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Research Article

The Effect of Paracetamol Administration on Interleukin-6 Levels and the Incidence of Shivering in Cesarean Section Patients with Spinal Anesthesia

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ABSTRACT

Background: Cesarean section operation with spinal anesthesia is one of the most frequently performed surgical operations worldwide. Perioperative shivering is a problem that often happens during surgery with spinal anesthesia, with an incidence that can be up to 50%. Nevertheless, this shivering condition still receives less attention in the literature and daily clinical practice. Paracetamol lowers hypothalamic temperature set points to reduce postoperative shivering by centrally inhibiting prostaglandins. By lowering thermoregulatory set points and IL-6 levels, paracetamol has also been demonstrated to lessen postoperative stress.

Methods: This study was designed as a double-blind, randomized, controlled trial involving 34 participants randomly distributed between two groups. Group 1 (n=17) will receive paracetamol 15 mg/kg body weight, and group 2 (n=17) will receive 100 mL of 0.9% sodium chloride solution. Shivering is assessed using the Bedside Shivering Assessment Score at 0, 15, 30, 45, 60, and 120 minutes after injecting the drug into the subarachnoid space. Interleukin-6 (IL-6) levels will be taken by taking peripheral blood samples 3 times (1 hour before surgery, 1 hour after surgery, and 6 hours after surgery) and then examined using the Enzyme-Linked Immunosorbent Assay (ELISA) method in pg/dL.

Results: The statistical analysis showed no significant difference (P>0.05) in the IL-6 comparison between the paracetamol and control groups. However, compared with the control group, the paracetamol group's average IL-6 levels were lower. Statistical analysis revealed a significant difference (P = 0.038) in the incidence between those receiving paracetamol and those in control groups. The paracetamol group demonstrated a lower incidence of shivering (35.3%) than the control group (76.5%). Significant variations (P = 0.038) were also observed in the onset of shivering between the paracetamol and the control group. The paracetamol group experienced shivering at a later time (between minutes 45 and 120) than the control group (between minutes 30 and 60).

Conclusion: Administration of 15 mg/kg BW paracetamol significantly reduced shivering incidents, shivering onset, and the need for rescue pethidine compared to the control group that received 100 ml of 0.9% sodium chloride after a cesarean section with spinal anesthesia but did not significantly reduce IL-6 levels.

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Introduction

Cesarean section operation is one of the most frequently performed surgical operations worldwide. Spinal anesthesia is the preferred technique of anesthesia in elective surgery and emergency surgery because the process is fast, has minimal drug exposure to the fetus and mother, and consistently yields successful outcomes [1]. Perioperative shivering is a frequent issue during the surgical process with spinal anesthesia, with an incidence of up to 50% [1-3].

Nevertheless, this shivering condition still receives less attention in the literature and daily clinical practice. Perioperative shivering may cause adrenergic stimulation and increased plasma catecholamine levels, leading to tachycardia and higher cardiac output. It also causes an increase in metabolism, two to three times the oxygen consumption rate, causing hypoxemia and increased carbon dioxide production. In addition, this condition is less comfortable for the birthing mother and can have an impact on her experience of giving birth [2]. Shivering can interfere with oxygen saturation, blood pressure, and electrocardiographic monitoring. It may lead to increased intraocular pressure and intracranial pressure [1].

The process of shivering during cesarean section surgery under neuraxial anesthesia is currently still not known with certainty. One mechanism thought to contribute to shivering includes heat redistribution resulting from vasodilatation due to spinal anesthesia and oxytocin use, all related to the development of hypothermia. Additional contributing factors include the cold ambient temperature of the operating room, the use of unwarmed intravenous fluids, and the application of the neuraxial anesthesia technique [2].

