to a lesser degree, central thermoreceptors, the hypothalamus regulates autonomic reflexes that increase body cooling or warming.[1] The main physiologic warming responses to defend against hypothermia are shivering and peripheral vasoconstriction. Peripheral vasoconstriction can be triggered centrally or by decreased local skin temperature.

Hypothermia is the result of net heat loss. Heat can be lost by conduction, convection, radiation, and evaporative mechanisms. Heat always flows from a warmer object or medium to a cooler object or medium. Conduction is the direct transfer of heat between objects that are touching each other. Convection is the transfer of heat from an object to a gas or liquid that is in motion. Radiation is the transfer of heat by electromagnetic energy between 2 objects that are exposed to each other; the body can be warmed by the sun or cooled by exposure to the night sky. Evaporation causes heat to be lost by the endothermic reaction of vaporizing water in sweat or wet clothing. Heat loss due to evaporation also accounts for insensible losses from skin and from breathing.

Humans are adapted to tropical climates. Human physiologic responses to cold have limited potential to protect against hypothermia. In a well-nourished person, if conditions are mild or insulation is adequate, exercise and shivering can raise the metabolic rate enough to prevent hypothermia. In colder conditions, humans must depend on behavioral responses to wear insulating clothing and to take shelter.

Pathophysiology

Cooling of the body results in decreased resting metabolism and decreased neurologic function. Shivering is induced by skin cooling, even when the core temperature is normal.[1] Shivering increases metabolism directly by increased muscle activity and indirectly by increased ventilation and cardiac output.[2] Shivering increases as core temperature decreases and is maximal at a core temperature of about 32°C. Shivering decreases below 32°C and ceases by about 30°C.[3] Below 32°C, metabolism generally decreases with decreasing core temperature.

The main clinical effects of hypothermia are due to decreases in brain and cardiorespiratory functions. Brain cooling causes impaired function beginning at about 34°C and worsening with further cooling.[4,5] Clinical signs are irritability, confusion, apathy, poor decision-making, lethargy, somnolence, coma, and finally death. Most of these changes, other than death, are reversible. Even patients in coma often recover neurologically intact. Decreased metabolic requirements of a cold brain can be neuroprotective, especially during anoxic conditions such as drowning.[6] Cold-induced diuresis, plasma leak, and decreased fluid intake decrease circulating blood volume.[7] Cooling of the heart causes decreased cardiac output and, usually, bradycardia. As the heart cools to 30°C and below, atrial dysrhythmias and premature ventricular contractions become common and ventricular fibrillation (VF) can occur.[8] Especially below 28°C, VF can be easily induced by acidosis, hypocarbia, hypoxia, or rough movement.[1] Hypoventilation and respiratory acidosis result from decreased ventilatory sensitivity to carbon dioxide (CO_2).[9]