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Original contribution

# Unexpectedly high incidence of hypothermia before induction of anesthesia in elective surgical patients☆,☆☆,★

**Anna J. Wetz (Dr med)[a,*], Thorsten Perl (PD Dr med)[a], Ivo F. Brandes (PD Dr med)[a], Markus Harden[b], Martin Bauer (Prof Dr Dr med, MPH)[a], Anselm Bräuer (Prof Dr med, DEAA)[a]**

[a]*Department of Anesthesiology, University of Goettingen, Robert-Koch-Str 40, 37075 Goettingen, Germany*
[b]*Institute of Medical Statistics, University of Goettingen, Humboldtallee 32, 37073 Goettingen, Germany*

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**Abstract**

**Study objective:** Perioperative hypothermia is a frequently observed phenomenon of general anesthesia and is associated with adverse patient outcome. Recently, a significant influence of core temperature before induction of anesthesia has been reported. However, there are still little existing data on core temperature before induction of anesthesia and no data regarding potential risk factors for developing preoperative hypothermia. The purpose of this investigation was to estimate the incidence of hypothermia before anesthesia and to determine if certain factors predict its incidence.

**Design/setting/patients:** Data from 7 prospective studies investigating core temperature previously initiated at our department were analyzed. Patients undergoing a variety of elective surgical procedures were included.

**Interventions/measurements:** Core temperature was measured before induction of anesthesia with an oral (314 patients), infrared tympanic (143 patients), or tympanic contact thermometer (36 patients). Available potential predictors included American Society of Anesthesiologists status, sex, age, weight, height, body mass index, adipose ratio, and lean body weight. Association with preoperative hypothermia was assessed separately for each predictor using logistic regression. Independent predictors were identified using multivariable logistic regression.

**Main results:** A total of 493 patients were included in the study. Hypothermia was found in 105 patients (21.3%; 95% confidence interval, 17.8%-25.2%). The median core temperature was 36.3°C (25th-75th percentiles, 36.0°C-36.7°C). Two independent factors for preoperative hypothermia were identified: male sex and age (>52 years).

☆ Registration of clinical trial: DRKS00005109. http://apps.who.int/trialsearch/.

☆☆ The contents (original contribution) have not been published elsewhere, and the paper is not being submitted elsewhere. The manuscript has been read and approved by all coauthors.

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* Corresponding author. Tel.: +49 551 39 22995; fax: +49 551 39 13886.
*E-mail addresses:* anna.wetz@med.uni-goettingen.de (A.J. Wetz).

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**Conclusions:** As a consequence of the high incidence of hypothermia before anesthesia, measuring core temperature should be mandatory 60 to 120 minutes before induction to identify and provide adequate treatment to hypothermic patients.


## 1. Introduction

*Perioperative hypothermia*, defined as a decrease of core temperature below 36.0°C [1], is a well-known [2] and frequent phenomenon of general anesthesia [1,3–5]. It is known to be associated with serious adverse patient outcomes including increased incidence of unstable angina pectoris, myocardial infarction, cardiac arrest, myocardial ischemia, and ventricular tachycardia in high-risk cardiac patients [1,6], events which all increase the risk of death during and directly after anesthesia and surgery [7]. Furthermore, hypothermia increases postoperative wound infection [8], disrupts thrombocyte function and coagulation, increases intraoperative blood loss, and leads to an increased requirement for blood product transfusion [1]. By increasing morbidity and length of hospital stay [8,9], perioperative hypothermia also incurs increased medical costs [10]. It can be assumed that preoperative hypothermia will necessarily continue into the operative period unless active rewarming is commenced.

Several patient-dependent risk factors for the development of perioperative hypothermia have been identified including age [11], weight [12,13], hypothyroidism [14], and diabetes mellitus [15]. Although Abelha et al [3] confirmed a significant influence of the pre(anesthetic) induction temperature on the subsequent development of intraoperative and postoperative hypothermia, data on core temperature before induction of anesthesia are limited, and no data identifying risk factors for hypothermia before beginning anesthesia are available. The aim of this study was to determine the incidence of hypothermia before induction of anesthesia and to identify any biometric factors that predict the incidence of preoperative hypothermia.

## 2. Materials and methods

The results of 7 separate prospective studies previously initiated at our department, with a combined total of more than 500 inpatients, were analyzed (Table 1). This secondary analysis of existing data was registered under the following number: DRKS00005109, and ethical committee approval was provided for each individual study. In 3 studies, core temperature was recorded before induction of anesthesia as part of a quality control program, and in the remaining 4 studies, core temperature was recorded before induction as part of a randomized trial of perioperative warming devices. The ambient temperature of the operation room ranged from 19°C to 21°C.

Patients 18 years or older undergoing a variety of elective surgical procedures including head and neck, thoracic, abdominal, urologic, and gynecologic operations, as well as orthopedic and trauma procedures, were included. Outpatients and pregnant patients were excluded, as were patients with thyroid disease or fever and patients who refused consent. Seven patients younger than 18 years were excluded, and a further 32 patients were excluded because the data collected were incomplete.

**Table 1** Origin of the different data sets

| Study no. | Patients, n | Included patients, n | Recruitment period | Temperature measurement | Publication | |
|---|---|---|---|---|---|---|
| A | 80 | 75 | 2012 | Sublingual | *Der Anaesthesist* | 2013, 62(2):137-142 |
| B | 90 | 87 | 2011-12 | Sublingual | *Minerva Anestesiol* | 2014, 80(4):436-43 |
| C | 40 | 40 | 2010 | Sublingual | *Cent Eur J Med* | 2012, 7(3):284-289 |
| D | 39 | 19 | 2010 | Infrared | *J Cardiothorac Surg* | 2011, 6:117 |
| E | 127 | 124 | 2009 | Infrared | *Der Anaesthesist* | 2010, 59(9):842-850 |
| F | 120 | 112 | 2008-2009 | Sublingual | unpublished data | |
| G | 36 | 36 | 1995-1996 | Membrane contact | *Anaesthesiol Intensivmed Notfallmed Schmerzther* | 2000, 35(12):756-762 |

Sublingual thermometer: Geratherm rapid, Geratherm Medical AG, Geschwenda, Germany; tympanic infrared thermometer: Genius First Temp, Tyco Healthcare, UK; tympanic membrane contact thermometer: Mon-A-ThermTympanal, Mallinckrodt Medical, Hennef/Sieg, Germany. See Appendix A for further specific details of the 7 different trials.