Paracetamol is commonly used as an analgesic for cesarean section operations. However, its role in postoperative prevention has not been further studied. Paracetamol lowers hypothalamic temperature set points to reduce postoperative shivering by centrally inhibiting prostaglandins. According to a recent study, when intravenous paracetamol was given 30 minutes before surgery, as opposed to when it was given after anesthesia was induced or not given, there was a decreased incidence of postoperative hypothermic shivering and hypothermia. Stress after surgery can raise postoperative thermoregulatory set points, which are linked to elevated levels of interleukin-6 (IL-6). It has also been demonstrated that paracetamol lowers postoperative stress by lowering thermoregulatory set points and IL-6 levels [4].

The objective of this study is to assess the effect of paracetamol administration on IL-6 levels and the incidence of shivering among patients undergoing cesarean section with spinal anesthesia.

Methods

This study was undertaken following approval from the Ethics Commission of Biomedical Research on Humans at the Faculty of Medicine, Hasanuddin University, with number 1040/UN.4.6.4.5.31/PP36/2024. It utilized a double-blind, randomized controlled trial design. The participants were patients scheduled to undergo a cesarean section utilizing spinal anesthesia as the anesthetic technique in the central surgical room of Dr. Wahidin Sudirohusodo Hospital and its teaching network hospitals. Participants were selected through a random sampling method to select the sample from the population that met the study's inclusion criteria. Subjects following inclusion criteria were enrolled: mothers aged 18 to 40 years, a body weight of 50 to 70 kg, a height of 150 to 170 cm, a body mass index (BMI) of 18.5 to 29.9 kg/m², and only patients classified as American Society of Anesthesiologists (ASA) physical status classification of I or II were included. Patients were excluded from the study if they experienced anesthetic or surgical complications, had to convert from spinal anesthesia to general anesthesia during the procedure, or chose to withdraw from the study. Ultimately, the study included 34 participants who were divided equally into two groups. Group 1 (n=17) will receive paracetamol 15 mg/kg body weight (BW), and group 2 (n=17) will receive 100 mL of 0.9% sodium chloride. Shivering events were assessed using the Bedside Shivering Assessment Score at 0, 15, 30, 45, 60, and 120 minutes after injecting the drug into the subarachnoid space. Interleukin-6 (IL-6) levels will be taken by taking peripheral blood samples 3 times (1 hour before surgery, 1 hour after surgery, and 6 hours after surgery) and then examined using the Enzyme-Linked Immunosorbent Assay (ELISA) method in pg/dL. Rescue shivering with pethidine 25 mg/IV is given if the shivering score is above ≥ 3.

Data analysis using SPSS 26 for Windows and appropriate statistical tests. To assess whether the data followed a normal distribution, the Shapiro-Wilk test was applied. Numerical data were displayed with the mean ± standard deviation and analyzed with an unpaired t-test when the distribution was confirmed normal or displayed with the median (min-max). For data with a non-normal distribution, comparisons were made with the Mann-Whitney U test. Categorical data are shown as frequencies (n) and percentages. Data were analyzed with the Chi-Square test; if cells are <5, Fisher's exact test will be performed. Correlation tests were performed with Pearson correlation if the data distribution is normal or

with Spearman correlation if the data distribution is abnormal.

Results

Characteristics

(Table 1) provides a comparison of key characteristics between the two groups. The two groups in this study have homogeneous characteristics.

Vital Signs

In this study, the patient's vital signs (systolic, diastolic, MAP, pulse, temperature) were measured in minutes at intervals 0 (T0), 15 (T1), 30 (T2), 45 (T3), 60 (T4), and 120 minutes (T5) after the drug was injected into the subarachnoid space. There were significantly different results in systolic (p = 0.033) and diastolic (p = 0.013) measurements at 15 minutes, where both systolic and diastolic blood pressure reduction was observed in the paracetamol group compared with the control group. In other measurements, the two groups had no significant difference in systolic and diastolic values (Figure 1). Meanwhile, the MAP did not differ significantly between the two groups.

In this study, there were significantly different results in pulse measurements at minute 0 (p = 0.032) and minute 45 (p = 0.034), where the pulse was higher in the paracetamol group at minute 0, and the pulse was lower in the paracetamol group at minute 45. In other measurements (30, 60, and 120 minutes after the drug was injected into the subarachnoid space, statistical analysis revealed no significant difference between the two groups.

