

Novel Measurement Approaches Are Needed in The Pre-Hospital Setting to Prevent Accidental Hypothermia.

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Abstract

Accidental hypothermia can be fatal if not recognised early, and effective management relies on the accurate recording of core body temperature. The focus of this critique - a recent study by Podsiadło et al. (2019) – highlighted the need for reliable measurement of core body temperature in the pre-hospital and austere setting. An esophageal temperature probe may prove to be a reliable, and best practice approach for measuring core body temperature in critically unwell, unconscious patients suffering accidental hypothermia.

Introduction

An inadvertent fall in a patient's core temperature is commonly referred to as accidental hypothermia and can be fatal if not corrected promptly. Remote, pre-hospital or austere environments can make it challenging for emergency care clinicians to assess and treat hypothermic patients, and figure 1 summarizes the best practice approaches to managing a hypothermic patient (Paal et al. 2016). The accurate assessment of core body temperature is crucial in the pre-hospital setting because it informs initial and ongoing treatment (Strapazzon et al. 2014). The pathophysiological changes that result from a reduced core temperature include increased blood viscosity, respiratory or metabolic acidosis, diuresis, or cardiac

arrhythmias (Mallett 2002). As hypothermia progresses, tachycardia is initiated by the core temperature dropping between 33-35 degrees Celsius. As the core temperature decreases, tachycardia progresses into bradycardia with hypotension associated with a continual drop to 28 degrees Celsius. This eventually leads to ventricular fibrillation when the core temperature drops to 27 degrees Celsius. Other physiological changes in hypothermia are listed in Table 1.

Emergency clinicians should have a thorough working knowledge of their equipment and a sound understanding of the strengths and weaknesses of various temperature measurement devices (Strapazzon et al. 2019). For instance, current temperature measurement devices such as tympanic, nasopharyngeal, rectal, and urinary thermometers can readily be employed by emergency clinicians and are non-invasive. Rectal and bladder thermometers were not optimal in gaining effective core temperature measurement due to having to expose key areas of the patient (Sarker et al. 2015). Tympanic and laser thermometers are viewed as having limited effectiveness and cannot reliably measure for severe hypothermia (Strapazzon et al. 2014). This knowledge will assist emergency clinicians to tailor their device decisions to the purpose of the measurement (i.e., intermittent vs.

continual temperature measurement). Best practice core temperature measurement approaches in the austere prehospital settings are unclear. However, a recent

study by Podsiadło et al. (2019) may provide some emerging evidence and is the focus of this research critique.

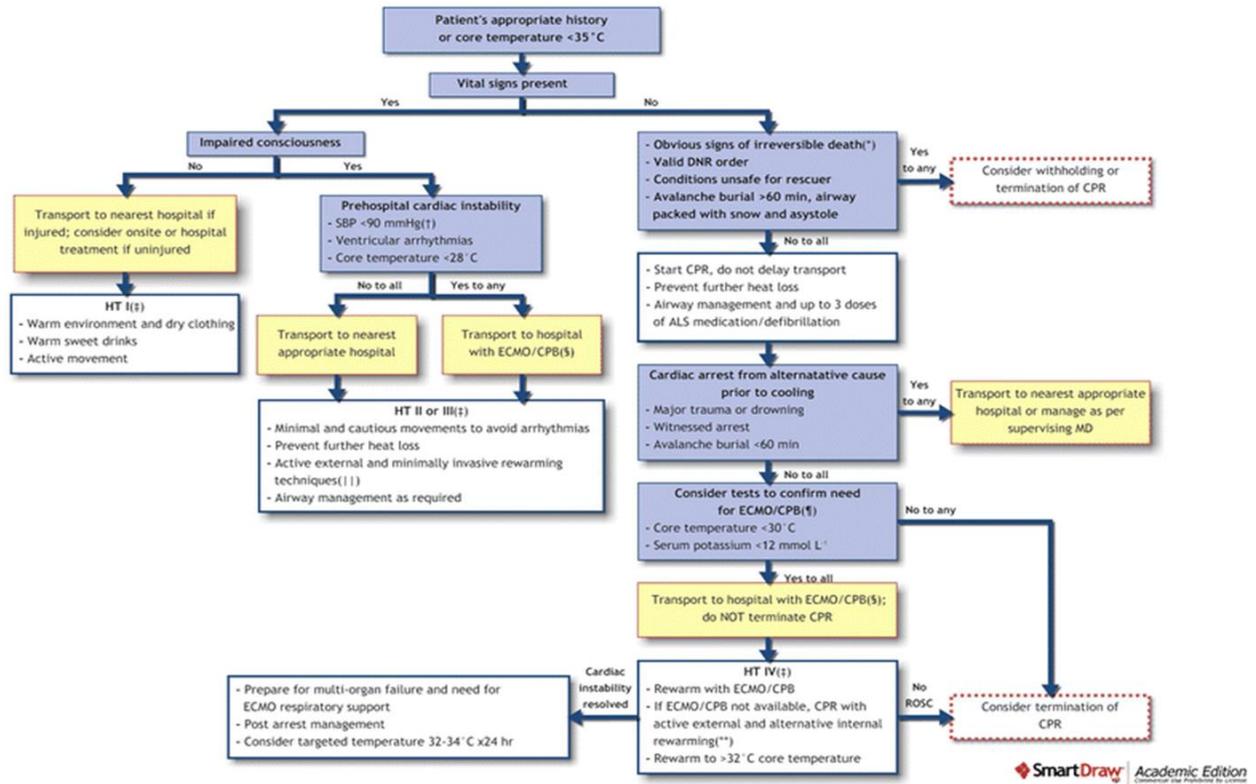


Figure 1. Management of Accidental Hypothermia (Paal et al. 2016; Reproduced with permission).

