



The relationship between operation duration and shivering in post-spinal anaesthesia patients

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ABSTRACT

Background: Giving spinal anaesthesia is an effort to relieve pain to create optimal conditions for surgery operation consciously. A shivering event frequently follows the phenomenon of the long duration of the operation.

Purpose: The study aimed to determine the relationship between operation duration and shivering in post spinal anaesthesia patients.

Methods: The study design is a quantitative study and uses a cross-sectional approach. Sampling used a systematic sampling technique on the population of patients undergoing surgery under spinal anaesthesia. The instrument used Croessley and Mahajan's observation sheet. This study uses Spearman rank rho as the statistical test with a significant value of $p=0.05$.

Results: The study showed almost respondents, as many as 86.15 respondents (56 patients) experienced shivering. Based on the Spearman statistical test, the p -value is 0.046.

Conclusions: It can be concluded that there was a relationship between operation duration and incidence of shivering. Therefore, to reduce the occurrence of shivering, it is necessary to take measures such as giving warm blankets, warm fluids, and tools to maintain body temperature (force air warming).

Keywords: operation duration; shivering; spinal anaesthesia

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INTRODUCTION

Technological advances have developed health services, especially in terms of anaesthesia and surgery. Anaesthesia is an effort to relieve pain consciously (spinal anaesthesia) or unconsciously (general anaesthesia) to create optimal conditions for surgery (Widiyono, et.al., 2020). Anaesthesia is the loss of all modalities of sensation, including pain sensation, touch, temperature, and position. It is divided into general anaesthesia, regional anaesthesia, and local anaesthesia. Spinal anaesthesia is the administration of local Anaesthetic drugs into the subarachnoid. It is widely used for surgical procedures in the 21st century (le Roux, et.al., 2022).

Widiyono et.al., (2020) states that spinal anaesthesia is widely used in various surgical procedures, with more than

Nursing and Healthcare Practices

- *Shivering among patient with post-spinal anaesthesia should be a concerned by nurses and other health care team.*
- *Optimization operation duration could prevent the shivering condition.*
- *Tight observation post-spinal anaesthesia should be a critical point for nurses.*

80% of operations performed using spinal anaesthesia techniques. Spinal anaesthesia is still the main choice for cesarean sections, abdominal surgery, and lower extremities because it makes the patient still conscious, then faster recovery period and quick mobilisation (Mashitoh, et.al., 2018). The recovery period after spinal anaesthesia is an important time for physiological stress in many patients. In addition to having advantages, spinal anaesthesia can cause complications (Winarni, 2020).

Post Anaesthetic Shivering (PAS) incidence in spinal anaesthesia patients amounts to 33-56.7%. It can occur due to several factors, including cold environmental exposure, ASA physical status, age, nutritional status and low body mass index, gender, and duration of surgery. In addition, the long duration of surgery causes longer Anaesthetic time. This condition will increase exposure duration to cold temperatures, more Anaesthetic agents, and prolonged use of drugs or Anaesthetic agents (Mashitoh, et.al., 2018).

Shivering is often encountered in anaesthesia, both spinal anaesthesia and general anaesthesia. After giving spinal anaesthesia, shivering usually occurs in the intraoperative and postoperative periods. The incidence varies wildly between 5% to 65%. Shivering causes detrimental physiological effects such as peripheral vasoconstriction, increased oxygen demand compensation up to five times, resulting in increased carbon dioxide production, decreased arterial oxygen saturation, decreased drug metabolism, interfered clotting factors formation, decreased immune response, impaired wound healing, increased protein breakdown and ischemic

heart muscle (Prasetyo et.al., 2017).

The number of patients undergoing spinal anaesthesia at Anaesthesia Installation of Saiful Anwar Hospital Malang every month is about 65 patients. As 40 patients of whom experienced hypothermia. Patients who experience hypothermia have variations in the length of surgery and surgical cases, including urological surgery, digestive surgery, gynaecological surgery and orthopaedic surgery. Based on interviews with nurses on duty at Anaesthesia Installation in January, there were 65 patients with spinal anaesthesia. Moreover, data showed shivering was still relatively high, with the duration of surgery between 30 minutes to more than 120 minutes. Based on clinical data, five out of ten patients (50%) underwent surgery with spinal anaesthesia experienced shivering.