In this study, there were significantly different results in temperature measurements at minute 30 (p = 0.002), where the temperature was higher in the paracetamol group. In other measurements (minutes 0, 15, 45, 60, and 120 after the drug was injected into the subarachnoid space), the two groups did not differ significantly according to statistical findings (Figure 2).

Interleukin-6 (IL-6)

In this study, IL-6 levels were measured 1 hour prior to surgery (T0), 1 hour after surgery (T1), and 6 hours after surgery (T2). (Table 2) compares IL-6 levels at the three measurement times and shows changes in IL-6 levels. The comparison of the IL-6 levels between the paracetamol and the control group is not significant. The average IL-6 levels were found lower among subjects treated with paracetamol than those given a placebo.

Table 1- Demographic data

Variables	Group 1 (n=17)	Group 2 (n=17)	P value
Age (years)	33 (28-43)	25 (18-41)	0.152^{ns}
Body weight (kg)	69.12 ± 3.3	68.76 ± 2.4	0.726^{ns}
Height (cm)	164.12 ± 4.4	162.76 ± 4.5	0.389^{ns}
BMI (kg/m2)	25.6 ± 0.81	25.9 ± 1.09	0.355^{ns}
ASA PS class 2	17 (100)	17 (100)	-
Duration of surgery (minutes)	90 (75-90)	90 (80-90)	0.348^{ns}

BMI: body mass index; ASA PS: American Society of Anesthesiologists physical status. *: significantly different; ns: no significant difference (not significantly different)

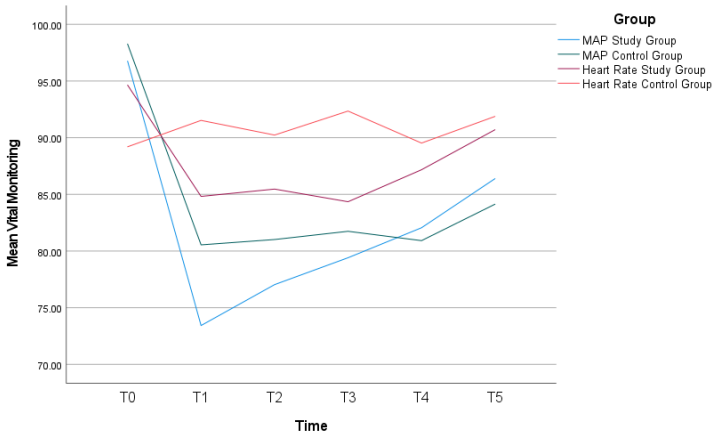

Figure 1- MAP and heart rate monitoring in each group

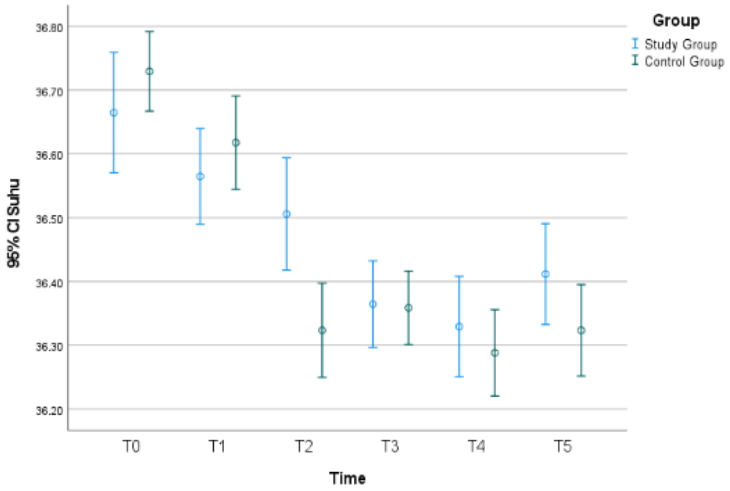

Figure 2- Temperature monitoring in each group

Table 2- Comparison of IL-6 levels between groups 1 and 2.

