Temperature Management in Critically Ill Patient

Essay

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in **Intensive Care**

By

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Abstract

Background: Body temperature abnormalities are among the most commonly noted symptoms of critically ill patients, and they occur because of several different infectious and non-infectious etiologies. Moreover, these abnormalities frequently trigger changes in patient management. The beneficial effects of fever may include reduction in bacterial growth and promotion of antibodies and cytokines synthesis, thereby activating immune cells and improving survival. Conversely fever is believed to be harmful, especially in patients with life threatening illnesses, because febrile responses are known to increase the metabolic rate, minute ventilation, and oxygen consumption; therefore it can have adverse effects on neurological outcomes. Several studies have also suggested that suppression of the febrile response with antipyretic drugs could worsen patient outcomes. Hypothermia can be caused by a number of factors, including cold exposure, sever infections, endocrine abnormalities, and drug overdose, all of which require intensive care . Temperature is not only an important clinical marker of severity of illness but also an independent predictor of morbidity and mortality in critically ill patient.

Objective: The aim of the assay is to review definitions, causes and management of body temperature abnormalities.

Conclusion: Trials are currently under way to examine the efficacy of targeted temperature management(TTM) in treatment of many diseases and methods to reach TTM are changing while technology evolves.

Keywords: Temperature abnormalities, Targeted temperature management, Cooling devices.

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List of Abbreviations

AHA : American Heart Association

AP-1 : Activator protein-1

ARDS : Acute respiratory distress syndrome

BAL : Bronchoalveolar lavage

CAVR : Continuous arteriovenous rewarming

CCD : Central Core Disease

CDC : Centers for Disease Control

CNS : Central nervous system

COX-2 : Cyclo-oxygenase-2

COX-3 : Cyclooxygenase-3 enzyme

CT : Computerized tomography

CVA : Cerebral vascular accident

CVVH : Continuous veno-venous rewarming with hemodiafiltration

DVT : Deep vein thrombosis

EA : Endotoxin activity assay

ECG : Electrocardiogram

ED : Emergency Department

EEG : Electroencephalogram

FDA : Food and Drug Administration

GI : Gastrointestinal tract

GCS : Glasgow coma scale

HSPs : Heat shock proteins

ICU : Intensive Care Unit

ICP : Intracranial pressure

IDSA : Infectious Diseases Society of America

IL : Interleukin

IL-1RA : IL-1 receptor antagonist

ILCOR : International Liaison Committee on Resuscitation

MH : Malignant hyperthermia

MI : Myocardial infarction

MmD : Multi minicore disease

MRSA : Methicillin- resistant staphylococcus aureus

NABISH : North America Brain Injury Study Hypothermia

NF-KB : Nuclear factor-kappa B

NICE : National Institute for Health and Clinical Excellence

NNT : Number needed to treat

NSAIDs : Non-steroidal anti-inflammatory drugs

OHCA : Out- of- hospital cardiac arrest

OVLT : Organum vasculosum of the laminae terminalis

PCAS : Post cardiac arrest syndrom

PCI : Percutaneous coronary intervention

PE : Pulmonary embolism

PGE2 : Prostaglandin E2

RCTs : Randomized controlled trials

RYR : Ryanodin receptor

SIRS : Systemic inflammatory response syndrome

SSRIs : Selective serotonin reuptake inhibitors

STEMI : Segment-elevation myocardial infarction

TBI : Traumatic brain injury

TH : Therapeutic hypothermia

THAPCA : Therapeutic hypothermia after pediatric cardiac arrest

TLR-4 : Toll-like receptor 4

TNF : Tumor necrosis factor

TTM : Targeted temperature management

UTIs : Urinary Tract Infections

VAP : Ventilator acquired pneumonia

VF : Ventricular fibrillation

WBCs : White blood cells

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Introduction

Body temperature is a routinely measured vital sign in all patients admitted to the intensive care unit (ICU). Body temperature abnormalities are among the most commonly noted symptoms of critically ill patients, and they occur because of several different infectious and non-infectious etiologies. Moreover, these abnormalities frequently trigger changes in patient management **(Laupland KB, 2009)**.

Fever is part of a host's acute phase response to infectious as well as non-infectious inflammatory stimuli and, as such, is one of the most prominent symptoms of infection **(O'Grady NP et al., 2008)**. Although its incidence in adult patients in the ICU may have decreased lately **(Hawkswoth JS et al., 2009),** fever occurs in approximately half of the patients admitted to the ICU and is reported to be associated with adverse outcomes **(Niven DJ et al., 2013)**.

The beneficial effects of fever may include reduction in bacterial growth and promotion of antibodies

and cytokines synthesis, thereby activating immune cells and improving survival **(Viller J et al., 1994)**. Conversely fever is believed to be harmful, especially in patients with life threatening illnesses, because febrile responses are known to increase the metabolic rate, minute ventilation, and oxygen consumption; therefore it can have adverse effects on neurological outcomes **(Bernard SA et al., 2002)**. Several studies have also suggested that suppression of the febrile response with antipyretic drugs could worsen patient outcomes **(Eyers S et al., 2010)**.

Hypothermia can be caused by a number of factors, including cold exposure, sever infections, endocrine abnormalities, and drug overdose, all of which require intensive care **(Magarbane B et al., 2000)**. Inflammatory-associated hypothermia is considered a thermoregulatory failure, and it has been recognized as a significant clinical condition. Although hypothermia may be an unintended consequence of critical illness in patient with infectious and non-infectious conditions, the influence of hypothermia on the physiological severity and outcome of critically ill patients is not well understood **(Romanovsky AA et al., 2005)**.

In the ICU, temperature is measured using a number of different methods, including thermistors on intravascular, bladder, esophageal, or rectal probes, in addition to infrared tympanic membrane and temporal artery thermometers. Although the pulmonary artery catheter has been considered the gold standard measurement technique, in most situations, relatively small differences exist between the other commonly used methods **(O'Grady NP et al., 2008)**.

Temperature is not only an important clinical marker of severity of illness but also an independent predictor of morbidity and mortality in critically ill patient. Close monitoring and regulation to avoid extremes of body temperature is particularly important in the critically ill patient. This will prevent the uncontrolled disruption of homeostasis and associated subsequent organ dysfunction and failure **(Kushimoto S et al., 2014)**.

Aim of the Work

The aim of this work is to review the definitions and occurrence of body temperature abnormalities, in addition to their impact on the disease severity and mortality, and their management in the critically ill patients.

Definitions and Epidemiology

Normothermia

In human, normal core temperature is between 36.5 and 37.5°C, depending on factors such as the time of day, site, and the method of measurement. In part, this is because of diurnal variation, ±0.5°C, with lower temperatures in the morning and higher in the evening. There is also a large difference between the core (brain, thoracic, and abdominal organs) temperature and body surface temperature; the latter is lower than core temperature with a range of 32-35°C **(Baron JE , 2009).**

Hypothermia

Hypothermia is generally accepted to mean a core body temperature less than 36°C. This can then be further subdivided into mild (35.0-35.9°C), moderate (32.0-34.9°C), and sever (<32°C) hypothermia (**Laupland et al., 2012)**.