Body temperature, Aldrete-Kroulik index, and patient discharge from the Post-Anesthetic Recovery Unit

ABSTRACT
Patient discharge from post-anesthetic recovery (PAR) depends, among other factors, on normothermia and the patient’s score on the Aldrete-Kroulik index. The objective of this study was to verify the relationship between the Aldrete-Kroulik index and body temperature in patients. This study was performed at the University of São Paulo University Hospital. Convenience sampling was used, and the sample consisted of 60 patients of ages between 18 and 60 years who underwent general anesthesia. The patients’ body temperature was obtained by tympanic measurement, and the Aldrete-Kroulik index was measured on admission and at discharge from post-anesthetic recovery. The data were processed using SPSS, considering a significance level of 5%, and the Spearman and Wilcoxon tests were applied. In conclusion, no significant correlation was found between the two parameters for discharge.

RESUMO
A alta do paciente da recuperação pós-anestésica (RPA) depende, dentre outros fatores, do retorno à normotermia e do escore alcançado pelo Índice de Aldrete e Kroulik. Sendo assim, o objetivo deste estudo foi verificar a relação entre o Índice de Aldrete e Kroulik e a temperatura corporal dos pacientes. O local de pesquisa foi o Hospital Universitário da Universidade de São Paulo. O cálculo amostral foi determinado por conveniência e foi constituído por 60 pacientes, entre 18 e 60 anos, submetidos a anestesia geral. Foram verificados a temperatura corporal na região timpânica e o Índice de Aldrete e Kroulik durante a recepção e alta de recuperação pós-anestésica. Os dados obtidos foram processados pelo pacote estatístico SPSS, considerando um nível de 5% de significância, e aplicaram-se o teste de Spearman e o teste de Wilcoxon. Conclui-se que não houve correlação significativa entre os dois parâmetros indicativos de alta.

DESCRITORES
Hypothermia
Recovery Room
Patient discharge
Perioperative nursing

REFERENCES
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INTRODUCTION

Body temperature is among the most rigorously controlled physiological parameters of an organism. The system responsible for this function permits variations between 0.2º and 0.4º Celsius (ºC) around 37ºC to maintain its metabolic functions(1). Therefore, temperature measurement should be as trustworthy as possible. Body temperature can be measured form several locations, and tympanic measurement is the one that provides the value closest to the central temperature(2).

During surgery and anesthesia, unintentional hypothermia is a common occurrence due to the direct inhibition of thermoregulation by the anesthetics, the patient’s reduced metabolism and exposure to the cold environment of the operating room, besides the infusion of cold liquids(3). Hypothermia can be classified as mild (34ºC to 36ºC); moderate (30ºC to 34ºC), and severe (less than 30ºC).

After surgery, patients are usually transferred to post-anesthetic recovery (PAR) with mild hypothermia, unstable vital signs, reduced motor activity and protective reflexes, and an altered conscious level. Patients remain in this unit until recovering these functions, which guarantees their prevention against possible postoperative complications(4).

A persistent hypothermia in the PAR can cause several complications, which may be metabolic, respiratory, and cardiovascular, particularly if associated with risk factors and compensatory shivering(5-6).

A study that aimed at identifying the most frequent nursing diagnosis during post-anesthetic recovery found that an unbalanced body temperature (mild hypothermia) ranked at a noteworthy position, with a frequency of 100%(3).

Unintentional hypothermia is common in PAR, and it usually does not impede patients from being discharged, as long as their clinical parameters, assessed using the Aldrete-Kroulik index, suggest they should be transferred back to the original unit, i.e., when a total score between 8 and 10 is obtained.

Unintentional hypothermia is common in PAR, and it usually does not impede patients from being discharged, as long as their clinical parameters, assessed using the Aldrete-Kroulik index, suggest they should be transferred back to the original unit, i.e., when a total score between 8 and 10 is obtained.

OBJECTIVE

To verify the relationship between the Aldrete-Kroulik index and the body temperature of PAR patients; to verify the body temperature and Aldrete-Kroulik index of PAR patients.

METHOD

This prospective cross-sectional study was performed at the anesthetic recovery unit of a University Hospital in São Paulo, SP, Brazil, which is located on the 2nd floor of the Hospital and has seven beds. The nursing team is comprised by one nursing technician and one nurse for each shift. The studied period was between October and November of 2007.