Practical nursing care to overcome shivering after spinal anaesthesia needs to be carefully prepared, especially before major surgery, which lasts more than 1 hour (60 minutes). Improving hemodynamics, metabolism and maintaining body temperature is the best approach (Syauqi et.al., 2019). In addition, according to Winarni (2020) non-pharmacological approaches can be carried out by heating methods, including blanket warmers, oxygen humidification, and heating of intravenous fluids. Intervention to prevent hypothermia and shivering with a non-pharmacological approach is called rewarming technique (Ekorini & Lumadi, 2021). Shivering is usually triggered by hypothermia related prolonged duration of surgery. However, it occurs even in normothermic patients during the perioperative period. The aetiology of shivering has been understood insufficiently. Another potential mechanism is pain and acute opioid withdrawal (especially with short-acting narcotics). Besides, that shivering is poorly understood, and the gold standard for treatment and prevention has not been defined yet. Perioperative hypothermia prevention is the first method to avoid shivering (Lopez, 2018).

From the description above, shivering can occur due to a long duration of surgery, spontaneously causing more prolonged Anaesthetic action. Besides, that shivering can also cause other side effects such as discomfort and pain. Therefore, this study determined the relationship between the length of surgery and the incidence of shivering in post-anaesthesia patients.

METHOD

Design

The study design was a descriptive-analytic method with a cross-sectional design.

Sample and Setting

The population was all patients who underwent surgery with spinal anaesthesia. The study occurred in October 2021 as 65 patients at the Anaesthesia Installation of dr. Saiful Anwar Hospital. Sampling technique using probability sampling with systematic sampling technique, sample selected by inclusion and exclusion criteria as follows:

Inclusion Criteria

- Patients undergoing moderate to long-term surgery under spinal anaesthesia.
- Male and female gender.
- Age 18-55 years.
- Physical status (American Society of Anesthesiologists) 1 and 2
- Did not receive antipyretic premedication

Exclusion Criteria

- Patients with decreased consciousness.
- Patients taking medications that potentially affect thermoregulation (e.g., Clonidine, phenothiazine, meperidine).

Variables

Independent variable was the duration of the operation. The dependent variable was shivering incidence in post-spinal anaesthesia.

Instruments

Instruments used an observation sheet of operation duration and the Modified Crossley and Mahajan Scale.

Data Collection

Data collection was carried out by researchers and enumerators (anaesthetist nurses and anesthesiologist interns). In addition, enumerator training has been carried out to equalise perceptions while implementing data collection.

Data Analysis

The statistical test used the spearman rho correlation test. Level of significance or confident interval (CI) 95% or = 0.05.

Table 1. Characteristics of respondents (n=65)

Characteristics	n	%
Gender		
Male	34	52.31
Female	31	47.69
Age		
18 - 35 years	28	43.08
36 - 45 years	13	20.00
46 - 55 years	24	36.92

Table 2. Criteria of operation duration (n=65)

Criteria	n	%
Short time (<60 minutes)	0	0.00
Moderate (60-120 minutes)	47	72.31
Long-time (>120 minutes)	18	27.69

Table 3. Criteria of shivering incidence (n=65)

Criteria	n	%
None	9	13.85
Shivering	56	86.15

Ethical Consideration

This study has passed the research ethics test by the Health Research Ethics Committee of dr. Saiful Anwar Malang Hospital and has received approval number: 400/195/K.3/302/2021 on October 2, 2021.

RESULTS

Based on [table 1](#), most respondents were male amount 34 patients (52.31%). Most respondents were in the 18-35 years age range as 28 (43.08%) patients. Results showed most of the respondents as 47 patients (72.31%) with operation duration between 60-120 minutes (moderate) ([Table 2](#)). Results showed that almost all respondents, 86.15% of respondents (56 patients), experienced shivering and only 13.85% of respondents (9 patients) did not experience shivering ([Table 3](#)). Based on [table 4](#) amount 38 respondents (80.85%) who experienced shivering underwent surgery in the moderate category (60-120 minutes).

