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FREQUENCY AND ASSOCIATED FACTORS OF INTRAOPERATIVE SHIVERING IN ELECTIVE CAESAREAN SECTION UNDER SPINAL ANESTHESIA: A CROSS-SECTIONAL STUDY

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Abstract

Background: *Shivering is characterized by spontaneous, involuntary and repetitive muscular contractions. It increases patient's discomfort, oxygen consumption, surgical site bleeding and also increases patient hospital stay in postoperative period. Shivering interferes with the monitoring of electrocardiography, blood pressure and pulse oximetry. The objective of this study was to determine the frequency and associated factors of intraoperative shivering in elective caesarean section under spinal anesthesia.*

Methodology: *This cross-sectional study was conducted over a period of 6 months in obstetrics OT at Mardan Medical Complex (MMC), Mardan. Total 116 parturients were included in this study. Chi square test was performed to determine the association between categorical variables. P value <0.05 considered as statistically significant.*

Results: *The overall incidence of intraoperative shivering was recorded in 55(47.4%) patients. Majority of the patients experienced shivering between (6-20) minutes. In this study duration of surgery, BMI, body temperature and operating room temperature were significantly associated with shivering.*

Conclusion: *In this study duration of surgery, high BMI, hypothermia and cold operating room temperature were the independent risk factors of intraoperative shivering.*

INTRODUCTION

Shivering is a protective physiological reflex characterized by spontaneous, involuntary, and repetitive muscular contractions of the skeletal muscle that serve to increase the production of body heat (1). This phenomenon is not only a source of significant discomfort but is also one of the most frequent complications associated with the administration of spinal anesthesia (SA). The overall incidence of shivering post-SA is reported to be as high as 56.7% of patients, a figure that escalates dramatically to affect

up to 85% of individuals undergoing a caesarean delivery under this form of regional anesthesia (4, 18). The immediate trigger for shivering in the perioperative setting is widely understood to be the process of vasodilation caused by the anesthetic agent (1). This vasodilation leads to accelerated heat dissipation from the body and a subsequent redistribution of core body heat to the periphery, culminating in hypothermia (a central blood temperature below 36 (1, 7). This resultant decrease in core temperature, alongside the anesthetic's direct interference with normal thermoregulatory control, effectively lowers the threshold for the onset of the shivering response (1, 4). SA specifically reduces the body's normal set-points for vasoconstriction and shivering by approximately 0.5^{\circ}C to 1^{\circ}C (4). While typically self-limiting, shivering induces a profound hypermetabolic state that places a substantial strain on the patient's physiological reserves. This includes a massive increase in oxygen consumption (300%–400%) and an elevation in cardiac output and metabolic heat production by up to 600% (3). Such demands can precipitate severe and potentially life-threatening complications, particularly in patients with pre-existing cardiorespiratory diseases, manifesting as hypoxemia, increased carbon dioxide production, and lactic acidosis (2). Beyond the metabolic strain, shivering increases patient discomfort, exacerbates wound pain, elevates intracerebral and intraocular pressure, and critically, interferes with the accurate and continuous monitoring of vital signs such as pulse oximetry and blood pressure (2). Despite its prevalence and clinical significance, the precise underlying causes of perioperative shivering are not fully elucidated, and a definitive, universally established gold standard for its prevention and treatment remains to be adopted across the medical profession (5). Given that spinal anesthesia is the preferred and most popular anesthetic technique for caesarean section due to its rapid onset and minimal fetal impact (16, 17), determining the precise frequency of intraoperative shivering and meticulously identifying its associated risk factors in this specific patient population is an essential clinical and research objective for improving overall maternal patient safety.Associated risk factors include age, gender, duration and type of anesthesia/surgery, level of sensory blockade, operating room temperature, the temperature of infusion fluids, and the patient's thermal state (hypothermia or normothermia) (6). Shivering is also sometimes observed unexpectedly in normothermic patients, and the underlying causes are not fully understood (5).The pattern of shivering can be tonic (a consistent sinusoidal shape, often a thermoregulatory response to hypothermia) or clonic (appears distinctively in the recovery phase following volatile anesthesia, possibly due to the loss of inhibitory control over spinal reflexes) (5).Shivering severity is monitored using the Bedside Shivering Assessment Scale (BSAS), a 4-level tool ranging from grade 0 (no shivering) to grade 3 (gross movements of the trunk and all extremities) (11, 12).Management involves both pharmacological and non-pharmacological strategies. Effective pharmacological agents administered intravenously (IV) or intrathecally include pethidine, fentanyl, sufentanil, tramadol, ketamine, magnesium sulphate, dexmedetomidine, and clonidine (3). Non-pharmacological methods focus on maintaining warmth through warm fluid therapy, radiant warm heaters, and covering the patient with blankets (19).

