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Management of shivering after spinal anesthesia in parturient

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***Abstract*---**Aim: This study aimed to evaluate and compare the effectiveness and safety of different methods of shivering control in patients with spinal anesthesia during cesarean delivery in Al-Abbas, Obstetrics and Gynecology (Imam Al-Hujjah), and Al Kafeel hospitals in Karbala. Methods: This cross-sectional study was conducted on pregnant women who have delivered from 2016 to 2022 in Karbala city. More than 90% of cesarean delivery in Karbala were conducted in 3 hospitals including Imam Al-Hujjah hospital, Al-Abbas, and Al Kafeel. Patients were selected by a simple random method and the sample size for each hospital was defined with the proportion to size method. The researcher-made checklist was used to collect the data and data were extracted from medical documents of patients. In case of huge missing data in medical documents, the patient was excluded from the study, and another patient was selected by the same method. Result: In this study, 755 patients were included to the study. The mean age of participants was 24.48 ± 4.56 years. The incidence of shivering was 21.59% in participants, which were 31.34% in participants who received no intervention, warmed cover, and fluid therapy; and 18.05% in participants who received tramadol, and

pethidine, or clonidine. In addition, our multivariable logistic regression showed that the odds of shivering in participants who received no intervention was 6.29 times (95% CI: 1.28, 30.78; P=0.023), for the warmed blanket was 3.97 times (95% CI: 1.97, 7.99; P<0.001); for fluid therapy was 3.29 time (95% CI: 1.91, 5.66; P<0.001), for pethidine was 2.06 time (95% CI: 1.91, 5.66; P=0.007), and for meperidine was 2.49 time (95% CI: 1.37, 4.49; P=0.003) compare with participants who received tramadol as shivering control treatment, that was statistically significant. Discussion: Our result showed that shivering is one of the prevalent problems that occurred after cesarean delivery that undergoing spinal anesthesia. Using Tramadol, Pethidine, and Clonidine have a significant association with decreasing the incidence of shivering. We suggest to health politicians update the protocol of shivering control in pregnant patients.

***Keywords*---**Spinal anesthesia, shivering, pregnancy, cesarean delivery, Karbala.

Introduction

In humans, temperature is one of the most accurate keys of physiological parameters. Central body temperature in most mammals should be well regulated (1). sensory neurons were expressed from the skin surface, peripheral tissues, central organs, neuraxis, and autonomous and behavioral responses were merged and sent to the hypothalamus which manages the regulation of temperature in mammals and heat-regulating (2-4) .

In Iraq, 25% of parturient were conducted as cesarean (5), and cesarean delivery is most conducted under neuraxial anesthesia (6, 7). Usually, spinal anesthesia is used for analgesia and anesthesia of lower abdominal, lower extremity, perineal procedures, spine surgery, pelvic, and delivery. While this method is acceptable for delivery, some side effects occurred due to spinal anesthesia. One of the most common side effects after surgery is shivering. Shivering is a physiological response to hypothermia with the involuntary use of striated muscle contractions to produce heat that may occur following both general and central neuraxial anesthesia (8).

Previous studies reported that the incidence of shivering after spinal anesthesia was 52.5% (interquartile range= 36%-71%) (9-14). Shiver in patients may cause to rise in oxygen consumption, acidosis, hypoxemia, and followed by increasing the carbon dioxide production. It can also increase intraocular and intracerebral pressure in some cases, it can increase the pain of surgical wounds, and cause the adverse situation in the patient (15-18). Various methods including pharmacological and non-pharmacological methods are available to control shivering (19-21). However, the efficacy and potential side effects of curative methods in pregnant patients are mostly unknown. Therefore, this study will be conducted to evaluate and compare the effectiveness and safety of different methods of shivering control in postpartum mothers in Al-Abbas, Obstetrics and Gynecology (Imam Al-Hujjah), and Al Kafeel hospitals in Karbala.

Method

Design and participants

This study was conducted as a cross-sectional design. The participants of this study were parturients who had spinal anesthesia for cesarean delivery in Al-Abbas, Imam Al-Hujjah, or Al Kafeel hospitals. The included criteria were age (at least over 18 years old), having spinal anesthesia for cesarean delivery, have any intervention to prevent shivering. In addition, the exclusion criteria were having big missing data in the dataset of the patients.

Shivering treatment

The method of this study was observational. However, some pharmacological and non-pharmacological interventions (treatment) were used in the hospital to prevent or treat shivering as routine care. Ketamine, Tramadol, Pethidine, Clonidine, Fentanyl, Ondansetron, forced air condition device, warm intravenous fluid therapy, and warmed matters or covers are routine methods that performed to treat or preventing shivering.

Sample selection

Based on the parturient rate of each hospital, the proportion of sample size was selected (proportion to size sampling). list of the patients who had parturient in these hospitals was prepare from 2016 to 2022 and participants were selected by simple random sampling method. Patients with huge missing data in their documents were excluded from the study and another patient replaced by same random method.

Data collection

The researcher-made checklist was used to collect the variables from medical documents. The interested data include the age, weight of mother, BMI, job status of mother, blood pressure of mother, comorbidity, number of childbearing, weeks of the pregnancy, core and peripheral body temperature before and after the anesthesia, and incidence of the shivering.

