

DEVELOPMENT OF A CLINICAL CARE PROTOCOL FOR THE PREVENTION AND TREATMENT OF PERIOPERATIVE HYPOTHERMIA

DESENVOLVIMENTO DE PROTOCOLO CLÍNICO ASSISTENCIAL PARA PREVENÇÃO E TRATAMENTO DA HIPOTERMIA PERIOPERATÓRIA

DESARROLLO DE UN PROTOCOLO CLÍNICO DE ATENCIÓN PARA LA PREVENCIÓN Y EL TRATAMIENTO DE LA HIPOTERMIA PERIOPERATORIA

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Funding: No funding.

Submitted on: 09/08/2021

Approved on: 06/09/2022

Responsible Editors:

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ABSTRACT

Objective: to develop a protocol for the prevention and treatment of perioperative hypothermia. **Method:** research of the technological development in health type, carried out in three stages: i) review of clinical guidelines on risk factors for the development of perioperative hypothermia; ii) identification of the occurrence of perioperative hypothermia and the risk factors associated with its development in a surgical center; and iii) development of a protocol for the prevention of perioperative hypothermia. **Results:** the risk factors identified in the guidelines were categorized into clinical characteristics (age, Body Mass Index, comorbidities and body temperature) and anesthetic-surgical characteristics (type and duration of anesthesia and surgery and operating room temperature). In the second stage, 90 surgical patients were evaluated. The occurrence of hypothermia was 28.9% at surgical admission, 77.8% at admission to the Post-Anesthesia Care Unit and 45.6% at discharge from the operating room. There was a statistically significant association between the occurrence of hypothermia and ASA index ($p = 0.049$), age ($p = 0.037$), comorbidities ($p = 0.031$) and preoperative hypothermia ($p = 0.015$). **Conclusion:** for the elaboration of the protocol, the risk factors described in the literature, the results of a local study and the access to the technologies available in the institution were considered. The actions included the following aspects: assessment of risk factors and triggering situations; monitoring and recording of temperature and other parameters; passive warming for normothermic patients; active warming for hypothermic patients; infusion of warmed intravenous solutions; oxygen support for hypothermic patients.

Keywords: Hypothermia; Perioperative Period; Perioperative Nursing.

RESUMO

Objetivo: desenvolver um protocolo de prevenção e tratamento da hipotermia perioperatória. **Método:** pesquisa do tipo desenvolvimento tecnológico em saúde, realizada em três etapas: i) revisão de diretrizes clínicas sobre fatores de risco para desenvolvimento de hipotermia perioperatória; ii) identificação da ocorrência de hipotermia perioperatória e dos fatores de risco associados ao seu desenvolvimento em um centro cirúrgico; e iii) elaboração do protocolo de prevenção de hipotermia perioperatória. **Resultados:** os fatores de risco identificados nas diretrizes foram categorizados em características clínicas (idade, Índice de Massa Corporal, comorbidades e temperatura corporal) e anestésico-cirúrgicas (tipo e duração da anestesia e da cirurgia e temperatura da sala cirúrgica). Na segunda etapa, 90 pacientes cirúrgicos foram avaliados. A ocorrência de hipotermia foi de 28,9% na admissão cirúrgica, 77,8% na admissão da Sala de Recuperação Pós-Anestésica e 45,6% na alta do centro cirúrgico. Houve associação estatisticamente significativa entre ocorrência de hipotermia e índice ASA ($p = 0,049$), idade ($p = 0,037$), comorbidades ($p = 0,031$) e hipotermia pré-operatória ($p = 0,015$). **Conclusão:** para elaboração do protocolo, foram considerados os fatores de risco descritos na literatura, os resultados de estudo local e o acesso às tecnologias disponíveis na instituição. As ações incluíram os seguintes aspectos: avaliação de fatores de risco e de situações desencadeantes; monitorização e registro da temperatura e outros parâmetros; aquecimento passivo para pacientes normotérmicos; aquecimento ativo para pacientes hipotérmicos; infusão de soluções endovenosas aquecidas; suporte de oxigênio para pacientes hipotérmicos.

Palavras-chave: Hipotermia; Período Perioperatório; Enfermagem Perioperatória.

