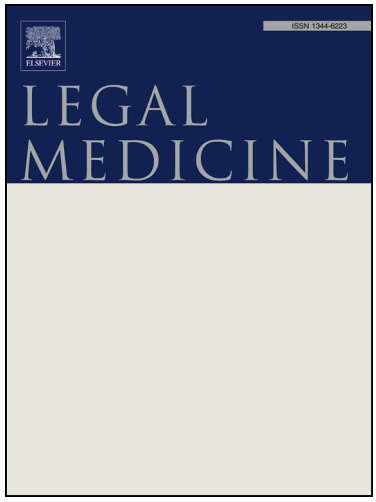

Influence of hypo- and hyperthermia on death time estimation – a simulation study

H. Muggenthaler, M. MHubig, S. Schenkl, G. Mall

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Influence of hypo- and hyperthermia on death time estimation – a simulation study

Muggenthaler H, Hubig M, Schenkl S, Mall G

Institute of Forensic Medicine, Jena University Hospital – Friedrich Schiller University Jena, Germany

Corresponding Author:
holger.muggenthaler@med.uni-jena.de (H. Muggenthaler)
Institut für Rechtsmedizin, Universitätsklinikum Jena, Friedrich-Schiller-Universität Jena, Am Klinikum 1, 07747 Jena, Germany.

Abstract

Numerous physiological and pathological mechanisms can cause elevated or lowered body core temperatures. Deviations from the physiological level of about 37°C can influence temperature based death time estimations. However, it has not been investigated by means of thermodynamics, to which extent hypo- and hyperthermia bias death time estimates.
Using numerical simulation, the present study investigates the errors inherent in temperature based death time estimation in case of elevated or lowered body core temperatures before death. The most considerable errors with regard to the normothermic model occur in the first few hours post-mortem. With decreasing body core temperature and increasing post-mortem time the error diminishes and stagnates at a nearly constant level.

Key Words

Death time estimation, hyperthermia, hypothermia, finite element simulation

Introduction

Death time estimation is one of the forensic key competencies in homicide investigations. Different methods can be applied ([1-3]), but due to the homoeothermality of humans temperature based methods should provide the most reliable death time estimates for short post-mortem intervals.

The most widespread temperature based death time estimation model was established by Henssge in 1979 ([4]). An empirical model was developed and validated using results from experimental rectal temperature measurements:

$$T_r = \left((37{,}2 - T_e)\frac{p}{p-Z} e^{Z\cdot t} - (37{,}2 - T_e)\frac{Z}{p-Z} e^{p\cdot t} \right) + T_e$$

$$Z = 0{,}0284 - 1{,}2815 \cdot m^{-0.625}$$

$$p = 5 \cdot Z \quad 5°C \le T_e \le 23{,}2°C$$

$$p = 10 \cdot Z \quad T_e \ge 23{,}3°C$$

The body mass is represented by m, T_e is the ambient temperature and T_r the calculated rectal temperature. Different cooling conditions including the substratum, environmental factors (wind, irradiation, etc.) and clothing can be incorporated by applying a so called corrective factor. This factor is used to scale the body mass.