Measurement time	Group	IL-6 (pg/dL)	P
T0	1	47.7 ± 11.3	0.407^{ns}
	2	53.6 ± 14.9	
T1	1	50.4 ± 9.3	0.172^{ns}
	2	56.2 ± 14.3	
T2	1	51.9 ± 14.2	0.882^{ns}
	2	56.3 ± 46.80	
T1-T0	1	9 (0-29)	0.41^{ns}
	2	11 (0-42)	
T2-T0	1	7 (1-41)	0.549^{ns}
	2	14 (1-26)	

*: significantly different; ns: no significant difference

Shivering Event

Shivering incidence was evaluated based on the Bedside Shivering Assessment Score (BSAS) at minute 0 (T0), minute 15 (T1), minute 30 (T2), minute 45 (T3), minute 60 (T4), and minute 120 (T5) after the drug was injected into the subarachnoid space. (Table 3) compares the incidence of shivering.

Table 3- Comparison of shivering incidence between groups 1 and 2.

	Shivering Incident		P
Group	No Shivering	Shivering	0.038*
1	64.7% (11)	35.3% (6)	
2	23.5% (4)	76.5% (13)	

*: significantly different; ns: no significant difference

This study compared the incidence of shivering between the paracetamol and the control groups and was significantly different. Shivering was lower in the paracetamol group (35.3%). The onset of shivering in the paracetamol group and the control group that experienced shivering also showed significant differences (Table 4), where the paracetamol group experienced shivering at a later time (between minutes 45 and 120) than the control group (between minutes 30 and 60).

Table 4- Comparison of shivering onset between groups 1 and 2 who experienced shivering events.

Group	Time of first shivering (minutes)	P value
1	60 (45-120)	0.038*
2	45 (30-60)	

*: significantly different; ns: no significant difference

Statistical evaluation revealed no significant difference in the scores for shivering between the paracetamol and the control groups, which experienced shivering. However, patients who experienced shivering with a score of 3-4 in the paracetamol group (16.6%—2 patients) were lower than the control group (83.3%—10 patients).

(Tables 5 and 6) show the correlation between shivering scores and body temperature in both groups. A significant negative correlation was found between the shivering scores and body temperature of the paracetamol group at 45 minutes and 60 minutes, where an increase in temperature significantly decreased the shivering score.

(Tables 7 and 8) show the correlation between shivering scores and IL-6 in both groups.

Needs of Rescue Shivering (Pethidine 25 mg/IV)

The need for rescue measures differed significantly between the study groups (Table 9), where the need for rescue shivering was comparatively lower in the paracetamol group. The time of giving the first rescue shivering in patients given pethidine also demonstrated a statistically significant difference between the two groups (Table 10), where the time of giving the first rescue shivering occurred later in the paracetamol group.

Table 5- Correlation of shivering incidence scores with body temperature in group 1.

Measurement time	Shivering score	Temperature	rs	P
T0	0	36.66 ± 0.18	-	-
T1	0	36.56 ± 0.15	-	-
T2	0	36.51 ± 0.17	-	-
T3	0.17 ± 0.52	36.3 ± 0.13	-0.538	0.026*
T4	0.3 ± 0.8	36.3 ± 0.15	-0.508	0.037*
T5	0.2 ± 0.7	36.4 ± 0.15	-0.393	0.119^{ns}

*: significantly different; ns: no significant difference.

Table 6- Correlation of shivering incidence scores with body temperature in group 2.

Measurement time	Shivering score	Temperature	rs	P
T0	0	36.73 ± 0.12	-	-
T1	0	36.62 ± 0.14	-	-
T2	0.9 ± 1.7	36.32 ± 0.14	-0.467	0.059^{ns}
T3	0.5 ± 1.17	36.3 ± 0.13	-0.443	0.075^{ns}
T4	1 ± 1.5	36.2 ± 0.13	0.52	0.84^{ns}
T5	0.11 ± 0.4	36.3 ± 0.13	-0.135	0.60^{ns}

*: significantly different; ns: no significant difference.