RESUMEN

Objetivo: desarrollar un protocolo para la prevención y el tratamiento de la hipotermia perioperatoria. **Método:** una investigación de desarrollo tecnológico sanitario, desarrollada en tres etapas: Revisión de las directrices clínicas sobre los factores de riesgo para el desarrollo de la hipotermia perioperatoria; Identificación de la ocurrencia de la hipotermia perioperatoria y de los factores de riesgo asociados a su desarrollo en un centro quirúrgico y Elaboración de un protocolo de prevención de la hipotermia perioperatoria. **Resultados:** los factores de riesgo identificados en las directrices se clasificaron en características clínicas (edad, Índice de Masa Corporal, comorbilidades, temperatura corporal) y anestésico-quirúrgicas (tipo y duración de la anestesia y la cirugía, temperatura del quirófano). En la segunda etapa, se evaluaron 90 pacientes quirúrgicos. La aparición de hipotermia fue del 28,9% al ingreso quirúrgico, del 77,8% al ingreso en la Sala de Recuperación Postanestésica y del 45,6% al alta del quirófano. Se encontró una

Como citar este artigo:

Oliveira RF, Lima IP, Gabiatti D, Nascimento ASM, Fuganti CCT. Development of a clinical care protocol for the prevention and treatment of perioperative hypothermia. REME-RevMinEnferm.2022[cited _____];26:e-1453. Available from: _____ DOI:10.35699/2316-9389.2022.40293

asociación estadísticamente significativa entre la aparición de hipotermia y el índice ASA ($p = 0,049$), la edad ($p = 0,037$), las comorbilidades ($p = 0,031$), la hipotermia preoperatoria ($p = 0,015$). **Conclusión:** para desarrollar el protocolo, se consideraron los factores de riesgo descritos en el documento, los resultados de un estudio local y el acceso a las tecnologías disponibles en la institución. Las acciones incluían la evaluación de los factores de riesgo y las situaciones desencadenantes, la monitorización y el registro de la temperatura y otros parámetros, el calentamiento pasivo para los pacientes normotérmicos, el calentamiento activo para los pacientes hipotérmicos, la infusión de soluciones intravenosas calentadas y el apoyo de oxígeno para los pacientes hipotérmicos. **Palabras clave:** Hipotermia; Periodo Perioperatorio; Enfermería Perioperatoria.

INTRODUCTION

Perioperative hypothermia is defined as body temperature below 36 °C and is related to anesthetic agents, operating room temperature, surgical wound extension, blood and fluid loss, among others.^{1,2} It triggers physiological responses that, when they are not enough to maintain normothermia, they cause changes in systems and organs, leading to complications and increased morbidity and mortality.³ Prevention and treatment include a set of actions ranging from temperature measurement to body warming.²

Complications resulting from hypothermia are intraoperative hemorrhage; alteration of medication metabolism; postoperative cardiac complications; surgical site infection; increased length of stay in the Post-Anesthesia Care Unit (PACU); discomfort; increased hospital costs; disappointment. Complications affect 4 to 72% of surgical patients, with reported incidence above 90% in some studies.²⁻⁴

As for the surgical team, the challenge lies in appropriating the problem, complications and preventive methods, seeking to carry out actions based on scientific evidence, not traditions and convenience.^{2,4} The early detection of hypothermic patients and the identification of risk factors of each surgical patient leads to the performance of individual actions necessary for the management of hypothermia, improving the quality of care and patient comfort.^{2,4,5}

The insertion of clinical care protocols in Nursing practice guides decision-making for the provision of adequate care, based on scientific evidence and on the economic-technological assessment of health services. Thus, the research that makes up the protocols may have different methods, which can make it difficult to reach a consensus on the best actions.^{4,6}

One of the strategies to determine preventive measures for perioperative hypothermia is clinical risk stratification.⁴ The scientific literature shows the risk factors,

but it is necessary to analyze the relevance of these factors for the development of hypothermia, their effective clinical importance and identification of potential measures. preventive measures, evaluating cost and effectiveness.

Therefore, in addition to the best available evidence, it is essential that the elaboration of a protocol consider the local scenario and needs, covering the specific demands and available technology. Given this and the absence of a structured protocol in the surgical center under study, this research proposed to develop a protocol for the prevention and treatment of perioperative hypothermia.⁷

METHOD

Research of the technological development in health type carried out in three stages: 1) review of clinical guidelines on risk factors for the development of perioperative hypothermia; 2) identification of the occurrence of perioperative hypothermia and the risk factors associated with its development; and 3) development of a protocol for the prevention of perioperative hypothermia.

Step 1 - Review of clinical guidelines on risk factors for developing perioperative hypothermia

The question “What are the risk factors for the development of perioperative hypothermia in adult surgical patients described in practical guidelines from scientific communities?” guided the search in three clinical guidelines: Association of periOperative Registered Nurses (AORN),⁴ American Society of PeriAnesthesia Nurses (ASPAN)⁸ and National Institute for Health and Clinical Excellence (NICE).⁹ These societies were chosen due to the accessibility of the guidelines. clinics and for its relevance to the Perioperative Nursing specialty. The search took place in April and May 2017.

