



Cross-sectional Study

“The magnitude and associated factors of intraoperative shivering after cesarean section delivery under Spinal anesthesia”: A cross sectional study

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ABSTRACT

Background: Shivering is an involuntary, spontaneous, and repetitive contraction of the skeletal muscle and increases patients' discomfort, oxygen-consuming, wound infection; increased surgical bleeding, and morbid cardiac events. The aim of this study was to determine the magnitude and associated factors of intraoperative shivering after cesarean section delivery

Methodology: An institution-based cross-sectional study was conducted. A total of 326 willing patients were included in the study after obtaining ethical consent and we have used consecutive sampling techniques. Axillary temperature was recorded preoperatively and in the intra-operative period every 5 min. Descriptive statistics, cross-tabs, and binary logistic regression analysis were performed to identify the association shivering and independent variables. The strength of the association was presented using an adjusted odds ratio with a 95% confidence interval and a p-value < 0.05 was considered as statistically significant.

Results: The overall incidence of intraoperative shivering after cesarean section delivery under spinal anesthesia was 51.8% (95% CI: 46.3, 57.1). The majority of the patients who developed shivering were after 20 min of spinal anesthesia. In this study body temperature, mean arterial pressure of the patient, and duration of surgery were significantly associated with shivering.

Conclusion: In this study duration of surgery, hypothermia and hypotension were the independent associated risk factors for intraoperative shivering.

1. Introduction

Spinal anesthetic techniques are the most commonly indicated for cesarean section due to easy to administer, cheap, high success rate, lower maternal morbidity and mortality rates, and less neonatal depression compared with general anesthesia [1]. Shivering is one of the common problems with spinal anesthesia. And the incidence of shivering is greater than 55% after spinal anesthesia [2,3].

Shivering has frequent and undesirable complications and causes of discomfort and dissatisfaction in patients undergoing surgery and the incidence of shivering ranged in most studies 50%–60% [4–6]. Other studies also showed the incidence of post-anesthesia shivering ranges from 5% to 65% following general anesthesia and 55% after spinal anesthesia [7].

The etiology of shivering is not clearly understood, it may involve a combination of mechanisms, including modulation of thermoregulatory thresholds, changes in body heat distribution, reduction in body core temperature, and the cooling effect of the fluids injected into the

neurons axis [8]. Redistribution of body heat during spinal or epidural anesthesia typically decreases core temperature (0.5–1.0 °C) [9]. Shivering is an autonomic protective reflex mechanism that increases the generation of body heat through muscle contraction [10,11].

Shivering is an unpleasant, thoroughly discomforting, and frequent complication after surgery with many grades i.e. from a mild form of having skin eruptions to a severe form with generalized continuous skeletal muscle contractions. It can also interfere with the monitoring of electrocardiograms, blood pressure (BP), and oxygen saturation. It increases oxygen consumption, lactic acidosis, and carbon dioxide production, decrease patient satisfaction and increase discomfort ([12,13]). Shivering also increase the mortality and morbidity rate of patients with cardiovascular disease as it increases cardiac output and increases metabolic heat production up to 600% above basal levels (2 [14]).

There are prevention and management of shivering includes; either pharmacological or non-pharmacologic options. The intravenous and intrathecal route used for pharmacologic management and prevention of shivering like; intrathecal opioids like fentanyl, sufentanil, or

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perthidine, intravenous administration of tramadol, magnesium sulphate, and ketamine [11,15,16]. The non-pharmacological options include acupoint stimulation, warm fluid therapy, and covered with a warm blanket [17,18]. The severity of shivering classified into 4 groups based on muscular activities: 0, no shivering; 1, piloerection or peripheral vasoconstriction but no visible shivering; 2, muscular activity in only one muscle group; 3, muscular activity in more than one muscle group but not generalized shivering; and 4, shivering involving the whole body (2, 4, 12).