The convenience sample consisted of 60 patients admitted to the PAR, of both genders, of ages between 18 and 60 years, who had undergone elective surgery with a minimum duration of two hours, with general anesthesia and no prior pathologies that could affect their body temperature. The patients’ body temperature was measured using an infrared radiation tympanic thermometer on admission and at discharge. None of the patients were excluded during the study.

The patients’ anesthetic risk was assessed using the Classification proposed by the American Society of Anesthesiology (ASA), which was performed by the anesthesiologist, and consists of evaluating the patients’ clinical examination and the presence of comorbidities(7). The physiological condition of PAR patients was evaluated using the Aldrete-Kroulik index because of its acceptability.
since its creation in 1970, and because of its purpose, i.e.,
to systematize the evaluation of the physiological conditions
of PAR patients in a simple and objective way (8).

Data collection was performed on Monday to Friday,
in the afternoon shift, because this period is characterized
as the one with the greatest number of patient admissions
at the referred unit. The instrument that was used was de-
signed by the researcher, and consisted of two parts. Part I:
sample characterization data (age, gender, type of anesthe-
sia, type of surgery, and physical condition according to ASA).
Part II – Parameters: body temperature of the PAR patient
on admission and at discharge, and the patient’s score on
the Aldrete-Kroulik index also on admission and at discharge.

This study was approved by the Research Ethics Com-
mittee at University of São Paulo University Hospital (HU-
USP) (Register CEP-HU/USP: 824/08 A - SISNEP-CAAE:
0028.0.198.196-09), in compliance with the regulations of
the National Health Council Resolution 196/96 and other
complementary laws.

The data were analyzed using the Statistical Package
for Social Sciences 14.0. The continuous variables were
presented as minimum, maximum, means, and standard
deviation. The categorical data were presented as abso-
lute and relative frequencies. The Kolmogorov-Smirnov, T
test, and Wilcoxon’s test were used, considering a signifi-
cance level of 5%.

RESULTS

Table 1 - Sociodemographic and clinical characteristics of the stu-
died patients - São Paulo, 2007

<table>
<thead>
<tr>
<th>Variables</th>
<th>N (%)</th>
<th>Mean (sd)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>37 (61.7)</td>
<td>-</td>
</tr>
<tr>
<td>Male</td>
<td>23 (38.3)</td>
<td>-</td>
</tr>
<tr>
<td>Age (years)</td>
<td>-</td>
<td>39.4 (13.2)</td>
</tr>
<tr>
<td>Duration of procedure (hours)</td>
<td>-</td>
<td>2.09 (1.04)</td>
</tr>
<tr>
<td>Surgery specialty</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gastrointestinal</td>
<td>31 (52.7)</td>
<td>-</td>
</tr>
<tr>
<td>Oral-maxillary</td>
<td>09 (15.3)</td>
<td>-</td>
</tr>
<tr>
<td>Orthopedic</td>
<td>07 (11.9)</td>
<td>-</td>
</tr>
<tr>
<td>Otolaryngology</td>
<td>05 (8.5)</td>
<td>-</td>
</tr>
<tr>
<td>Plastic Surgery</td>
<td>04 (6.8)</td>
<td>-</td>
</tr>
<tr>
<td>Head and neck</td>
<td>02 (3.4)</td>
<td>-</td>
</tr>
<tr>
<td>Others</td>
<td>02 (3.4)</td>
<td>-</td>
</tr>
<tr>
<td>ASA*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>31 (51.7)</td>
<td>-</td>
</tr>
<tr>
<td>2</td>
<td>25 (41.7)</td>
<td>-</td>
</tr>
<tr>
<td>3</td>
<td>04 (6.6)</td>
<td>-</td>
</tr>
</tbody>
</table>

*Classification of the American Society of Anesthesiology

Table 1 shows the data regarding the sociodemographic
and clinical characteristics of the patients. It is observed
that most (37; 61.7%) patients were women, 31 (51.7%) did
not have any preexisting underlying pathology (ASA1)
and gastrointestinal surgeries predominated (31; 52.7%).