Table 7- Correlation of shivering incidence scores with IL-6 in group 1.

Measurement time	Shivering score	IL-6	rs	P value
T4	0.3 ± 0.8	50.41 ± 9.39	-0.136	0.602^{ns}

*: significantly different; ns: no significant difference. IL-6: interleukin-6.

Table 8- Correlation of shivering incidence scores with IL-6 in group 2.

Measurement time	Shivering score	IL-6	rs	P value
T4	0.3 ± 0.8	56.2 ± 14.3	-0.090	0.731^{ns}

*: significantly different; ns: no significant difference. IL-6: interleukin-6.

Table 9- Comparison of rescue shivering administration between groups 1 and 2.

	Rescue Shivering Administration						P value
Group	T0	T1	T2	T3	T4	T5	0.04*
1	0	0	0	0	11.8%	5.9%	
2	0	0	23.5%	11.8%	23.5%	0	

The chi-square kxk test *: significantly different; ns: no significant difference (not significantly different)

Table 10- Comparison of the time of administration of the first rescue shivering between groups 1 and 2, which were given rescue shivering.

Group	Time to administer the first rescue shivering (minutes)	P value
1	60 (45-120)	0.047*
2	45 (30-60)	

*: significantly different; ns: no significant difference

Incident of Side Effects (Nausea, Vomiting, Restlessness, Allergy)

Neither group experienced any side effects.

Discussion

Vital Signs

The patient's vital signs in this study (systolic, diastolic, and MAP) are similar to the study conducted by

Hamid et al., which reported a statistically significant difference in diastolic values at 15 minutes, where the diastolic value was lower in patients given 10 mg/kg BW paracetamol compared to patients given 100 mL of normal saline before cesarean section. Likewise, Hamid et al. stated that the systolic value at 15 minutes in the paracetamol group exhibited lower values than the control group, although not significant [5]. NQ et al. reported no statistically significant difference in patient vital signs (systolic, diastolic, and MAP). However, intraoperatively, it fluctuated between patients who administered 100 mL of paracetamol and those who received 100 mL of normal saline during myomectomy surgery [6]. However, Przybyła et al. reported that administering paracetamol at a regular dose (up to 4 grams/day in adults or 60 mg/kgBW/day) could cause a slight increase in systolic [7].

The patient's pulse differs from a previous study by Hamid et al., which reported no statistically significant difference in pulse values in patients given 10 mg/kg BW paracetamol compared to 100 mL of normal saline before cesarean section [5]. NQ et al. also demonstrated no statistically significant difference in pulse between patients who were administered 100 mL of paracetamol and those who received 100 mL of normal saline during myomectomy surgery [6].

Patient's temperature in this study differs from a study by Mohta et al., which indicated that there was no measurable difference in body temperature during induction of anesthesia, minutes 15, 30, 45, and 60, and after surgery was completed between groups that received paracetamol 15 mg/kg BW (max 1 gram) after induction of anesthesia, received paracetamol 15 mg/kg (max 1 gram) 30 minutes before surgery was completed, and received normal saline during surgery with general anesthesia during elective surgery [8]. Ularangkura et al. also demonstrated no statistical difference in body temperature during pre-anesthesia, 30 minutes after anesthesia induction, after surgery, and during the initial examination in the PACU between groups that received paracetamol 15 mg/kg BW or 1000 mg and groups that received 100 mL of normal saline during cesarean section with spinal anesthesia [9].

Interleukin-6 (IL-6)

In comparison with earlier research by Nugroho et al., there is a significant difference that was observed between the groups given 0.125% epidural bupivacaine + 1000 mg IV paracetamol and the control group of 0.125% epidural bupivacaine after lower limb orthopedic surgery, where IL-6 levels were lower in the group given paracetamol [10].