Stage	Clinical findings	Core temperature (°C) (if available)
Hypothermia (mild)	I Conscious, shivering	35–32 °C
Hypothermia (moderate)	II Impaired consciousness may or may not be shivering	<32–28 °C
Hypothermia (severe)	III Unconscious; vital signs present	<28 °C
Hypothermia (severe)	IV Apparent death; Vital signs absent	Variable

Table 1. Staging of accidental hypothermia (Brown 2015).

Aim

This study aimed to assess the ability of Emergency Medical Service clinicians to

measure core body temperature and adhere to international guidelines about the treatment of hypothermic patients (Podsiadło et al. 2019).

Method

The researchers used a cross-sectional survey design. The study sample included EMS clinicians in Poland responsible for 1523 road ambulances. All EMS clinicians were invited to complete a paper-based questionnaire. The thermometer construction/design (i.e. surface temperature, infra-red ear based, infrared-contactless), number in service, measurement range (i.e. lower limit of the range), and suitability to measure core were captured in the questionnaire. Descriptive statistics were used to analyse the data.

Results

A total of 180 questionnaires were returned giving a 100% response rate. A total of 1582 thermometers (96 different thermometer models) were reported in use across the EMS; however, only 50 (3.28%) of these were specifically designed to measure core body temperature. Further, data analysis revealed that many thermometers (91.4%) were not designed to operate at an ambient temperature below 10°C. The results of this study suggest that EMS clinicians in Poland are poorly equipped to measure core body temperature, which is crucial to inform clinical decision making when treating hypothermia. Further, most thermometers analysed in this study were unsuitable for outdoor/cold weather use, which is problematic if treating patients who are likely to suffer from accidental hypothermia

(Podsiadło et al. 2019). A portable, reliable thermometer design is needed to measure core temperature in the pre-hospital, austere setting. The Centre for Evidence-Based Management (CEBM; 2020) survey checklist guided the following critique (see Supplementary item 1).

Critique and Application to Practice

Accidental hypothermia should be assessed in the pre-hospital setting in all patients with a history of cold exposure or a clinical history that could predispose them to hypothermia (Strapazzon et al. 2014). Internationally, the management of accidental hypothermia has made substantial progress and the study findings reported by Podsiadło et al. (2019) adds to this knowledge and has relevance for emergency responders who are required to manage patients in the pre-hospital or austere setting.

Although promising, the study by Podsiadło et al. (2019) is not without limitations. The study sample was from only one country's EMS service, and the survey response categories did not explore how EMS clinicians aligned their practice (or not) to international guidelines on hypothermia management. Thus, a larger scale multi-site and service study is needed that should also evaluate what helps and hinders clinicians' adherence to best practice hypothermic treatment guidelines. However, Boynton (2004) suggests that the sample response rate of 100% is a strength of the study, and reflects the authors had a good understanding of the study group.

A key recommendation from this study was the need for a portable, reliable thermometer to measure core temperature in the pre-hospital, austere setting in the critically unwell patient (Podsiadło et al.

2019). Rectal and bladder thermometers are not conducive to gaining effective measurement in extremely cold climates due to the requirement to expose the patient from the waist down to place the probe (Peranitol et al. 2015). Emerging evidence suggests that an esophageal temperature probe provides a core temperature measurement that is safe and more accurate in cold climates than traditional methods (Foggle 2019; Zafren & Mechem 2020). For effective temperature reading, the esophageal probe is placed two thirds down the esophagus. (Strapazzon et al. 2014) The best position in the oesophagus has been determined to be between the eighth and ninth thoracic vertebrae T8 and T9. (Rempel et al. 1990; Gatward et al. 2012). This position in the oesophagus is in line with the left ventricle and aorta.

The insertion of the esophageal temperature probe is considered an invasive procedure; however, in a critically unwell patient with an altered level of consciousness, it is the most accurate measurement method for temperature reading in the field (Strapazzon et al. 2014). While an esophageal temperature probe is reported to be well accepted by awake patients (Erdling and Johansson 2015), in the unwell hypothermic patient it is recommended the patient's airway is initially secured either by an endotracheal tube or supraglottic device (Brugger et al. 2013). Securement of the airway is crucial if the patient has an impaired level of consciousness, and can be achieved by pre-hospital emergency clinicians, or in the austere or combat setting by appropriately trained clinicians (Brugger et al. 2013). Providing esophageal temperature probe skill competency training to emergency clinicians via high fidelity simulation has shown promise (Makic, Lovett & Azam

2012) and may facilitate uptake in clinical practice.

Conclusion

Accurate assessment of core temperature is crucial to aid the clinical decision-making process when treating accidental hypothermia. Esophageal temperature probe provides a novel approach for temperature reading that is more accurate than traditional methods used in the pre-hospital, austere setting for the critically unwell and unconscious patient. The opportunity of employing other devices such as the esophageal temperature probe has shown to be effective for monitoring hypothermic conditions in the alpine regions and should be considered as an alternative to the current equipment being used. This is due to recording more accurate readings of core temperatures.

Declaration of competing interest

None declared.

Credit Authorship Statement

Timothy Binyon: Conceptualisation, Data curation, Formal analysis, Methodology, Writing - original draft, Writing - review & editing.

Benjamin Mackie: Conceptualisation, Data curation, Formal analysis, Methodology, Writing - original draft, Writing - review & editing.

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