Material and method

This cross-sectional study was conducted in the obstetrics operating theatre of Mardan Medical Complex over a six-month period, from June 2023 to November 2023. A total of 116 participants were included, with the sample size calculated using OpenEpi.com based on a prevalence rate of 8.15%, a 95% confidence level, and a 5% margin of error. A non-probability convenient sampling technique was employed for participant Before administration of spinal anesthesia, patients received a preload of crystalloid infusion (Ringer's lactate solution). The lumbar puncture was performed in a sitting position at the L3–L4 or L4–L5 intervertebral space using a 25G Quincke's spinal needle. Blood pressure was monitored every five minutes, while oxygen saturation and heart rate were continuously observed throughout the procedure.

Data were analyzed using SPSS version 22.0. Frequencies and percentages were calculated for categorical variables such as the occurrence of shivering. The chi-square test was applied to assess the association between shivering and variables including

patient age, body mass index, duration of surgery, body temperature, and operating room temperature. All variables, except age, showed a strong association with shivering, indicated by highly significant p-values less than 0.05. A p-value of less than 0.05 was considered statistically significant.

3. RESULTS

Total 116 patients were considered out of which 93(80.2%) of the cases were recorded between the age group of 18-30 years followed by 23(19.8%) of cases reported between 31-45 years as shown in **(Table 3.1).**

Table 3.1: Age of patients

Age of patients	Frequency	Percent
18-30 years	93	80.2%
31-45 years	23	19.8%
Total	**116**	**100%**

Frequency of severity of shivering has been shown in below figure in which 35.34% patients were recorded with moderate shivering followed by 12.07% with mild shivering, while 52.59% did not shiver. **(Figure 1)**

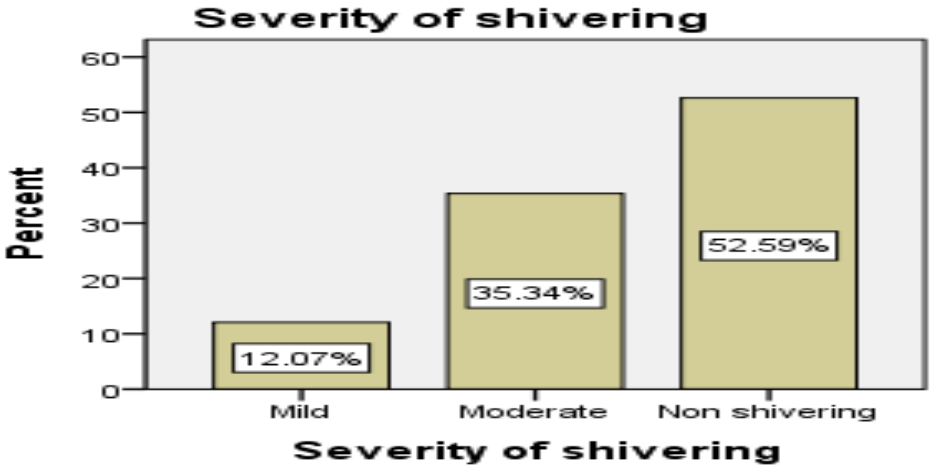


Figure 1: Shows severity of shivering.