This study's findings align with a study by Gazali et al. The study reported that the cohort administered 400 mg IV ibuprofen alongside 1000 mg IV paracetamol following the third molar omentectomy surgery exhibited a significant reduction in IL-6 levels from preoperative to 24 hours post-operatively. Nevertheless, there was no discernible change in IL-6 levels between the preoperative and 24-hour postoperative periods in the group that only received 1000 mg IV. This implies that IL-6 levels are not significantly reduced by paracetamol alone [11].

Interleukin-6 (IL-6) is crucial in shaping local and systemic inflammatory responses. Elevated levels of IL-6 following surgery indicate the extent of the inflammatory response and can signal potential excessive inflammation and negative outcomes. Serum IL-6 levels are widely recognized as biomarkers of surgical inflammation, demonstrating a consistent increase following operative trauma, increasing 1 to 3 hours after the procedure, peaking between 4 and 24 hours postoperatively, and persisting at elevated levels for 48 to 72 hours. Generally, the more significant the surgical trauma, the higher the serum IL-6 response will be [10]. However, literature studies suggest that paracetamol does not have the significant anti-inflammatory activity associated with classic COX-1 inhibitors such as aspirin [7]. A recent study suggests that the weak anti-inflammatory effect of paracetamol is linked to its role as a reducing agent associated with COX-1 and COX-2 enzymes. Paracetamol is structurally classified as a phenolic compound, and phenol is recognized for its effectiveness as a reducing agent. When paracetamol acts as a reducing agent, it reduces intracellular lipid hydroperoxides, which reduce COX-1 and COX-2 to an enzymatically inactive state. This process ultimately decreases prostaglandin synthesis. However, during inflammation, elevated levels of peroxides can inhibit the reducing action of paracetamol, resulting in a diminished anti-inflammatory effect [12].

Shivering Event

Findings from this study about shivering events are similar to a previous study by Chowdhary et al., which reported a notable statistical difference in the incidence of shivering between the group receiving 1000 mg paracetamol and the group receiving 100 mL of normal saline in abdominal surgery. Chowdhary et al. reported within the first-hour post-surgery in the recovery room, the paracetamol group showed a markedly lower incidence of shivering than the normal saline group, with 33 patients (50.76%) exhibiting shivering at levels 3 or 4 in the normal saline group. However, only nine patients (13.84%) reached level 3 to 4 shivering in the paracetamol group [13]. Mohta et al. stated that intravenous paracetamol administration 30 minutes before surgery was completed resulted in a significantly lower incidence of shivering than paracetamol administration after induction of anesthesia or without paracetamol. In their study, Mohta et al. state that the incidence of shivering in the intravenous paracetamol

group 30 minutes before surgery was nine incidents, the intravenous paracetamol group after anesthesia induction was 22 incidents, and the control group was 23 incidents. Patients who experienced shivering scores of 3-4 in the intravenous paracetamol group 30 minutes before surgery had seven incidents; the intravenous paracetamol group after anesthesia induction had 20 incidents, and the control group had 19 incidents [8]. According to a study by Kinjo et al., patients having elective gynecological laparotomies under spinal or general anesthesia experienced significantly less severe postoperative shivering (defined as a shivering score greater than 3) in the post-anesthesia care unit in the paracetamol group (22.2%) compared to the placebo group (73.7%) [14]. However, the findings in this study differ from the study by Ularangkura et al., which suggests that the comparison between the groups did not yield a significant difference between the 1 gram paracetamol group and the normal saline group in reducing the incidence of shivering in cesarean section with spinal anesthesia, which was possibly caused by postoperative patient warming [9].

This study's correlation between shivering scores and body temperature in both groups aligns with previous studies. Hypothermia is the most common cause of postoperative shivering. Shivering is linked to pain management, surgical stress, and recuperation following inhalation anesthesia, even though it can happen in normothermic patients. Shivering is a response to peripheral vasoconstriction in hypothermic individuals, which aims to raise body temperature. [13].