2. Methods

After institutional and ethical committee approval from the University of Gondar Hospital, College of Medicine and Health Sciences, a cross-sectional study design was conducted from September 01-December 30; 2020. Informed consent was taken from all patients. The article has been registered with the UIN of the research registry (7260) and the work has been also reported in line with the STROCSS criteria [19]. All patients that underwent cesarean section under spinal anesthesia were included by using a consecutive sampling technique. However, uncooperative patients, patients with impaired cognitive ability, patient refusal, patients who underwent epidural, combined spinal-epidural anesthesia, Psychological disorders, hypo- or hyperthyroidism, an initial body temperature $>38^{\circ}\text{C}$ or $<36^{\circ}\text{C}$ were excluded from this study. All patients were premedicated with an antiemetic (4 mg dexamethasone) and 10 mg metoclopramide before 30 min of surgery for the prevention of nausea and vomiting. The spinal anesthesia was done for all patients between lumbar 3 and lumbar 4 with 0.5% bupivacaine (2.5 ml). Patients' axillary temperature, pulse rate, and blood pressure were monitored and recorded every 5 min in the intra-operative period. The severity of shivering was also assessed by using the grade of shivering. We have got information from the chart, like patient age, weight, height, type of local anesthesia (LA), dose of LA, volume of LA, level of sensory block, volume fluid American Society of Anesthesiologists (ASA) status and duration of surgery were recorded.

2.1. Sample size determination

$$n = (Z \alpha/2)^2 p (1-p)/d^2$$

Where;

n = is the desired sample size; z = is standard normal distribution usually set as 1.96

(Corresponds to 95% confidence level); p = population proportion (26%, 0.26) and q which is $1-0.26 = 0.74$, d = degree of accuracy desired (marginal error is 5% (0.05))

$$n = (1.96)^2 \times (0.26 \times 0.74) / (0.05)^2$$

= 295.65–296. Then 10% contingency/non-response rate was added on 296

$$= 296 \times 10\% = 29.6-30$$

$$= 296 + 30 = 326, \text{ this was the total sample size.}$$

2.2. Data quality management

To ensure the quality of data, a pretest of the data collection was done on 5% of patients from the calculated sample size. But not included in the main study and the collected data were checked out for completeness, accuracy, and clarity. Two anesthetists were selected to collect the data after they got good training about techniques of data collection.

2.3. Data processing and analysis procedures

Data was collected using an interviewer administered, pre-coded, pre-tested, and semi-structured questionnaires. For this study, we have used the Epi-data version 4.2 and SPSS version 20 for data entry, cleaned, coding, entered, and analysis. A chi-squared test was used to determine associations between the predictor and each outcome variable. The association between dependent and independent variables was assessed by using binary and multiple logistic regressions. Texts, tables, and graphs were used for the presentation of descriptive analysis, and 95% confidence interval, adjusted odds ratio, and p-value were also computed to identify associated factors and to determine the strength of the association. P-value < 0.05 was considered statistically significant in this analysis.

3. Results

3.1. Socio-demographic and physical characteristics of the study participants

A total of three hundred twenty-six participants were included in this study with fulfilling the criteria. The study was conducted on all participants with a response rate of 100%.

The mean age of the patients was 28.1 with a standard deviation of 6.11 years old and also the mean height of the patients was 1.59 with a standard deviation of 0.07. In this study, 19 (60.4%) of the patients had an age between 18 and 30 years old and the remaining were above thirty. The minimum age of patients in this study was 18 years old and 43 years old was the maximum age. All patients were either ASA II or ASA III. The most frequent diagnosis for cesarean section was previous cesarean section (34.4%) with labor and the least one was cephalic pelvic disproportion (3.1%) (Table 1).

3.2. Incidence of intraoperative shivering

The overall incidence of intraoperative shivering after cesarean section delivery under spinal anesthesia in the current study was 51.8% (95% CI: 46.3, 57.1), Northwest Ethiopia; September 01 to, December 30, 2020 (Fig. 1).

Table 1

Socio-demographic characteristics of the study patients, who underwent cesarean section delivery under spinal anesthesia, North West Ethiopia; September 01 to, December 30, 2020.

