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Effects of Intraoperative Hypothermia on Patients Undergoing Laparoscopic Surgery: A Retrospective Cohort Study

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Abstract

This study aims to explore the association between intraoperative hypothermia and outcomes in adult patients undergoing laparoscopic surgery. A retrospective analysis of 2048 adult laparoscopic surgery patients treated between 2020 and 2021 was conducted at Songklanagarind Hospital, Thailand. Intraoperative hypothermia, defined as a core temperature below 36 °C, was recorded as either one or more than one episode. Patient demographics, clinical information and postoperative outcomes were extracted from the hospital information system. The outcomes were intraoperative and postoperative cardiac arrhythmias, postoperative oxygen requirement, length of post-anesthetic care unit (PACU) stay, and length of hospital stay. Univariate and multivariate logistic/linear regression models were fit to assess the association between hypothermia and outcomes, presented as odds ratio (OR) or beta-coefficient (b) with 95% confidence interval (CI).

Attachments



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Methodology

1 This study was approved by the Institutional Ethics Committee of the Faculty of Medicine, Prince of Songkla University, Songkhla, Thailand in 11 July 2022 (REC 65-226-8-9). Since this is a retrospective study, informed consent was waived by the Institutional Ethics Committee of the Faculty of Medicine, Prince of Songkla University. The data were accessed on 12 July 2022 after the Ethics Committee's approval. All data were fully anonymized before being accessed by the investigators. All patient, anesthesia, and surgery-related information were retrieved from the anesthetic recording system and Hospital Information System (HIS) of Songklanagarind hospital. The data collection was performed solely by the principal researcher and research assistants. The information was treated as confidential, known only to the research team.

2 **Study population and sampling**

This was a single center retrospective cohort study and included all adult patients who underwent laparoscopic surgery at Songklanagarind Hospital, Prince of Songkla University from January 2019 to December 2021. The inclusion criteria were patients aged >18 years who underwent laparoscopic surgery and an American society of anesthesia (ASA) classification I-III. Cases were excluded if they had open surgery, if their temperature was not monitored, if they experienced intraoperative hyperthermia (defined as core temperature >37.8°C) or if they were intubated and on a ventilator prior to surgery.

3 **Standard operating procedure**

All study patients had surgery in the regular operating rooms and were provided with surgical drapes and blankets. All patients received general anesthesia. The induction agents were either propofol or thiopental depending on anesthesiologist staff. Fentanyl or morphine was the narcotics used the most. Cisatracurium or rocuronium was the neuromuscular blocking agent of choice. Tracheal intubation was done in all the cases and anesthesia was maintained with volatile anesthetic agents, narcotics, and neuromuscular blocking agents as per the choice of the anesthesiologist staff. All patients were provided with a warming mattress and forced air warming system before the start of surgery. Temperatures were measured by nurse anesthetists using various routes and were recorded in the patients chart every 30 minutes. Active interventions such as force air warmer with further transfusion line warmers, along with other measures, were used if patients experienced a drop in temperature.

4 **Data collection**

All necessary data including patient-related factors such as age, gender, body mass index (BMI), ASA classification, and surgery-related factors such as type (general or gynecologic), duration, and classification (emergency or elective), were collected from the HIS. Anesthesia-related factors

including the technique and the type of agents used intraoperatively, were also recorded from the HIS. The lowest temperature measured anytime during the intraoperative period was considered for measuring hypothermia. The core body temperature was measured using the esophageal, nasopharynx, tympanic membrane, or rectal temperature. Since temperatures measured in the ear have been shown to be less accurate compared to rectal measurements, with a potential error of less than 0.5 °C, we adjusted the recorded temperatures by adding 0.5°C to correct for this discrepancy.

4.1 ***Dependent and independent variables for consequences of hypothermia***

Independent variables and potential confounders included patient characteristics: age (years),

sex, weight (in kg), height (in meters), BMI (kg/m²), ASA classification (I-III), surgery-related variables and technique of anesthesia. The main exposure variable was intraoperative hypothermia, defined as the core temperature <36 °C. The number of episodes of hypothermia during the intraoperative period were classified as either one or more than one. The severity of intraoperative hypothermia in our setting was classified as mild hypothermia (34 to <36°C), moderate hypothermia (32 to <34°C), and severe hypothermia (<32°C). The dependent variables were intraoperative and postoperative cardiac arrhythmias, postoperative oxygen requirement, post-anesthetic care unit (PACU) admission, length of PACU stay, and length of hospital stay.

5 **Definition**

Site of operation included gastrointestinal, gynecological, genito-urinary surgery and others which included transabdominal preperitoneal repair hernia, adrenalectomy, hepatectomy, pancreatectomy and splenectomy. Duration of surgery was defined as the time from induction of anesthesia to extubation (in minutes). Cardiac arrhythmias were defined as any abnormality from

the normal sinus rhythm or normal rate including bradycardia, supraventricular tachycardia, and atrial fibrillation. Postoperative oxygen requirement was noted if the patient had utilized oxygen in the PACU or at the ward. Delayed awakening was defined if more than minutes elapsed before the patient woke up after the end of anesthesia. Intraoperative or postoperative blood transfusion (ml) was defined if a patient with hypothermia received blood transfusion either during the operation or after the operation. Length of postoperative hospital stay (in days) was defined as the time from surgery until discharge from hospital. Duration of hypothermia was defined as the period during which core body temperature was <36°C measured in 30 minute intervals. If within any 30 minute period, the body temperature fluctuated from normal to below 36 °C or vice versa, 15 minutes was added to the total duration. Length of PACU stay (in minutes) was defined from the time from finishing the operation until discharge from recovery room.

Statistical analysis

- 6 Data were entered with Epidata (version 3.1). All variables were presented descriptively with mean and standard deviation or median and interquartile range as appropriate for continuous variables, and frequency and percent for categorical variables. Unpaired Student's t-tests or Wilcoxon's rank sum tests were used to compare normally or non-normally distributed variables, respectively. The chi-square test and Fisher's exact test were used to compare categorical variables. Logistic regression and linear regression were used to determine the association between intraoperative hypothermia and the outcomes depending on the type of outcome. Variables with a P-value <0.1 from the univariate analyses were included in the multivariate regression models. We assessed the distribution of residuals from the linear model and, if it was not normal, we transformed the outcome by taking its logarithm. We also assessed the model for multicollinearity and homoscedasticity to satisfy linear assumptions. The model was then refined by sequential backward elimination of non-significant variables performed by the likelihood ratio test, providing the odds ratios (OR)/beta coefficient (β) and their 95% confidence intervals. We subsequently removed each variable with the highest P value and assessed the AIC value for that model. The model with the lowest AIC value as accepted as our final model. Factors were considered significant if their likelihood ratio test P values were < 0.05. The missing data were reported and automatically excluded in the analysis process.
- 7 The sample size calculation was performed based on a pilot study by reviewing the anesthetic records of laparoscopic surgery cases between January and December 2021 (115 hypothermia, 980 non-hypothermia) to achieve the primary objective under a power of 80% and a level of significance of 0.05. Based on the sample size formula for comparing two proportions, at least 2000 patients were required.