[Table 5](#) shows the p-value was $0.046 < 0.05$, which means H1 was accepted. Therefore, it can be concluded that there is a significant relationship between operation duration and shivering incidence in the Anaesthesia Installation of dr. Saiful Anwar Malang Hospital. The strong relationship between the two

Table 4. Cross-tabulation of operation duration with shivering incidence

Operation Duration	Shivering Incidence		Total
	None n (%)	Shivering n (%)	
Moderate (60 -120 minutes)	9 (19.15%)	38 (80.85%)	47 (100%)
Long-time (>120 minutes)	0 (0.00%)	18 (100%)	18 (100%)

Table 5. Statistical test

	Shivering Incidence	p-value
Operation Duration	r = 0.248 sig = 0.046 n = 65	p < 0.05

variables was 24.8% (0.248), so it was declared a weak category. The association was positive synergies, longer duration of operation, and more frequent shivering occurring in the Anaesthesia Installation of dr. Saiful Anwar Malang Hospital.

DISCUSSION

Identification of Operation Duration in Post-Spinal Anaesthesia Patients

Spinal anaesthesia is a technique widely used in various surgical procedures, more than 80% of operations are performed using spinal anaesthesia techniques compared to general anaesthesia (Widiyono, et.al., 2020). Spinal anaesthesia techniques are still the main choice for cesarean sections, abdominal surgery, and lower extremities. This technique makes the patient conscious so that the recovery period is faster and can be mobilised more quickly. Based on the study result, the relationship between the length of surgery and incidence of shivering at Dr Saiful Anwar Hospital showed of 65 respondents, the majority were 47 respondents (72.31%) with the duration of operation between 60-120 minutes (moderate) and remaining 18 respondents (27.69%) with operating time > 120 minutes (long-time).

This study found many moderate surgery categories, including orthopaedic, obstetric, and gynaecological surgery. In addition, those are classified as long-time operations, namely digestive surgery and some orthopaedic cases, which are affected by significant surgery, complicated operations, profuse bleeding, decreased patient condition, and accumulation of Anaesthetic drugs.

Identification of Shivering Incidence in Post Spinal Anaesthesia Patients

Postoperative recovery is a time with a high risk of developing anaesthetic complications. Anaesthetic complications occurred in at least 2.5% of patients. One of the complications that often occur in general and regional anaesthesia is shivering. Post-anaesthesia shivering or post-anaesthesia shivering is a repetitive and involuntary muscle movement that aims to compensate for hypothermia caused by an excessive decrease in body temperature. Spinal anaesthesia causes vasodilatation, causing a redistribution of heat from the core to the periphery. Thus, hypothermia in spinal anaesthesia is caused by the redistribution of body heat from the core to the peripheral surface. In spinal and epidural anaesthesia, the threshold for vasoconstriction and shivering responses is reduced to 0.6°C, it higher than in general anaesthesia (Hidayah et.al., 2021).

Results of the study showed from 65 respondents, almost all respondents, amount 56 respondents (86.15%) experienced shivering. This study is in line with research (Mashitoh, et.al., 2018) in which more respondents experience shivering than those who do not. The incidence of shivering is also influenced by gender. The results of the odd ratio calculation show that women have a 3.2 times more risk of experiencing hypothermia than men. This can be influenced because in women, there is a lot of fat accumulation where shivering is mediated by fat tissue (Valencak, et.al, 2017)

Shivering is also influenced by several things, including age and weight, type and length of a surgical procedure causing temperature changes, operating room temperature (less than 20°C), the specific gravity of the drug solution used can reduce the vasoconstriction

threshold and increase the cold sensation threshold (Qi et al., 2022). Cold fluids will cause a decrease in temperature and an increase in the average cold sensation, this amount of bleeding causes the body to run out of fluids so it can cause hypothermia, and hypothermia is an early sign of shivering.