Table 2 – Minimum, maximum, and mean temperature values on
admission and at discharge from post-anesthetic recovery - São
Paulo, 2007

<table>
<thead>
<tr>
<th>Temperature measurements in PAR</th>
<th>Minimum °C</th>
<th>Maximum °C</th>
<th>Mean °C</th>
</tr>
</thead>
<tbody>
<tr>
<td>On admission in PAR</td>
<td>34.5</td>
<td>37.2</td>
<td>35.9</td>
</tr>
<tr>
<td>At discharge in PAR</td>
<td>33.3</td>
<td>37</td>
<td>36.1</td>
</tr>
</tbody>
</table>

p≤ 0.023

Table 2 compares the patients’ temperature measured
on admission and at discharge, with the respective mini-
num, maximum, and mean values. A 1.2°C variation was
observed between the PAR patients’ minimum tempera-
ture on admission and discharge. Similarly, a 0.2°C varia-
tion occurred between the maximum temperature on ad-
mission and at discharge. The mean values show a 0.2°C
variation.

The comparison between the patients’ mean tem-
peratures on admission and discharge from PAR showed
a significant difference (p=0.023) between them, i.e., the
tympanic temperature measurements of the patients at
discharge were smaller compared to the temperatures on
admission.

Table 3 – Aldrete-Kroulik values on admission and at discharge
from the Anesthetic Recovery Room - São Paulo, 2007

<table>
<thead>
<tr>
<th>Variables</th>
<th>Admission</th>
<th>Discharge</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aldrete-Kroulik index</td>
<td>0.611</td>
<td>0.595</td>
</tr>
<tr>
<td>Temperatura</td>
<td>0.958</td>
<td>0.095</td>
</tr>
</tbody>
</table>

p≤ 0.05

The results presented in Table 3 indicate that, on ad-
mission to PAR, most patients (44; 73.4%) scored 8 on
the Aldrete-Kroulik index, which indicates they could be
discharged from the PAR, but because of the patients’
unstable condition during the first hour post-surgery, it is
recommended they stay in the unit until achieving a score
9 or 10.

Table 4 – Association between the Aldrete-Kroulik index and
body temperature on admission and discharge from PAR – São
Paulo, 2007

<table>
<thead>
<tr>
<th>Aldrete-Kroulik index</th>
<th>Admission</th>
<th>Discharge</th>
</tr>
</thead>
<tbody>
<tr>
<td>N %</td>
<td>N</td>
<td>N %</td>
</tr>
<tr>
<td>7</td>
<td>2</td>
<td>3.3</td>
</tr>
<tr>
<td>8</td>
<td>4</td>
<td>73.4</td>
</tr>
<tr>
<td>9</td>
<td>11</td>
<td>18.3</td>
</tr>
<tr>
<td>10</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>Total</td>
<td>60</td>
<td>100.0</td>
</tr>
<tr>
<td>100.0</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 4 shows the association between the PAR pa-
tients’ Aldrete-Kroulik index and body temperature mea-
sured at the two proposed times. It is observed that there
is no statistically significant correlation between the stud-
ied variables.
DISCUSSION

According to literature, unintentional hypothermia is a consequence of the surgical anesthetic procedure; a clinical condition in which the body is incapable of regulating its temperature because the elements involved in this mechanism are compromised by the drugs that depress the temperature-regulating center of the body\(^9\).

Thus, patients who undergo surgical anesthetic procedures are exposed to multiple factors that can alter their thermoregulation mechanisms, and, for this reason, hypothermia occurs in the post-operative period. Some of the referred factors are the temperature of the operating room, the intravenous infusion of cold solutions, patient’s age, muscular relaxation, exposure of cavities, surgery time, type of surgery, and ventilation with unheated gases\(^6,10\).

However, it is important to identify the risk factors in the pre- and intra-operative period that could be controlled, alone or together, in order to minimize the morbi-mortality of patients undergoing surgical procedures.

According to the results on Table 2, the mean body temperature on admission was 35.9°C. Another study found higher temperatures, in which after assessing 284 patients, 27 (9.5%) presented hypothermia (below 35.5°C). This result is attributed to the effects of the surgical anesthetic process, which is well-documented in literature. Furthermore, there was a variation between the pre-operative period (37°C) and PAR (36.4°C). These authors considered that there was a small 0.6°C variation attributed to the use of heating devices in the operating room\(^11\).

