Clinical Overview of Incidental Systemic Hypothermia

Ferry Auparay¹, John Sigit Purnomo¹

¹Wamena General Hospital, Jayawijaya, Indonesia

ARTICLE INFO

Keywords:
Acid-base balance
Cardiac arrest
Cold exposure
Hypothermia
Thermoregulation

*Corresponding author:
Ferry Auparay

E-mail address:
ferry.auparay@gmail.com

All authors have reviewed and approved the final version of the manuscript.

https://doi.org/10.59345/sjfm.v1i2.61

ABSTRACT

Systemic hypothermia is defined as a condition where the core body temperature drops below 35°C. This syndrome can be categorized as either primary, which occurs due to prolonged exposure to extremely low environmental temperatures, or secondary, which is caused by a breakdown in the body’s ability to regulate temperature. The purpose of this review was to provide a comprehensive analysis of the clinical manifestations of inadvertent systemic hypothermia. The manifestations of hypothermia are generally vague and demonstrate considerable diversity, contingent upon the individual's overall health condition and degree of exposure to cold temperatures. It is important to do laboratory tests to assess the acid-base equilibrium, electrolyte concentrations (particularly potassium and glucose), kidney, liver, and pancreatic function, freezing process, and the occurrence of rhabdomyolysis. Reheating is the main and essential treatment for patients with hypothermia. The process of resuscitation begins by rapidly assessing and providing aid to the airway, breathing, and circulation. The treatment should give priority to the utilization of efficacious CPR procedures in conjunction with actively raising the patient's body temperature. In cases of cardiac arrest in severely hypothermic patients, the administration of epinephrine or vasopressin may be considered.

1. Introduction

Systemic hypothermia is characterized by a core body temperature that falls below 35°C. This syndrome can be classified as either primary, resulting from long-term exposure to extremely low environmental temperatures, or secondary, caused by a malfunction in thermoregulation. Both can coexist simultaneously. Hypothermia should be taken into account for those who have been exposed to a cold environment for an extended period, particularly those who have experienced cold-related injuries in the past. Hypothermia occurs when the body's ability to regulate temperature is compromised due to prolonged or recurrent exposure to cold.¹⁻³ This review aimed to describe the clinical aspect of incidental systemic hypothermia.

Symptoms and signs of hypothermia

The symptoms and signs of hypothermia are typically nonspecific and exhibit significant variation depending on the patient's health status and level of cold exposure. The acid-base balance, electrolyte levels (especially potassium and glucose), the functioning of the kidneys, liver, and pancreas, the freezing process, and the presence of rhabdomyolysis should all be checked in the lab. Deviation from precise laboratory values may arise if the blood sample is subjected to a temperature of 37 °C during analysis.
It is imperative to assess all patients for concurrent illnesses such as hypoglycemia, trauma, infection, overdose, and peripheral cold injury.\(^2\)\(^-\)\(^5\)

To acquire precise measurements of core body temperature, it is recommended to use a core temperature probe with a low-reading capability that can measure temperatures as low as 25°C. Stage I hypothermia typically occurs when the core body temperature ranges from 32°C to 35°C. It is characterized by shivering and may also involve impaired judgment or coordination. However, individuals in this stage normally maintain stable blood circulation and have a normal degree of consciousness. Stage II hypothermia is characterized by a core body temperature ranging from 28 to 32 °C. The cessation of shivering is accompanied by bradycardia, dilated pupils, decreased reflexes, increased urine production, as well as disorientation and lethargy. An electrocardiogram (ECG) can display J waves or Osborn waves, which are positive deflections in the terminal portion of the QRS complex. These waves are most noticeable in leads II, V5, and V6 (Figure 1).\(^6\)\(^-\)\(^9\)

When the core body temperature drops below 28°C, there is a significant increase in the probability of experiencing hemodynamic instability and cardiac arrest. Stage III hypothermia, with a core body temperature ranging from 24-28 °C, is marked by unconsciousness but still exhibiting vital signs. Stage IV hypothermia, characterized by a core body temperature below 24°C, results in the absence of vital signs. If a patient has a coma, loss of reflexes, asystole, or ventricular fibrillation, the clinician may mistakenly conclude that the patient has died, even if these symptoms can be reversed by treating hypothermia.\(^10\)\(^,\)\(^11\)

![Figure 1. The ECG displays leads II and V5 in a subject with a body temperature of 24°C.](image)

Notes: Observe the presence of bradycardia and Osborn waves. These findings become more noticeable as body temperature decreases and are progressively resolved by warming up again. The Osborn wave is characterized by an additional positive deflection in the later half of the QRS complex. This wave is most prominent in the inferior and lateral precordial leads, particularly leads II, V5, and V6.

