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Prehospital diagnosis and staging of hypothermia (ICAR)

Präklinische Diagnose und Stadieneinteilung der Hypothermie (ICAR)

SUMMARY

The ICAR MedCom has adopted a simple system of staging hypothermia in the field based on clinical criteria. Treatment is based on clinical stage (HT I–V), which correlates in a general way with core temperature. Temperature measurements in the field, either esophageal or epitympanic (not tympanic), are also useful for monitoring.
HT I patients (35–32 °C) exhibit clear consciousness with shivering and may not require hospital treatment. HT II patients (32–28 °C) will have impaired consciousness without shivering; they will require hospital treatment. Patients in HT III (28–24 °C) will be unconscious and will require aggressive treatment and rapid transport. HT IV patients (24–13 °C?) will appear dead, but may be revived in some cases. Previously 15 °C was the published cutoff, but based on new evidence the lower end of the range should now be considered to be below 14 °C. At some point, however – Stage V (< 13 to 9 °C) – death is due to irreversible hypothermia.
Keywords: Hypothermia, staging, ICAR

ZUSAMMENFASSUNG

Die ICAR MedCom hat ein einfaches System zur Stadieneinteilung der Hypothermie im Gelände eingeführt, das sich nach klinischen Gesichtspunkten orientiert. Die Behandlung richtet sich nach klinischen Stadien (HT I–V), die im Prinzip mit der Kerntemperatur korrelieren. Temperaturmessungen im freien Gelände, entweder ösophageal oder epitympanisch (nicht tympanisch), sind ebenfalls nützlich als Monitoring.
HT-I-Patienten (35–32 °C) zeigen ein klares Bewusstsein mit Muskelzittern und bedürfen keiner Hospitalisierung. HT-II-Patienten (32–28 °C)

haben ein beeinträchtigtes Bewusstsein ohne Muskelzittern, sie benötigen eine stationäre Behandlung. Patienten mit HT III (28–24 °C) sind bewusstlos und brauchen eine aggressive Therapie und einen schnellen Transport. HT-IV-Patienten (24–13 °C?) erscheinen klinisch tot, können jedoch in speziellen Fällen wiederbelebt werden. Erst kürzlich war 15 °C der Grenzwert in Publikationen, aber basierend auf neuen Erkenntnissen, sollte das untere Ende schon unter 14 °C angesiedelt werden. Ab dem Stadium V (< 13 bis 9 °C) tritt der Tod aufgrund einer irreversiblen Hypothermie ein.
Schlüsselwörter: Hypothermie, Stadien, ICAR

INTRODUCTION

Accidental hypothermia is defined as a core temperature below 35 °C. Victims of mountain accidents are often hypothermic. The degree of hypothermia determines the optimal treatment for these patients, although core temperature is often difficult to measure in the field, especially during the initial assessment and stabilization. For this reason, the Commission for Mountain Emergency Medicine of the International Commission for Alpine Rescue (ICAR MedCom) has adopted a system of staging hypothermia in the field based on clinical criteria, including core temperature, if it can be accurately measured. This paper discusses the staging system we have developed.

The staging system is intended for rescuers, whether rescue physicians or non-physician first responders. The criteria are level of consciousness, presence of shivering, cardiac activity and core temperature. The stages are shown in Table 1 (from the ICAR paper by Durrer et al.) (1). These stages are not static and may change during the rescue. In general, the patient's condition is unlikely to improve in the field, regardless of treatment. If the temperature drops quickly in spite of insulation and attempts at rewarming in the field, the rescuer should suspect a serious underlying injury.

Asystolic patients with severe hypothermia (HT IV) have been successfully resuscitated even after cardiac arrest. However, if the mountain rescue doctor can differentiate death (HT V) from apparent death (HT IV), unnecessary risks to the rescuers may be avoided. Electrocardiographic monitoring and temperature monitoring may be essential in making this distinction. Monitoring may be done using an epitympanic temperature for HT I-III, but esophageal temperature should be used in HT IV-V.