Analysis of Relationship between Operation Duration and Shivering Incidence

Post anaesthesia shivering causes discomfort and increases pain due to traction on the surgical wound. This repetitive muscle movement can also increase metabolic heat production to 500-600% of basal value, increase oxygen consumption and carbon dioxide production, cause lactic acidosis, increase heart rate, and trigger vasoconstriction, which causes increased vascular resistance. This will be a problem in patients with limited cardiopulmonary function. In addition, shivering disrupts the ECG monitoring, blood pressure, and oxygen saturation during surgery (Gunadi, et.al., 2015).

Results of the study indicate a p-value of $0.046 < (0.05)$, which means that H1 is accepted. Therefore, it can be concluded that there is a significant relationship between operation duration and shivering incidence. The strong relationship between the two variables is 24.8% (0.248) in the weak category. The relationship is positive synergy, higher duration of operation, and higher incidence of shivering in Anaesthesia Installation at Dr Saiful Anwar Hospital. Based on the analysis using the Spearman Rho test, there was a correlation between operation duration and incidence of shivering in patients after spinal anaesthesia. The study results align with this study Mashitoh, et.al., (2018), which shows a significant relationship between operation duration and the incidence of shivering in post-spinal anaesthesia patients at the Yogyakarta City Hospital.

Respondents who underwent major surgery (>60 minutes) experienced shivering. This is in line with Mashitoh, et.al., (2018), who stated that post-spinal anaesthesia shivering mostly occurred in respondents who underwent surgery with a duration of 61-120 minutes. Shivering is an unpleasant phenomenon that occurs during the perioperative period. Shivering has several harmful physiological

effects, such as increasing SVR, left shifting of oxygen saturation curve, changing mental status, impaired renal function, delayed drug metabolism, impaired wound healing, and increased risk of infection. Perioperative shivering can increase oxygen consumption by fivefold and may decrease arterial oxygen saturation associated with increased myocardial ischemia (Azam et al., 2018).

The action of spinal anaesthesia can eliminate the adaptation process and disrupt the physiological mechanisms of thermoregulatory function. Spinal anaesthesia also affects three thermoregulation elements: afferent input elements, regulation of signals in the central area and efferent responses, and shifts threshold for responses to vasoconstriction, shivering, vasodilation, and sweating processes. During anaesthesia, the thermoregulatory threshold is lower in geriatric patients when compared to younger patients, which is about 10°C . As a consequence, the patient's body temperature during surgery becomes poikilothermic. It will follow ambient temperature. Almost all anaesthetic drugs interfere with thermoregulatory responses. For example, lidocaine, bupivacaine, and tetracaine are the leading local Anaesthetic agents used for spinal blockade. Lidocaine is effective for 1 hour, and bupivacaine and tetracaine are effective for 2 to 4 hours. At the end of anaesthesia, lidocaine, bupivacaine, and tetracaine sometimes cause hypothermia to chills. This is due to the effects of anaesthetic drugs that cause thermoregulation disorders (Widiyono, et.al., 2020).

In this study, results showed a significant relationship between operation duration and incidence of shivering in the Anaesthesia Installation of dr. Saiful Anwar Hospital showed a p-value of $0.046 < (0.05)$, which means H1 is accepted, so it can be concluded that there is a significant relationship between operation duration and incidence of shivering. The strength of the relationship between variables is 24.8% (0.248), in the weak category. Therefore, the association is positive, longer duration of surgery, higher incidence of shivering at Anaesthesia Installation of dr. Saiful Anwar Hospital. It is caused by several factors, including length of surgical procedure, age and weight, type of operation, operating room temperature, specific gravity, drug solution, use of cold fluids, and amount of bleeding.

According to the researcher's assumption, shivering is experienced by patients due to

exposure to low temperatures in the operating room. Injured tissue during surgery can release pyrogenic substances, which can increase the onset point in the thermoregulatory system and induce post anaesthetic shivering. The more prolonged operation is carried out, the more post-anaesthetic shivering occurs. Another assumption is significant surgery (>60 minutes), following the theory that shivering is a response to hypothermia during surgery between blood and skin and core body temperature. Surgery with prolonged spinal anaesthesia increases the body's exposure to cold temperatures, causing changes in body temperature. Results showed a relationship between the surgery duration and posted anaesthetic shivering incidence.