Variable	Patients with shivering (n = 326)
Age (in years)	
18–30	197 (60.4)
31–43	129 (39.6)
BMI in(kg/m²)	
18.5–24.9 normal weight	109 (33.4)
25–29.9 over weight	132 (40.5)
30–40 (Obese)	85 (26.1)
ASA status	
ASA II	207 (63.5)
ASA III	119 (36.5)
Mean arterial pressure(mm hg)	59.11 ± 10.37
Axillary temperature (°C)	35.66 ± 0.67
Duration of surgery(minute)	64.12.14 ± 13.5
Indication of cesarean section	112 (34.4)
Previous cesarean section	88 (27)
Fetal distress	41 (12.5)
Malposition	27 (8.3)
Preeclampsia	22 (6.7)
Antepartum hemorrhage	14 (4.3)
Meconium cephalic pelvic disproportion	12 (3.7)
Others	10 (3.1)

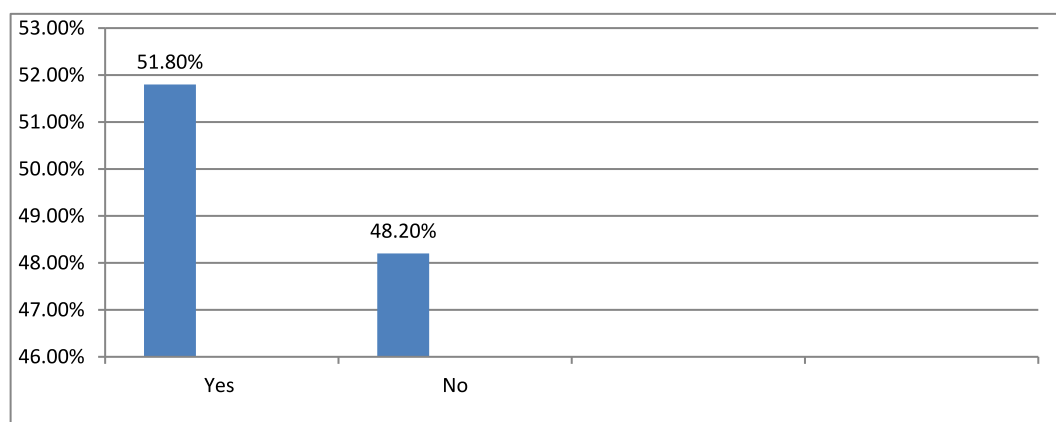


Fig. 1. Incidence of intraoperative shivering after cesarean section delivery under spinal anesthesia, Northwest Ethiopia from September 01 to December 30, 2020 (n = 326).

3.3. Onset and severity of shivering

In this study, 169 patients developed shivering after spinal anesthesia. The majority of patients were developed shivering after 20 min and more than 45% of patients were develop grade III shivering. However, only 5 patients were developed grade IV shivering (Table 2).

3.4. Factors associated with intraoperative shivering

Hosmer Lemeshow test of goodness of fit was used to check the appropriateness of the analysis model. Age, duration of surgery, does of LA, amount of fluid used, axillary temperature and blood pressure of the patients were associated with shivering in the bivariate logistic regression at p-value<0.2. However, variables like patients' age, dose of LA anesthesia and the amount of fluid used didn't associate with shivering. In this study axillary temperature, blood pressure of the patient, and duration of surgery were significantly associated with shivering in multivariate logistic regression at p-value<0.05.

In this study, hypothermia was significantly associated with the development of shivering. Hypothermic patients were ten times more likely to develop shivering than non-hypothermic patients [AOR = 10.3; (95%CI: 5.75, 18.29) and p-value<0.0001] (Table 3).

In addition to this, there was a significant association between hypotension and the outcome variable so our result showed that hypotensive patients were five times more likely to develop shivering than patients, which were normotensive [AOR = 4.6;(95%CI:2.6,8.27) and p-value<0.0001](Table 3).

Duration of surgery was also one of the associated factors for shivering in our study, and long surgeries which took greater than 60 min were three times more likely to develop shivering than short surgeries which were less than 60 min [AOR = 3.3, (95%CI:2.9,11.3) and p-value<0.0001](Table 3).

Table 2

Onset and Severity of intraoperative shivering after cesarean section delivery under spinal anesthesia, Northwest Ethiopia; September 01 to, December 30, 2020 (n = 326).