Below table shows that there is no association betweene and shivering with the p value of 0.347 which is greater than 0.05. Total 116 patients were considered out of which total 55 cases experienced shivering while 61 patients had no shivering. Statistically 46(83.6%) cases were recorded with shivering and 47(77.0%) with no shivering between the age range of 18-30 years, followed by 9(16.4%) cases with shivering and 14(23.0%) with no shivering between the age 31-45 years **(Table 3.2).**

Table 3.2: Shivering Age of patients

	Age of patients			
	18-30 years	31-45 years	Total	P value

Shivering	Yes	46 83.6%	9 16.4%	55 100.0%	0.374
	No	47 77.0%	14 23.0%	61 100.0%	
Total		93 80.2%	23 19.8%	116 100.0%	

Below table shows association between shivering and BMI with strong significance (p-value) 0.001, which is less than p value of 0.05. In the BMI range of 18.5-24.9, only 1(1.8%) showed shivering and 57(93.4%) had no shivering, followed by shivering in 29(52.7%) cases and 4(6.6%) with no shivering, found with BMI ranging from 25-29.9 (overweight), followed by 24(43.6%) of patients having shivering and 0(0.0%) with no shivering having 30-39.9 kg/m^2 while only 1(1.8%) of shivering and 0(0.0%) with no shivering was found in patients with BMI > 40 kg/m^2 **(Table 3.3).**

Table 3.3: Association between Shivering and Body Mass index

Shivering	Body Mass index				Total	P value
	18.5-24.9	25-29.9	30-39.9	> 40		
Yes	1 1.8%	29 52.7%	24 43.6%	1 1.8%	55 100.0%	0.001
No	57 93.4%	4 6.6%	0 0.0%	0 0.0%	61 100.0%	
Total	58 50.0%	33 28.4%	24 20.7%	1 0.9%	116 100.0%	

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Below table shows association between shivering and duration of surgery with strong significance p-value 0.001 that is less than 0.05. 18(32.7%) experienced shivering and 58(95.1%) did not experience shivering in surgery duration < 60 minutes, while the percentage of shivering cases were 37(67.3%) and non-shivering cases were 3(4.9%) in the duration > 60 minutes, **(Table 3.4).**

Table 3.4: Association between Shivering and Duration of surgery

Shivering	Duration of surgery in (Minutes)		Total	P value
	<60 minutes	>60 minutes		
Yes	18 32.7%	37 67.3%	55 100.0%	0.001
No	58 95.1%	3 4.9%	61 100.0%	
Total	76 65.5%	40 34.5%	116 100.0%	

Below table shows association between shivering and body temperature with strong significance p value 0.001 that is less than 0.05. Total 116 patients were considered out of which 55 patients experienced shivering and 61 did not experience shivering. Out of 55 patients, 8(14.5%) cases were reported with shivering and 0(0%) cases with no shivering between the temperature range of 36-38°C, followed by

47(85.5%) shivering cases and 0(0%) non-shivering cases recorded with temperature < 36°C **(Table 3.5).**

Table 3.5: Association between Shivering and Body temperature

	Body temperature during shivering in degree celcius				
	36-38 °C (Normothermia)	<36 °C (Hypothermia)	Non shivering	Total	P value
Shivering	8 14.5%	47 85.5%		55 100.0%	0.001
Non shivering	0 0.0%	0 0.0%	61 100.0%	61 100.0%	
Total	8 6.9%	47 40.5%	61 52.6%	116 100.0%	

Below table shows association between shivering and operating room temperature with strong significance p value 0.001 that is less than 0.05. Total 52(94.5%) cases were recorded with shivering and 5(8.2%) with no shivering between the temperature range of 16-24°C, followed by 3(5.5%) shivering cases and 56(91.8%) non-shivering cases found between 25-35°C **(Table 3.6).**

Table 3.6: Association between Shivering and Operating room temperature

		Operating room temperature in degree celcius			
		16-24 °C	25-35 °C	Total	P value
Shivering	Yes	52 94.5%	3 5.5%	55 100.0%	0.001
	No	5 8.2%	56 91.8%	61 100.0%	
Total		57 49.1%	59 50.9%	116 100.0%	

DISCUSSION

This research was conducted in mardan medical complex (MMC) mardan, to determine the frequency and associated factors of intraoperative shivering in patient undergoing elective caesarean section under spinal anesthesia. Total 116 patients were included in this study.