Mohta et al. stated that the group with the highest incidence of intraoperative hypothermia also experienced a higher incidence of shivering. In the intravenous paracetamol 30 minutes before surgery, the incidence of hypothermia was 60%, and experiencing shivering with a score of 3-4 was 26.6%; in the intravenous paracetamol group after anesthesia induction, the incidence of hypothermia was 50.6%, and experiencing shivering with a score of 3-4 was 9.3%, and the control group the incidence of hypothermia occurred in 60% participants and experiencing shivering with a score of 3-4 was 25.3%. However, Mohta et al. did not conduct statistical testing on the incidence of hypothermia and shivering scores [8].

A study by Kinjo et al. found that the rates of perioperative hypothermia and measured body temperature did not significantly differ between the group receiving 15 mg/kg body weight of paracetamol and the control group given 0.9% normal saline during gynecological laparotomy under general anesthesia. This lack of difference may be due to the effectiveness of perioperative warming devices in maintaining body temperature within the normal range. Kinjo et al. emphasized that safe perioperative warming is crucial in preventing accidental hypothermia and reducing the risk of postoperative infections in patients receiving intraoperative paracetamol. Therefore, further research is needed to resolve whether perioperative paracetamol might increase the incidence of postoperative infections and unintentional hypothermia [14].

In their study, Shirozu et al. found that paracetamol lowers the shivering threshold, provides vasodilating effects, and increases skin blood flow. However, patients who received paracetamol (n = 268) had significantly lower peripheral temperatures after surgery than those who did not receive paracetamol (n = 173). Specifically, the temperatures were 34.7°C (31.8–35.9°C) for the paracetamol group and 35.7°C (34.2–36.5°C) for the non-paracetamol group, with a P value of less than 0.001. These results imply that a potential preventive effect of paracetamol on shivering may primarily stem from its ability to lower the shivering threshold. Overall, paracetamol appears to help prevent shivering after surgery at low peripheral temperatures [15].

Meanwhile, this study shows no correlation between shivering scores and IL-6 levels. Theoretically, paracetamol may reduce postoperative shivering by inhibiting prostaglandins, which lowers the hypothalamic temperature set point. Surgical stress can raise the thermoregulatory set point postoperatively, linked to increased interleukin (IL)-6 levels [8].

Needs of Rescue Shivering (Pethidine 25 mg/IV)

Findings in this study are similar to Wahdan et al., which stated that the total pethidine dose required was significantly reduced in the paracetamol group (42.50 ± 8.80) compared to the saline group (52.39 ± 14.53), who underwent liposuction surgery with a combination of epidural and general anesthesia.

Wahdan et al. also stated that patients who did not need shivering therapy were significantly lower in the paracetamol group [16]. However, another study by Hamid et al. stated that there was no statistically significant difference observed in the dose of pethidine used by the paracetamol group and the normal saline group, although the dose used in the paracetamol group (34.78 ± 12.47) was lower than the saline group (40.53 ± 58.12) [5].

Incident of Side Effects (Nausea, Vomiting, Restlessness, Allergy)

In this study, neither group experienced any side effects. Hamid et al. also stated that there was no statistically significant difference in the incidence of nausea and vomiting between the paracetamol group and the saline group after cesarean section with spinal anesthesia [5]. The study by Chowdhary et al. also stated that nausea and vomiting incidence did not differ significantly between the paracetamol and normal saline groups after abdominal surgery with general anesthesia [13]. Nq et al. stated that there was no statistically significant difference in drug side effects (nausea,

vomiting, itching, and drowsiness) between the paracetamol and the normal saline groups in myomectomy surgery [6].

Limitations

This study has several limitations. This study did not consider the room temperature when measuring patients' temperature and shivering scores. IL-6 level measurements were carried out three times (1 hour before surgery, 1 hour after surgery, and 6 hours after surgery), and blood samples were not taken when the patient experienced shivering.

Conclusion

In this study, 15 mg/kg BW paracetamol administration significantly reduced shivering incidents and the need for rescue pethidine compared to 100 mL of 0.9% sodium chloride after a cesarean section with spinal anesthesia. Also, 15 mg/kg BW paracetamol did not significantly reduce IL-6 levels compared to the control group after the cesarean section with spinal anesthesia. There were no side effects in either group.

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