	Frequency	No. (%)
Onset of shivering	<5 min	25 (14.8)
	6–20 min	57 (33.7)
	>20 min	87 (51.5)
Grade of shivering	I	21 (12.1)
	II	68 (39.3)
	III	79 (45.7)
	IV	5 (2.9)

Table 3

Bivariate and multivariate logistic binary regression analyses result: associated factors of intraoperative shivering after cesarean section delivery under spinal anesthesia, Northwest Ethiopia; September 01 to, December 30, 2020.

Variables	Intraoperative Shivering		OR (95%CI)		
	Yes n (%)	No n (%)	Crude OR (95%CI)	Adjusted OR (95%CI)	p-value
Mean arterial pressure	57 (38)	93 (62)	1 ^a	1 ^b	P < 0.0001
≥65mmhg (Normotensive)	112 (63.6)	64 (36.4)	2.9 (1.8,4.5)	4.6 (2.6,8.3)	
<65mmhg (Hypotensive)					
Axillary Temperature	38 (25.7)	110 (74.3)	1 ^a	1 ^b	P < 0.0001
36–38 °C (Normal)	131 (73.6)	47 (26.4)	8.1 (4.9,13.3)	10.3 (5.8,18.3)	P < 0.0001
<36 °C (Hypothermia)	42 (29.6)	100 (70.4)	2.6 (2.1,5.9)	3.3 (2.9,11.3)	
Duration of surgery	127 (69)	57 (31)			
= <60 min					
>60 min					

OR=Odd ratio, C I=Confidence interval.

^a Significant from the bivariate logistic regression model.

^b Significant from the multivariate logistic regression model.

4. Discussion

The prevalence and magnitude of postoperative shivering ranged from 5% to 65% of patients after general anesthesia and in 30% of patients undergoing regional anesthesia which was less than in our study 51.8% [20]. There are a lot of associated factors of shivering including type and duration of anesthesia, duration of surgery, level of sensory blockade, gender, age, the temperature of the patient, operating room, and infusion fluids [21].

Shivering is one of the unwanted and the most common complications after spinal anesthesia. There is no clear mechanism of shivering after spinal anesthesia. However, there are possible mechanisms of shivering during spinal anesthesia result from central thermoregulation [22–24].

The main complication of shivering is an increase in oxygen consumption and triggers an increase in metabolic demand, which generally translates into higher oxygen combined with increased minute ventilation. The metabolic demands by itself increase the capacity to deliver oxygen peripherally and result in anaerobic metabolism and end up with cardiac morbidity.it also increases cardiac output, pulse rate, and

intraocular pressure, and interferes with monitoring of oxygen saturation, electrocardiogram, and blood pressure [2,7,15,25–27].

In this study, the incidence of intraoperative shivering after cesarean section delivery under spinal anesthesia was 51.8%. It was similar to other studies which were done in a different country even though they have used forced-air warming and warmed intravenous fluid infusions preoperatively [2,28,29]. In addition to this, the prevalence of shivering ranged between 36% and 85% of patients undergoing cesarean delivery under spinal anesthesia due to spinal anesthesia was the preferred anesthesia technique for developed countries [26,28,30,31].

The incidence of shivering after spinal anesthesia in this study is high compared to the other study done in a Sub-Saharan tertiary hospital (8.1%) it might be an absence of active forced-air warmer and fluid warmer [12].

Some studies showed that being male had a high risk to develop shivering [32–34]. It might be female's core body temperature is slightly higher than a male's but in other studies, there was no difference between genders to develop shivering [35,36]. However, we couldn't see the difference in our study due to the same gender which was all females.

In this study there was no difference among different age groups to develop shivering after spinal anesthesia and supported by multi studies [16,33,37]. However, some studies showed that being a young adult had a higher prevalence rate of shivering than the elderly person [32,35,38–40]. It might be the thermoregulatory responses to cold and heat are attenuated in older patients.