Factors related to clinical (age, Body Mass Index - BMI, comorbidities and body temperature) and anesthetic-surgical characteristics of adult patients (type of anesthesia, surgical time, type of surgery, volume and temperature of infusions and temperature of operating room) were included. Child patients were excluded.

The studies included in the clinical guidelines in which the contributing factors to perioperative hypothermia identified were cohort and randomized clinical trials, whose main outcome was the development of perioperative hypothermia.

Clinical guidelines were accessed via the internet, directly on the scientific community website. The authors

searched for the risk factors described in each clinical guideline related to the development of perioperative hypothermia, and they were systematized in a table (Table 1).

Table 1 - Risk factors for the development of perioperative hypothermia according to clinical guidelines from scientific societies. Londrina - PR, Brazil, 2017

Factors related to clinical characteristics	Weight/BMI Age/Extremes of age Women Blood pressure < 140 mmHg ASA index II to V Preoperative body temperature < 36 °C Patients with cardiovascular comorbidities
Factors related to the anesthetic-surgical procedure	Spinal block level General and combined anesthesia Type and duration of anesthesia Intermediate or major surgery Cold surgical environment Open cavity surgeries

Step 2 - Identification of the occurrence of perioperative hypothermia and the risk factors associated with its development

Cross-sectional, descriptive study with a quantitative approach, carried out with the aim of identifying the occurrence of perioperative hypothermia and the association of risk factors with its development. Data collection was performed in the surgical center of a tertiary-level public university hospital in northern Paraná, linked to the Unified Health System (*SUS-Sistema Único de Saúde*). The hospital has seven operating rooms and uninterrupted operation, making around 600 surgeries per month.

Ninety patients undergoing surgeries of different specialties were evaluated by convenience sample. Patients aged 18 years or older, admitted to the preoperative room and submitted to any anesthetic-surgical procedure in the period selected for collection, were included. Exclusion criteria were patients referred directly to the operating room, coming from the Intensive Care Unit (ICU) and polytraumatized.

Data collection was performed in the preoperative room, in the operating room and in the PACU with patients who underwent anesthetic-surgical procedure in July and August 2017. As a data collection procedure, every day the responsible researcher selected the patients on admission to the operating room in the preoperative room and patients who met the inclusion criteria. The patient or family member received explanations about the study and was invited to participate in the research and sign the Free and Informed Consent Term (ICF). For

patients under the influence of pre-anesthetic medication, consent to participate in the study was given by a family member and/or guardian.

The data were recorded in a script prepared for the research and previously evaluated by five professors in the perioperative area and by specialist nurses in the area, selected due to their expertise and training in the perioperative area. In the first part of the script, the clinical and demographic data of the study participants were recorded. In the second part, the recorded data referred to the tympanic temperature measurements and the use or not of body warming methods.

Peripheral temperature was measured at the tympanic membrane using an infrared electronic tympanic thermometer COLOR CHECK AC322, which measures body temperature between 32 and 42.9 °C, with an accuracy of approximately 0.1 °C. There was no standardization on the side to be measured. Infrared tympanic temperature was measured at preoperative admission, immediately before anesthetic induction, at the end of anesthesia, and at PACU admission and discharge. The measurement of body temperature was not part of the institution's intraoperative monitoring routine.

Data collection was performed by a main researcher. Through research in the patient's chart, clinical and surgical variables were obtained. The variables collected in the medical records were sex; age; weight and height (body mass index-BMI was calculated later); preoperative systolic pressure; comorbidities such as hypertension, diabetes *mellitus*, asthma, bronchitis and hypothyroidism; surgical specialty; American Society of Anesthesiologists (ASA) index; surgery classification; surgical size; and type of anesthesia. The temperature measurement was obtained by the main researcher in the perioperative period. It was recorded whether there was body warming; if so, the method and device used were also recorded.

Descriptive analyzes of simple frequency were performed for categorical variables, analysis of measure of central tendency (mean) and variability (standard deviation) for numerical variables. A chi-square association test was performed for the variables age, BMI, ASA index, aseptic technique, systolic blood pressure, preoperative temperature, and intraoperative warming in relation to temperature at awakening. Sample homogeneity test was not performed. All analyzes presented were performed with the aid of the R[®] software, version 3.4.1. For this study, a significance level of 5% was adopted ($p = <0.05$).

The research was approved by the Research Ethics Committee, CAAE No. 31277414.7.0000.5231, Opinion Report No. 662,232.

Step 3 - Elaboration of the protocol for the prevention of perioperative hypothermia

After analyzing the clinical guidelines and identifying the risk factors associated with the occurrence of hypothermia in the evaluated sample (steps 1 and 2), the protocol was prepared in 2018 and adjusted to the risk factors that had a statistically significant association with the development of hypothermia perioperative care of the local population and access to the technologies available in the institution.