On the other hand, the mean body temperature at discharge from PAR was 36.1°C, with a minimum value of 33.3°C and maximum value of 37°C. These results suggest that while in PAR, the patients’ body temperature did not stabilize, confirming the literature findings about the effects of anesthetic agents, the low temperature of the environment and the flaws of heating protocols for surgical patients\(^11\).

At the studied hospital, patient heating during surgery, transportation and while in PAR complies with a rigorous protocol that establishes using a hot air insufflator (warming blanket), keeping the patient dry and protected throughout the entire anesthetic procedure until the post-operative period. Nonetheless, it was observed that some patients’ temperature was below 36°C at discharge from PAR. This suggests the procedures should be reviewed and there should be continuous training of those involved in this care process.

It is known that clinical parameters such as blood pressure, breathing, muscle activity, O\(_2\) saturation and consciousness were elected to comprise the Aldrete-Kroulik index, because the authors recognize them as representatives of the physiological systems that are altered by the anesthetic procedure. Ever since, this index is frequently used in PAR, in which a score 10 indicates the moment the patient can be discharged from the unit. This score is translated as the stability of the patients’ vital signs, their regaining consciousness, protective reflexes and muscular activity. However, it is emphasize that this assessment does not include the body temperature measurement, although it is stated that normothermia is important for patient discharge, as well as the effect of non-induced hypothermia in possible post-operative complications. Among these possibilities are the surgical site infection, diminished collagen and platelet function, in addition to a delayed drug metabolism\(^{12-13}\). Other studies report the presence of adverse events in PAR caused by hypothermia, which can be cardiovascular (dysrhythmias, hypertension, hypotension), respiratory (bronchospasm, hypoxia)\(^14-15\).

A study identified a small percentage of complications among patients in PAR, but the authors referred that this result should be reviewed, and suggest making a clearer use of the word complication by the whole nursing team\(^16\).

Shivering is a common complication, which requires greater oxygen consumption. This alteration is confronted by the results of a study performed with 300 patients, in which eight (2.7%) presented shivering and body temperature between 35.2°C and 37°C, while patients with temperatures below 35.2°C did not present this sign. The authors state the importance of the presence or absence of shivering as an indication of hypothermia, because shivering is not always exclusively associated with a low body temperature, as they can also result from the anesthesia (subarachnoida), because they reheat slower that patients who received general anesthesia, as muscle weakness and vasodilatation persist\(^9,10\).

Although the patients’ mean body temperature at discharge was 36.1°C, a significant variation (p = 0.023) occurred between the minimum (33.3°C) and maximum (37°C) temperatures at discharge.

In this view, it is observed, respectively, in Tables 2 and 3, that even though patients did not reach normothermia (36.7°C) and a score 10, eight patients (13.3%) were discharged from PAR, despite the fact that no statistically significant relationship was found between the Aldrete-Kroulik index and the patient’s body temperature (Table 4).

This result may be related to the fact that most patients were healthy or had a mild systemic diseases, had a stable pulse, blood pressure, motor activity, consciousness and oxygen saturation within the normal standards established by the index, which guided the discharge from PAR\(^11\).

Although no association was found between body temperature and the Aldrete-Kroulik index, it is highlighted that it is important to maintain normothermia for patient comfort, but also to avoid complications due to hypothermia, as stated earlier.
Therefore, it is understood that although the Aldrete-Kroulik index is frequently used and acknowledged for its proposition, it should not replace a critical judgment of a healthcare professional, particularly in terms of body temperature measurement for a safe discharge from PAR.

CONCLUSION

According to the present study results, no association was found between the patients’ body temperature and the Aldrete-Kroulik index at the two assessment times in post-anesthetic recovery.

The patients’ mean body temperature by tympanic measurement was lower on admission compared to the temperature at discharge from post-anesthetic recovery, just as most patients obtained a score 8 on the Aldrete-Kroulik index when admitted and a score 10 at discharge.

STUDY LIMITATIONS

It is suggested that the present study be repeated with a greater number of patients, although it was possible to apply the proposed statistical tests and a later analysis of the 60 patients that comprised the sample.

It is recommended to perform a control of the variables that could affect the temperature obtained in the Post-Anesthetic Recovery Room, for instance keeping patients warm between their transfer from the hospitalization unit to the operating room.

REFERENCES