There were a lot of studies done to prevent hypothermia and decrease the incidence of post-anesthesia shivering. Non-pharmacology methods are used to reduce the prevalence of shivering like radiant heat warmers, warming of the operative theatre, blankets, and using intravenous (IV) fluids at body temperature and also there are different pharmacological managements of shivering including IV administration of fentanyl, tramadol, pethidine, magnesium sulphate, and ketamine [7, 41–44].

Most studies were compared on the management part of post-anesthesia shivering. One of the examples of this was using tramadol and control group showed that the incidence of shivering in the tramadol group, 8.8%, however, the incidence of shivering in the control group was high even compared within our study 86.6% [22].

The other comparative study done among patients received 12.5 mg of 0.5% hyperbaric bupivacaine combined with 25 µg fentanyl and 12.5 mg of 0.5% hyperbaric bupivacaine combined with 0.5 ml normal saline for spinal anesthesia and the incidence was low in groups that had adjuvant were added than the control group (10%, 75%) respectively [13]. It was comparable to our study.

There are four ways that the human body loses heat include: conduction, convection, radiation, and evaporation. Hypothermia is usually caused by prolonged exposure to cold temperatures shivering is a protective response to produce heat through muscle activity. However, environments can also lead to hypothermia, depending on a person's age, body mass, body fat, overall health, and length of time exposed to cold temperatures. In our study hypothermia was the main factor for shivering and supported by different studies [12,26,40,45,46].

In addition to hypothermia, hypotension was also the main factor to develop shivering in the perioperative time and supported by studies done in sub-Saharan countries [12]. It might be hypotension that occurred after spinal anesthesia due to the vasodilation effect and increased heat loss from the skin surface. However, there was no difference between systolic and diastolic blood pressure for developing shivering in another study [16].

The other main associated factor in our study was the duration of surgery for developing shivering after spinal anesthesia. It was similar to different studies [32,38,47]. It might be while the duration of anesthesia and surgery long, the patient was exposed to the environment and became hypothermic due to heat loss and ended up shivering.

5. Limitations of study

There was covid 19 during the data collection period and patients fear to give information to data collectors with adequate time due to minimize the contact hour. There were also confounding factors directly or indirectly affect the outcome variables.

6. Conclusion and recommendations

In this study, the incidence of intraoperative shivering after cesarean section delivery under spinal anesthesia was comparable to many studies (51.8%). Hypothermia, Hypotension, and Duration of surgery were strongly associated factors for shivering. We have recommended that patients should be covered by warm blankets and preloaded with warm fluid. The surgeon also should minimize the hour of the surgery as much as possible.

Ethics approval and consent to participate

Ethical clearance to conduct the research was obtained from the ethical review committee of the school of Medicine, College of Medicine and Health Sciences, University of Gondar. Verbal informed consent was obtained from each study participant after a clear explanation of what they would have to do and take part in the study. Anyone not willing to participate in the study was informed that they have full right not to participate or stop at any time and those who were not voluntary were excluded. Confidentiality was guaranteed by keeping the secrecy of personal identification, keeping completed questionnaires and checklist results in a well-secured area.

Consent for publication

Not applicable.

Availability of data and materials

All data generated or analyzed during this study were included in this published article.

Ethical approval

Ethical clearance was obtained from Gondar College of Medicine and Health Science, School of Medicine Ethical Review Committee. Informed verbal consent was obtained from each study participant after clear explanation about the merits of the study. Anyone not willing to participate in the study were informed that, they have full right not to participate at any time. Confidentiality was guarantee by keeping the secrecy of personal identification, keeping completed questionnaires and results in well secured area.

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Author contribution

This work was carried out in collaboration among all authors. Y.A. Ferede contributed to the conception, the review and interpreted the literatures based on the level of evidence. H.A Aytolign. and A.T.Mersha in reviewing preparation of the manuscript. All authors participate in preparation critical review of the manuscripts and approved the manuscript.

Registration of research studies

Name of the registry: research registry

Unique Identifying number or registration ID: 7260

Hyperlink to your specific registration (must be publicly accessible and will be checked):<https://www.researchregistry.com/browse-the-registry#home/>

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Declaration of competing interest

There is no conflicts of interest.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.amsu.2021.103022>.

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