The need for monitoring and recording of temperature and oxygenation and circulation parameters was evidenced by the sector; prewarming; identification and quantification of body warming methods available in the sector; and identification of the most susceptible surgical specialties, situations, and patients. Within the sector's continuing education planning, the topic Prevention of Perioperative Hypothermia was inserted, with a workload of 2 hours for each group of 10 professionals from the Nursing team sector. The main concepts related to perioperative hypothermia, body warming methods and guidance on the perioperative hypothermia management protocol were addressed.

After the training, the protocol was implemented in the sector, where actions related to the following topics were inserted: preoperative assessment of risk factors and situations of surgical patients; recording and monitoring of temperature and oxygenation and circulation parameters; passive warming for normothermic patients; active warming for hypothermic patients; infusion of warmed intravenous solutions; oxygen support for hypothermic patients.

RESULTS

The risk factors for the development of perioperative hypothermia in adult surgical patients described in the guidelines of scientific societies are systematized and described in Table 1.

One of the guidelines defines the level of evidence for risk factors. Evidence can be weak — age, systolic blood pressure less than 140 mmHg, female gender, and level of spinal block — or strong. Risk factors based on strong evidence have not yet been delimited. The other societies do not indicate the level of evidence of the risk factors listed.

In the second stage, the clinical and anesthetic-surgical characteristics of the patients undergoing surgery at the study hospital were identified, as well as their association with the occurrence of perioperative hypothermia. Of the patients analyzed, 28.9% were hypothermic

before the anesthetic-surgical procedure. The occurrence of perioperative hypothermia on awakening from anesthesia was 80%, and 45.6% were discharged from the operating room still hypothermic (Figure 1).

As for the sample of patients, 51% were women and 24% were elderly. Most patients (61%) had BMI evaluated as a normal parameter (18.5 to 24.9 kg m²), and 72% had preoperative systolic blood pressure below 140 mmHg. The mean age of patients in this study was 44 years (sd = 18.3). The minimum age was 18 years and the maximum was 88 years; 36% of patients were classified as ASA II. Most surgeries lasted up to two hours, and only 8% of these patients underwent combined anesthesia.

The clinical and anesthetic-surgical variables that were associated with the occurrence of hypothermia were: age ($p = 0.037$), ASA index ($p = 0.049$), comorbidities ($p = 0.031$) and preoperative temperature ($p = 0.015$) (Table 2).

A total of 13 patients (14.4%) were warmed in the operating room by the study hospital team, of which 12 used passive warming (sheet and acrylic wool blanket). Only one patient had active warming (heated forced air system). In the PACU, 82 patients (91.1%) received some type of warming: 79 were heated with a passive method (sheet and acrylic wool blanket), two with an active method (heated forced air system) and one patient had an association of method. passive and active.

Perioperative hypothermia was detected in all surgical specialties at PACU admission: 100% in digestive, thoracic, plastic and otorhinolaryngology surgeries; 85.7% in the maxillofacial specialty; 81.8% in urology; 75% in neurology; 71.4% in orthopedics; 66.7% in vascular; 58.8% in obstetric gynecology; and 50% in ophthalmology.

The protocol's main actions and recommendations are described in Table 3.

DISCUSSION

Perioperative hypothermia is one that occurs as a result of factors related to the patient, anesthesia and surgical procedure. It brings several physiological changes and complications, but it is preventable. A set of measures can be adopted in order to maintain the body temperature of surgical patients.^{6,1}

This study proposed the development of a protocol for the management of perioperative hypothermia in three steps: 1) review of clinical guidelines; 2) analysis of risk factors associated with the occurrence of perioperative hypothermia in a surgical center; and 3) elaboration of the protocol.