In our study, the overall incidence of shivering under spinal anesthesia during caesarean section was recorded in 55 patients comprising 47.4%. We compare our findings with the study done by Yonas Admasu Ferede et al from 1st September 2020 to 30th December 2020, at the department of Anesthesia, College of Medicine and Health Sciences, University of Gondar, Gondar, Ethiopia. They reported 51.8% incidence of intraoperative shivering during caesarean section under spinal anesthesia. Another study was done in Sub-saharan Tertiary Hospital, that reported 8.15% of shivering (6).

Another multicentered study was conducted by Wodarski B et al from 1st December 2016 to 31st December 2017 in Poland. Total 200 patients were considered in which 21.9% experienced shivering. Others studies found 8.15% to 70.7% of shivering (20).

In our study, 46 (83.6%) patients shivered having age between 18-30 years followed by 9 (16.4%) patients having age between 31-45 years. We compare our

findings with the study done in Ethiopia, in which 60.4% patients experienced shivering having age between 18-30 years, while 39.6% patients shivered having age between 31-43 years. Highest frequency of shivering (52.7%) was found in patients with BMI ranging 25-29.9 (overweight) followed by 43.6% of patients with 30-39 kg/m^2. In the BMI range of 18.5-24.9, only 1.8% showed shivering while 1.8% of shivering was found in patients with > 40 BMI. Our study can be compared to the other study done, in which 33.4% patients experienced shivering had BMI 18.5- 24.9, 40.5% faced shivering having BMI 25-29.9, while 26.1% had shivering with BMI 30-40 kg/m^2. Many variables, including the kind and duration of anaesthesia, the duration of the surgery, the level of sensory blockage, the patient's age and gender, the temperature of the operating room, and the infusion fluids used, might cause shivering. One of the most common and unwanted complications following spinal anaesthesia is shivering. The reason of shivering following spinal anaesthesia is unclear. However, central thermoregulation may be the cause of some shivering processes during spinal anaesthesia Shivering's main problem is that it raises oxygen consumption and triggers a spike in metabolic demand, which frequently leads to higher oxygen concentrations and increased minute breathing. Anaerobic metabolism results from the metabolic demands alone, which also increase peripheral oxygen delivery capacity and finally induce cardiac morbidity. It also increases cardiac output, pulse rate, intraocular pressure and interferes with monitoring of oxygen saturation, electrocardiogram and blood pressure. Many studies were carried out to prevent hypothermia and reduce the chance of shivering after anaesthesia. Shivering can be treated pharmacologically using a variety of injections, including ketamine, magnesium sulphate, fentanyl, tramadol, and pethidine. Non-pharmacological treatments for shivering include radiant heat warmers, blankets, warming the operating room, and using IV fluids at body temperature. The human body loses heat in four different ways: radiation, convection, evaporation, and conduction. Shivering is the body's defensive response to produce heat through muscular activity when exposed to cold temperatures for an extended period of time. This can usually result in hypothermia. However, environmental factors can also result in hypothermia, depending on factors such as age, body mass, body fat, overall health, and duration of exposure to low temperatures. In our study, hypothermia was significantly associated with the development of shivering. Duration of surgery also associated with the development of shivering, longer surgeries which took greater than sixty minutes were more prone to develop shivering compare to those surgeries which took lesser than sixty minutes. It was similar to a study conducted in Ethiopia, the patient may have shivered because they lost heat and become hypothermic due to exposure to the environment throughout the extended anaesthesia and surgery time. In our study High BMI, and cold operating room temperature were also associated factors of intraoperative shivering. Our findings were comparable to the study done in Ethiopia which reported hypothermia and duration of surgery as the main factors for shivering (6).

CONCLUSION

In this study the incidence of shivering during caesarean section under spinal anesthesia was 47.4%. Duration of surgery, High BMI, Hypothermia and Cold operating room temperature were the independent risk factors of intraoperative shivering. It is advisable to ensure that patients are appropriately covered with blankets to maintain their body temperature during surgical procedures. Furthermore, surgeons are encouraged to minimize the duration of surgery in order to optimize patient outcomes and reduce potential complications.

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