Stage	Description	Temperature (°C)
HT I	Clear consciousness with shivering	35–32
HT II	Impaired consciousness without shivering	32–28
HT III	Unconsciousness	28–24
HT IV	Apparent death	24–13 ?
HT V	Death due to irreversible hypothermia	< 13? (< 9?)

Table 1: Hypothermia stages (modified from Durrer et al., 1998)

TEMPERATURE MEASUREMENT

Only two methods of temperature measurement are sufficiently accurate to guide treatment decisions in the field. Esophageal temperatures are well established as a relatively accurate measure of core-temperature. More recently, epitympanic temperatures have been shown to give a reasonable approximation to core-temperature. They have the advantage of being less invasive, but are not yet widely available. Epitympanic temperatures involve contact of a probe with the tympanic membrane, unlike tympanic temperatures which are measured using infrared radiation. Tympanic temperatures are notoriously inaccurate. In the field situation, they are very likely to measure the temperature of cooler surfaces surrounding the tympanic membrane which will yield a falsely cool reading.

Hypothermia stage I (HT I)
Mildly hypothermic patients will be conscious and oriented. They generally will be shivering. If the temperature can be measured, it should be between 35 °C and 32 °C. Most of these patients will not require hospital treatment if they do not have associated injuries.

Hypothermia stage II (HT II)
Moderately hypothermic patients will have a decreased level of consciousness and will no longer be able to shiver. This correlates roughly with a core temperature of 32–28 °C. These patients will require hospital treatment.

Hypothermia stage III (HT III)
Unconscious patients with vital signs still present are severely hypothermic and will require transfer to a specialized facility capable of active rewarming and/or cardiopulmonary bypass.

Hypothermia stages IV and V (HT IV and HT V)
Severely hypothermic patients without apparent vital signs may still be salvageable with proper care. This is the origin of the motto that "nobody is dead until they are warm and dead". This may lead to futile attempts at resuscitation which may endanger the rescuers. It is better to remember that "nobody is dead until they are warm and dead, unless they are already dead". Patients who can be saved will require aggressive treatment in a facility which can perform cardiopulmonary bypass.

Differentiating death from apparent death is complicated by the fact that reflexes are progressively lost as core temperature falls. Most reflexes vanish below 28 °C. Corneal and oculecephalic reflexes are the last disappear, below 24 °C (2).
If there are lethal injuries present, then the patient clearly cannot be resuscitated. A noncompressible chest and abdominal muscles that cannot be kneaded are indicators of death (HT V). If the EKG shows ventricular fibrillation then the patient may potentially be resuscitated, but asystole does not predict irreversible death. These criteria are summarized in Table 2.
At present, there is no well established lower limit of core temperature for HT IV but one patient has been resuscitate from a core temperature in the field of 14 °C and patients are routinely resuscitated from much lower temperatures induced during surgery. The absolute physiological limits are not known.

Exclude lethal injuries		
Criteria	**HT IV**	**HT V**
Clinical findings	No vital signs Chest compressible Abdominal muscles Kneadable	No vital signs Chest not compressible Abdominal muscles not kneadable
EKG	Ventricular fibrillation or asystole	Asystole
Core temperature	>13 °C?	<13 °C?
Potassium*	<12 mmol/L	>12 mmol/L

* Potassium is useful only in cases of hypothermia associated with asphyxia.

Table 2: On site triage of hypothermia stages IV and V (modified from Durrer et al., 1998)

If hypothermia is associated with asphyxia, as in avalanche burial, snow cave and immersion cases, potassium can be used to differentiate between real and apparent death, with cautionary notes regarding rhabdomyolysis and hemolysis of the sample. The cutoff value is 12 mmol/L. Above this value resuscitation is extremely unlikely. Current research is being conducted to enable determination of potassium in the field, but in patients with HT IV and V, obtaining a blood sample prior to rewarming may be extremely difficult.

LITERATURE

(1) Durrer B., Brugger H., Syme D.: The medical on site treatment of hypothermia. Commission for Mountain Emergency Medicine (1998).

(2) Danzl D. F., et al.: Accidental hypothermia. In Auerbach PS (ed.) Wilderness medicine: management of wilderness and environmental emergencies (3rd ed.) Mosby: St. Louis, pp. 51-103 (1995).