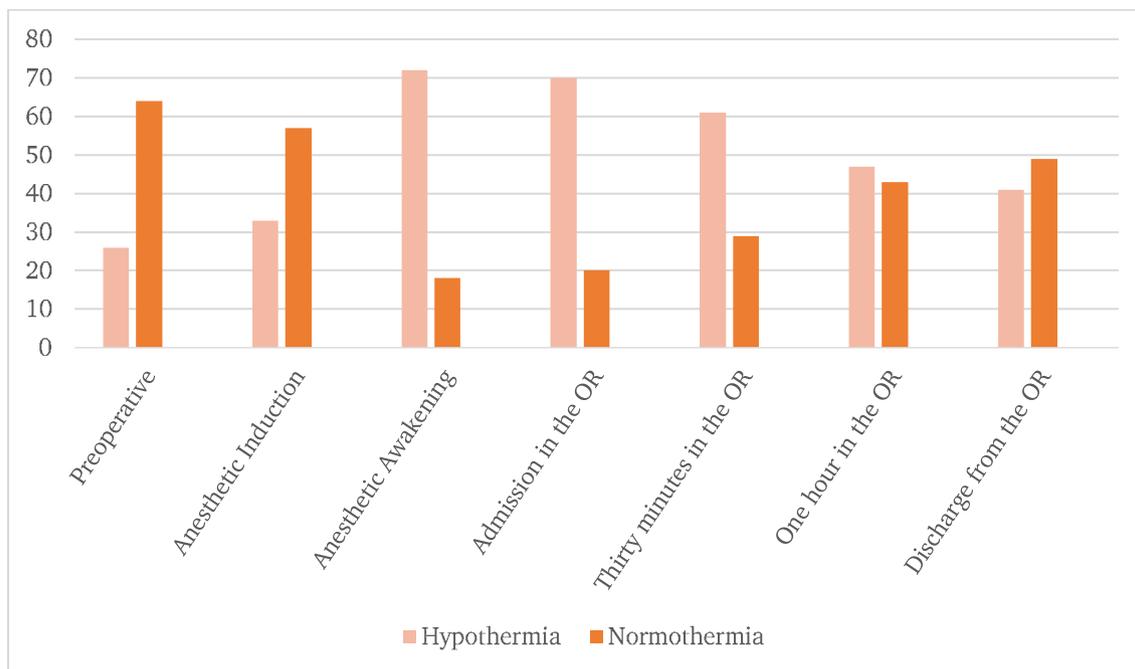


Figure 1 - Distribution of body temperature of surgical patients in the different periods evaluated in relation to the presence of hypothermia. Londrina, PR - Brazil, 2017

The risk factors identified in the guidelines were BMI, age, ASA Index, surgical size, type and duration of anesthesia, comorbidities, cold environment and preoperative temperature.^{4,8,9} In this study, the variables age ($p = 0.037$), ASA index ($p = 0.049$), comorbidities ($p = 0.031$) and preoperative hypothermia ($p = 0.015$) were associated with the development of hypothermia. It is noteworthy that the association of two or more risk factors predisposes any type of surgical patient to develop hypothermia.¹⁰

Age-related risk is related to age extremes. In the elderly, the senescence process causes changes in the thickness of the skin layers, which can interfere with the maintenance of body heat;³ children, in turn, have a smaller body surface and reduced regulatory capacity.¹¹

Comorbidities and ASA index were also associated with the occurrence of perioperative hypothermia in this study. In the guidelines of ASPAN,⁸ AORN⁴ and NICE,⁹ the presence of comorbidities (diabetes *mellitus*, arterial hypertension, complications or cardiovascular changes) potentiates the onset of hypothermia. An ASA index above II also predisposes the patient to have his temperature altered during surgery. These results corroborate the results of other studies, in which these variables were associated with the development of hypothermia.^{10,12}

In the present study, preoperative temperature was also considered a risk factor for developing hypothermia. Body temperature before anesthetic induction shows the heat content in peripheral tissues and the center-periphery temperature gradient, which will interfere with the magnitude of body temperature redistribution that occurs mainly in the first surgical hour. Therefore, with peripheral temperature below the appropriate parameter during the body heat redistribution phase, the drop in body temperature may be even more pronounced, contributing to the occurrence of perioperative hypothermia.¹³

Other studies have associated a preoperative temperature below 36 °C with perioperative hypothermia, which is cited as a risk factor in the guidelines.^{3,9,14} In the present study, the occurrence of perioperative hypothermia on admission to the PACU was 77.8%, which coincides with another study.¹⁵ Another study showed an incidence of 31.71% in surgical patients who received passive warming.¹⁶ One study identified an incidence of 6.32% of hypothermia in the PACU.¹⁷

Identifying risk factors associated with the development of perioperative hypothermia helps in planning multiple strategies to prevent perioperative hypothermia. With these strategies, it is possible to approach the multidisciplinary team and the stages through which

Table 2 - Distribution of clinical and anesthetic-surgical variables in relation to the development of hypothermia. Londrina - PR, Brazil, 2017