The combination of spinal anaesthesia and operation duration causes a disturbance in regulating body temperature, which leads to a decreased body temperature, causing shivering. The risk of shivering is higher if the period of more extended surgery. It will increase the time of exposure to exposed cold temperatures and cause an accumulation of side effects of spinal anaesthesia (Lenhardt, 2018). This generally occurs in moderate or significant surgery requiring more than 1 hour (60 minutes). In addition to operation duration, high anaesthetic doses accelerate the onset of action and increase the duration of sensory and motor blockade. The greater possibility of systemic toxicity limits an increase in Anaesthetic dose. Anaesthesia decreases the core temperature by reducing the body's natural ability to regulate its body temperature. Spinal anaesthesia causes vasodilation which can increase blood flow to the skin resulting in increased heat loss. A high dose of anaesthetic can cause an increase in blockade level, which further increases vasodilating effect, thereby increasing the possibility of shivering (Hermanns et al., 2018).

Shivering is more common in women because the tolerance level of thermoregulation in women is lower than in men. Women's skin temperature is 1-2°C lower than men's. It is related to vasoconstriction, which is more clearly seen in women, thereby reducing arterial blood flow to extremities such as hands and feet so that women are more susceptible to cold injuries. In addition, the different distribution of body fat between women and men is also one of the causes increase risk of post Anaesthetic shivering because shivering is also mediated by fat tissue (Valencak, et.al.,

2017). In this study, patients who underwent surgery at dr. Saiful Anwar Hospital rarely used a heating blanket during the duration of the operation, the patient's body was more exposed to cold temperatures. The long duration of the surgery will cause more prolonged anaesthesia and increase the time exposed to freezing temperatures in operating room, thereby increasing the risk of shivering.

However, shivering does not occur in all patients with spinal anaesthesia because it is influenced by age and individual weight factors. In infants, children, and late adulthood to the elderly, shivering is mediated by fat tissue. While in adolescents and early adults, shivering is mediated through body heat which is influenced by the thyroid gland. As a result, the shivering threshold in older age is 1 degree Celsius lower (Levy & Leonard, 2022).

Reducing the occurrence of shivering complications in spinal anaesthesia can be carried out by pharmacological and non-pharmacological management. Pharmacological management often includes opioids, namely pethidine injection and ketamine administration (Ramanathan et al., 2022). Ketamine which is equivalent to pethidine prevents postoperative shivering. Meanwhile, non-pharmacological management can be carried out, including giving warm blankets, either electric or passive heating blankets in the form of cotton cloth to avoid releasing heat to the environment, giving warm fluids, and using medical devices/tools to increase body heat (forced air warming) (Lopez, 2018).

CONCLUSION

Based on the study it can be concluded there was a significant relationship between operation duration and incidence of shivering p value = 0.046 ($p < 0.05$). The strength of the relationship between the two variables is 24.8% (0.248). It is a weak category. The relationship is positive synergy, longer duration of surgery, the incidence of shivering in Anaesthesia Installation of dr. Saiful Anwar Hospital.

Based on study, it can be considered that patients who undergo surgery and experience shivering can use pharmacological therapy through consultation with the medical team and non-pharmacological treatments such as using warm blankets, warm fluids, use of devices to maintain body temperature and reduce more serious complications.

Results of the study are expected to use

as information material in the nursing field of dr. Saiful Anwar Hospital Malang. Nurse implementation more alert to patients at risk of shivering after spinal anaesthesia by conducting intensive observation during operation and immediately providing nursing care by providing warm blankets, warm fluids, and a device to maintain body temperature. It helps the patient to feel comfortable until the operation is complete.

Results of this study are expected to be used as information in developing research on factors that influence the incidence of shivering in post-spinal anaesthesia patients, such as the amount of bleeding and type of use. For further researchers, it is recommended to conduct research with additional variables such as age, gender and BMI (Body Mass Index) that affect the incidence of shivering and selected just in one type of surgery and increase the number of samples involved.

Declaration of Interest

None

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Data Availability

The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

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