**Treatment of hypothermia**

Reheating is the primary and crucial intervention for all individuals suffering from hypothermia. The resuscitation process commences with promptly evaluating and providing assistance to the airway, breathing, and circulation. Additionally, it involves initiating rewarming and taking measures to avoid any additional heat loss. It is necessary to remove any clothing that is cold and wet and replace it with warm, dry clothing and blankets.\(^12\)\(^,\)\(^13\)

Passive external rewarming, such as replacing wet clothing with dry garments, or vigorous external rewarming can effectively treat mild or stage I hypothermia. Unlike patients with more severe hypothermia, undamaged people with moderate hypothermia are considered safe and are encouraged to engage in physical activity in order to generate heat. Active external rewarming is a noninvasive, highly efficient, and secure method for treating moderate hypothermia. This entails administrating external heat
to the patient’s skin. Some examples of methods to provide warmth include the use of warm mattresses, heated blankets, hot compresses, and immersion in a bath at a temperature of 40°C. Submerging in heated water hampers the capacity to observe the patient or address concurrent ailments. Individuals with mild hypothermia and who have a history of good health typically have positive responses to both passive and active external warming methods.\(^{14}\)

Stage II and III hypothermia are managed similarly to those described previously, but with the implementation of more assertive rewarming techniques. Close surveillance of vital signs and cardiac rhythm is necessary during the process of rewarming. Minimally invasive and efficacious, warm intravenous fluids with a temperature range of 38–42 °C are widely acknowledged.\(^{13-15}\)

As hypothermia worsens, the occurrence of difficulties related to both hypothermia and the process of rewarming becomes more frequent. Rewarming issues arise when colder blood from the outside parts of the body flows back into the central circulation. This can lower the body’s core temperature, reverse lactic acidosis by putting lactate back into the bloodstream, cause shock by widening blood vessels in the limbs, and cause conditions like low blood volume, ventricular fibrillation, and different kinds of irregular heart rhythms. Active rewarming of the external body, excluding the extremities, and minimizing muscle action by the patient can help decrease after drop. Great caution is exercised during the treatment of hypothermic patients to prevent the occurrence of life-threatening irregular heart rhythms, which is referred to as rescue collapse.\(^{16}\)

People who are having problems with their blood pressure or heart rhythm should be taken right away to a hospital that has extracorporeal membrane oxygenation (ECMO) or cardiopulmonary bypass equipment. Prompt identification and implementation of advanced treatment protocols are necessary for patients diagnosed with stage IV hypothermia. In the case of hypothermic individuals who are going through cardiac arrest, it is important to start and maintain high-quality CPR until the patient’s core body temperature reaches a minimum of 32°C. If the patient’s body temperature is below 30°C, arrhythmias and asystole may not respond to pharmacological therapy until the patient’s body is warmed up again.\(^{9,12}\)

Therefore, the treatment should prioritize the use of effective CPR techniques along with actively warming up the patient. Epinephrine or vasopressin may be administered to extremely hypothermic patients experiencing cardiac arrest. The International Commission on Mountain Emergency Medicine advises extracorporeal life support as the preferred course of action for people who are significantly at risk of hypothermic cardiac arrest. Extracorporeal life support has demonstrated a significant enhancement in the life expectancy of patients experiencing unstable circulation or cardiac arrest. Close monitoring is necessary for any hypothermic patient who has regained spontaneous circulation due to the increased probability of eventual multiorgan system failure.\(^{10,15}\)

Patients with hypothermia should be closely monitored for potential consequences. This surveillance is typically conducted during hospitalization or extended emergency department observation.\(^{15,16}\)

2. Conclusion

Systemic hypothermia refers to a condition where the core body temperature drops below 35°C. In hypothermic patients experiencing hemodynamic instability or cardiac arrest, the use of extracorporeal membrane oxygenation (ECMO) or cardiopulmonary bypass may be explored.

3. References