Variables	Normothermia n	Hypothermia n	p*
Age (years)			0.037
18 to 59	17	51	
≥ 60	1	21	
ASA Index			0.049
ASA 1	15	42	
ASA 2	3	30	
Comorbidities			0.031
Yes	3	32	
No	15	40	
Type of Anesthesia			0.241
General	6	28	
Block	6	23	
Plexus Block	2	8	
General + Block	0	8	
Sedation + Local Anesthesia	4	5	
Preoperative Temperature			0.015
Normothermia	17	47	
Hypothermia	1	25	
Sex			0.874
Male	8	36	
Female	10	36	
BMI (kg,m²)			0.916
Low weight (< que 18,5)	2	9	
Normal weight (18,5 to 24,9)	10	45	
High weight (25 to 29,9)	5	15	
Obesity (> que 30)	1	3	
Warming in the OR			0.150
Blanket	0	12	
Thermal Blanket	0	1	
None	18	59	
Preoperative Systolic BP			0.556
BP < 140 mmhg	14	51	
BP ≥ 140 mmhg	4	21	

*Chi-square.

the surgical patient passes, preventing or minimizing its occurrence and/or severity.¹⁰

These strategies included educational actions for the Nursing and medical staff, readjustment of the intraoperative record form, management of supplies for active warming of patients, care planning for the prevention of hypothermia with the Nursing teams of the inpatient

units. The insertion of more detailed information in the intraoperative registration form will allow a collection of data for research and teaching.

The group of resident nurses in Perioperative Nursing plans and participates in the team's educational activities, as well as in the periodic review of scientific evidence, contributing to the training of postgraduate nurses.

The addition of the protocol helps in the management of the sector and in the addition of quality indicators related to hypothermia. This information will help nurses' decision making, standardization of care, seeking continuous improvement and correction of possible nonconformities.

The use of protocols in clinical practice enables care based on scientific evidence, helping the team to choose the best practices. A study evaluating the rate of temperature monitoring and the use of active warming strategies before and after the implementation of a protocol to prevent hypothermia showed an 80% increase in monitoring and a 53% increase in the use of strategies to warm the surgical patient.¹⁸

At the study institution, other clinical protocols are already in place or are being implemented. However, although some actions for the prevention and treatment of hypothermia were carried out in the sector, its protocol was based on this study. Guidelines were made based on up-to-date evidence, with effective results, made available through the institution's computerized system and in print available in the sector. In addition, the study provided knowledge of the local reality, identifying the occurrence of perioperative hypothermia and the relationship with unsubstantiated actions. The insertion of the protocol brings the possibility of future research, which may be about the occurrence, management, complications or possibilities of prevention and treatment. It also opens the way for research with the child population.

A survey evaluated, in 26 German hospitals, the acceptance of the recommendations of a clinical protocol with two strategies for the prevention of perioperative hypothermia for the postoperative period (pre-warming and measurement of sublingual temperature in the postoperative period) two years after establishment of the protocol. The results showed that, after the implementation of the recommendations, of the 431 patients included, none developed postoperative hypothermia.⁶ This result shows the importance of inserting scientific evidence in clinical practice and how its acceptability can contribute to the quality of patient care. In addition, the cost-effectiveness analysis of inserting the protocol for preventing

Table 3 - Actions, recommendations and rationale of the Perioperative Hypothermia Prevention Protocol. Londrina - PR, Brazil, 2018

Action	Recommendation	Rationale
Guide patients and Nursing staff for preoperative care.	Perform a body bath with warm or hot water, avoiding washing the hair on the surgical day. If you do, dry your hair. During transport to the operating room, keep the patient covered with a sheet and/or blanket.	Hypothermia can start even in the preoperative phase. Some care can lead to loss of body heat to the external environment.
Evaluate clinical characteristics and risk situations of adult patients in the preoperative period.	Evaluate clinical characteristics and anesthetic-surgical planning in order to detect more susceptible patients and those in risk situations.	The identification of risk factors and situations guides decision making towards preventive measures and better treatment.
Maintain body temperature above 36 °C.	Check tympanic body temperature on admission to the operating room, before and after warming interventions, at the entrance to the operating room, during the surgical procedure (or every 30 minutes), at the end of the surgery, on admission to the PACU, every 15 minutes in the PACU and on discharge from the operating room.	Monitoring early identifies changes in body temperature, enabling actions in all perioperative phases.
Perform active warming of susceptible patients.	Elderly, patients with comorbidities and preoperative body temperature below 36 °C should receive prewarming with an active method.	These risk factors were associated with the development of perioperative hypothermia in a local study. Active prewarming can raise the peripheral temperature to close to the core, which can prevent or reduce the severity of hypothermia.
Maintain passive warming preoperatively when temperature is above 36 °C.	Perform passive warming, using an acrylic sheet and blanket in normothermic patients.	The patient, without anesthesia effect, has an effective thermoregulatory system to maintain body temperature. Passive warming isolates the patient from the external environment, preventing heat exchange.
Perform active warming when temperature is below 36 °C.	Perform active warming with a heated forced air system. - for 15 minutes for prewarming; - during the surgical procedure; - during stay in the PACU.	Active warming provides the heat that the body is unable to produce. It is the most effective method for maintaining body temperature.
Administer intravenous solutions warmed between 36 and 37 °C.	Warming solutions in specific equipment for this purpose.	Warmed intravenous solution along with active warming lessens the severity of perioperative hypothermia. Appropriate equipment for warming these solutions can monitor the temperature of the solution properly.
Monitor patients' vital signs – blood pressure, pulse, pulse oximetry, respiratory rate and temperature.	Check vital signs of surgical patients in terms of changes resulting from the drop in temperature.	Hypothermia causes vasoconstriction, changes in blood pressure and pulse oximetry.
Provide O ₂ support when the temperature is below 36 °C in the PACU.	Administer humidified oxygen in a mask at 5 to 6 L/min.	Hypothermia increases tissue oxygen demand.

Source: by the authors.

perioperative hypothermia showed cost savings and improved quality of life for surgical patients.¹⁹

The present study had the following limitations in its development: a small sample to identify risk factors associated with the development of perioperative hypothermia, extended age group, different surgical times and anesthesia and inclusion of different surgical specialties. In addition, the collection was performed in a single hospital, which may interfere with the generalization of the results. No study was performed before and after

implementation of the protocol to assess its effectiveness in preventing perioperative hypothermia.

CONCLUSION

The risk factors identified in the clinical guidelines were BMI, age, ASA index, surgical size, type and duration of anesthesia, comorbidities, cold environment and preoperative temperature.

In a second phase, the occurrence of perioperative hypothermia and the risk factors that were associated with the development of perioperative hypothermia in a surgical center were identified. The results showed that the occurrence of perioperative hypothermia was 28.9% of the surgical patients before the anesthetic-surgical procedure; on awakening from anesthesia, it was 80%; and 45.6% were discharged from the operating room still hypothermic. The risk factors present in the patients in the sample that were associated with the development of perioperative hypothermia were the ASA index, comorbidities, age and preoperative temperature.

After analyzing the literature and identifying the risk factors that were associated with the occurrence of hypothermia in the evaluated sample, a protocol for the prevention of perioperative hypothermia was developed for the surgical center analyzed. Actions included assessment of risk factors and triggering situations, monitoring and recording of temperature and other parameters, passive warming for normothermic patients, active warming for hypothermic patients, infusion of warmed intravenous solutions, and oxygen support for hypothermic patients.

CONTRIBUTION

The present study brings to the discussion the need to evaluate the surgical patient from the preoperative period, the importance of proposing individualized actions, and the recognition of the nurse's role as an important professional for the prevention and treatment of hypothermia. For Nursing, it provides a discussion about an event with a high incidence and little adherence to the proposed protocols.

REFERENCES

- Nordgren M, Hernborg O, Hamberg Å, Sandström E, Larsson G, Söderström L. The Effectiveness of four intervention methods for preventing inadvertent perioperative hypothermia during total knee or total hip arthroplasty. *AORN J*. 2020[cited 2021 Jan 10];111(3):303-12. Available from: <https://aornjournal.onlinelibrary.wiley.com/doi/epdf/10.1002/aorn.12961>
- Sociedade Brasileira de Enfermeiros de Centro Cirúrgico, Recuperação Anestésica e Centro de Material e Esterelização. Diretrizes de práticas em Enfermagem cirúrgica e processamento de produtos para a saúde. 7ª ed. Barueri: SOBECC; 2017.
- Alfonsi P, Bekka S, Aegerter P. Prevalence of hypothermia on admission to recovery room remains high despite a large use of forced-air warming devices: findings of a non-randomized observational multi-center and pragmatic study on perioperative hypothermia prevalence in France. *PLoS One*. 2019[cited 2021 Jan 17];14(12):e0226038. Available from: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6927638/pdf/pone.0226038.pdf>
- Association of perioperative Registered Nurses. Guidelines for Perioperative Practice. Denver: AORN; 2017.
- Balki I, Khan JS, Staibano P, Duceppe E, Bessissow A, Sloan EN, *et al*. Effect of perioperative active body surface warming systems on analgesic and clinical outcomes: a systematic review and meta-analysis of randomized controlled trials. *Anesth Analg*. 2020[cited 2021 Jan 20];131(5):1430-43. Available from: <https://pubmed.ncbi.nlm.nih.gov/33079867/>
- Gabriel P, Höcker J, Steinfath M, Kutschick KR, Lubinska J, Horn EP. Prevention of inadvertent perioperative hypothermia: guideline compliance in German hospitals. *Ger Med Sci*. 2019[cited 2021 Jan 20];17:Doc07. Available from: <https://pubmed.ncbi.nlm.nih.gov/translate.goog/31523222/>
- Catunda HLO, Bernardo EBR, Vasconcelos CTM, Moura ERF, Pinheiro AKB, Aquino PS. Percurso metodológico em pesquisas de Enfermagem para construção e validação de protocolos. *Texto Contexto Enferm*. 2017[cited 2021 Jan 13];26(2):e00650016. Available from: <https://www.scielo.br/j/tce/a/XNRPJGWWGp6Y6vcT8RWXQWv6x/?lang=p&t&format=pdf>
- Hooper VD, Chard R, Clifford T, Fetzer S, Fossum S, Godden B, *et al*. ASPAN's evidence-based clinical practice guideline for the promotion of perioperative normothermia: second edition. *J Perianesth Nurs*. 2010[cited 2021 Jan 13];25(6):346-65. Available from: <https://www.sciencedirect.com/science/article/pii/S1089947209003396?via%3Dihub>
- National Institute of Health and Clinical Excellence. Hypothermia: prevention and management in adults having surgery. Clinical Guideline. London, UK: NICE; 2008[cited 2021 Jan 10]. Available from: www.nice.org.uk/guidance/cg65
- Boddu C, Cushner J, Scuderi GR. Inadvertent perioperative hypothermia during orthopedic surgery. *Am J Orthop (Belle Mead NJ)*. 2018[cited 2021 Jan 13];47(7). Available from: https://cdn.mdedge.com/files/s3fs-public/issues/articles/ajo_-_inadvertent_perioperative_hypothermia_during_orthopedic_surgery_-_2018-07-16.pdf
- Perlman J, Kjaer K. Neonatal and maternal temperature regulation during and after delivery. *Anesth Analg*. 2016[cited 2021 Jan 10];123(1):168-72. Available from: <https://pubmed.ncbi.nlm.nih.gov/27314693/>
- Collins S, Budds M, Raines C, Hooper V. Risk Factors for perioperative hypothermia: a literature review. *J Perianesth Nurs*. 2019[cited 2022 Jan 15];34(2):338-46. Available from: <https://www.sciencedirect.com/science/article/pii/S1089947218301473?via%3Dihub>
- Sessler DI. Perioperative thermoregulation and heat balance. *Lancet*. 2016[cited 2021 Jan 13];387(10038):2655-64. Available from: <https://www.sciencedirect.com/science/article/pii/S0140673615009812?via%3Dihub>
- Gala T, Shahzad N, Edhi AI, Chawla TU. Perioperative hypothermia in colorectal surgeries: are we doing enough to prevent it? *J Pak Med Assoc*. 2020[cited 2021 Jan 10];70(2):304-7. Available from: <https://pubmed.ncbi.nlm.nih.gov/32063625/>
- Sari S, Aksoy SM, But A. The incidence of inadvertent perioperative hypothermia in patients undergoing general anesthesia and an examination of risk factors. *Int J Clin Pract*. 2021[cited 2021 Jan 10];75(6):e14103. Available from: <https://onlinelibrary.wiley.com/doi/epdf/10.1111/ijcp.14103>

16. Allene MD. Postoperative hypothermia and associated factors at Debre Berhan comprehensive specialized hospital 2019: a cross sectional study. *Int J Surg Open*. 2020[cited 2021 Jan 10];24:112-6. Available from: <https://www.sciencedirect.com/science/article/pii/S240585722030036X>
 17. Li C, Zhao B, Li L, Na G, Lin C. Analysis of the risk factors for the onset of postoperative hypothermia in the postanesthesia care unit. *J Perianesth Nurs*. 2021[cited 2021 Jan 17];36(3):238-42. Available from: <https://www.sciencedirect.com/science/article/pii/S1089947220302823?via%3Dihub>
 18. Giaretta LS, Martins ORS, Veras FC, Bruna TAD, Stefani LPCH. Manejo da hipotermia no perioperatório: implementação de estratégia de melhoria de qualidade assistencial. *Clin Biom Res*. 2017[cited 2021 Jan 10];37(supl):74. Available from: <https://lume.ufrgs.br/bitstream/handle/10183/171488/001052459.pdf?sequence=1&isAllowed=y>
 19. Conway A, Gow J, Ralph N, Duff J, Edward KL, Alexander K, *et al*. Implementing a thermal care bundle for inadvertent perioperative hypothermia: a cost-effectiveness analysis. *Int J Nurs Stud*. 2019[cited 2021 Jan 10];97:21-7. Available from: <https://www.sciencedirect.com/science/article/pii/S0020748919301142?via%3Dihub>
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