Statistical analysis

The frequency, percentages, and 95% confidence interval (CI) were used to analyze the qualitative variables with nearly normal distribution. In addition, the mean, standard deviation (SD), and 95% CI were used for describing the quantitative variables. The chi-square/Fisher exact test was used to determine the difference in the proportion of shivering for each group. In addition, a t-test was used for comparing the quantitative variable in 2 groups, and ANOVA (analysis of the variances) was used to compare the mean for more than 2 groups. We used uni-variable and multi-variable adjusted logistic regression models were used to find the association of the variables with the outcome, and odds ratio (OR) with 95% of CI as a measure of the association. For, multivariable regression analysis, and adjusting the confounders; a stepwise (backward and forward) model was used. All analysis was conducted as two-tailed and P-value less than 0.05 was considered as statistically significant. SPSSversion25 software was used for statistical analysis.

Ethical consideration

Ethical approval was obtained from the ethics committee of Tehran University of Medical Sciences (TUMS). Collected information was not published as individual data. In addition, the required data were without identity information such as name: zaman sabah mosleh Obaidi , ID number: 9913729001, national code: IR.TUMS.SPH.REC.1400.231, or any other identifying data.

Results

Descriptive

Totally, 755 patients were included in this study. The demographic data of participants are shown in Table 1. The mean age of participants was 24.48 ± 4.56years. The mean BMI of participants was 26.60 ± 4.18, the mean gestational age (week) of our participants was 37.35 ± 4.34 weeks, and participants have on average 0.78± 0.45-time history of pregnancy. In addition, the preoperative core, and peripheral temperature of the body were 37.44 ± 0.47, and 36.37 ±0.40, respectively (Table 1).

Table 1: demographic, socio-ecological, and medical history of participants between hospitals

Variable	Al-Abbas hospital N=260 (34.44%)	Imam Al-Hujjah hospital N=265 (35.10%)	Al Kafeel hospital N=230 (30.46%)	Total N=755 (30.46%)	P-value
Age (years)	25.02 ± 4.71	23.21 ± 3.79	25.35 ± 4.88	24.48 ± 4.56	<0.001
BMI (kg/m2)	26.49 ± 0.26	26.85 ± 0.26	26.43 ± 0.26	26.60 ± 4.18	0.516
History of pregnancy (time)	0.78 ± 0.45	0.78 ± 0.44	0.77 ± 0.47	0.78 ± 0.45	0.736
Gestational age (week)	37.06 ± 4.27	37.49 ± 4.45	37.50 ± 4.29	37.35 ± 4.34	0.760
Physical score (ASA)	0.90 ± 0.31	0.97 ± 0.31	0.96 ± 0.35	0.94 ± 0.32	0.077
Pulse rate	84.07 ± 6.90	84.42 ± 6.40	84.60 ± 6.41	84.35 ± 6.59	0.343
Systolic blood pressure	131.7 ± 19.2	129.2 ± 19.8	127.4 ± 20.6	129.5 ± 19.9	0.543
Diastolic blood pressure	78.4 ± 12.6	77.3 ± 13.2	77.1 ± 14.0	77.6 ± 13.2	0.272
SPO2	0.98 ± 0.01	0.97 ± 0.01	0.98 ± 0.01	0.98 ± 0.01	0.188
Temperature of body (core)	37.46 ± 0.47	37.41 ±0.47	37.46 ± 0.49	37.44 ± 0.47	0.809
Temperature of body (peripheral)	36.39 ± 0.40	36.36 ± 0.40	36.35 ± 0.42	36.37 ± 0.40	0.795

Analytic

Our result showed that 26.62% (n=201) of patients received the non-pharmacological intervention (including no intervention, Warmed cover, or Fluid

therapy), and 73.38% (n=554) of patients received the pharmacological intervention (including Tramadol, Pethidine, Clonidine) for shivering control. The total incidence of shivering was 21.59% (n=163); also, the incidence of shivering in participants without intervention and participants who received the non-pharmacological intervention was higher than in patients whose pharmacotherapy was conducted to control the shivering (31.34%, n= 63 vs 18.05%, n=100) (Table 2). In addition, the incidence of nausea in our participants was 39.21% (n=296); and the proportion of nausea was higher in patients who received clonidine (60.91%, n=67) was statistically significant (P<0.001) (Table 2). Also, the proportion of neonatal breastfeeding was 86.23% (n=651) in our participants; and the proportion of breastfeeding was lower in participants who received pharmacotherapy (pethidine) which was statistically significant (P=0.005).

However, the estimated blood loss (cc), pre-cesarean body temperature (core and peripheral), post cesarean body temperature (core and peripheral), hypotension, vomiting, pruritus (itching), drowsiness, headache, skin to skin contact in 30 min after surgery was not significant between intervention subgroups.

Table 2: The surgery, post-surgery, and infant characteristics of participants for each intervention subgroup

Variable	Without intervention N=7 (0.93%)	Warmed cover N=55 (7.28%)	Fluid therapy N=139 (18.41%)	Tramadol N=251 (33.25%)	Pethidine N=193 (25.56%)	Clonidine N=110 (14.57%)	Total N=755 (100%)	P-value
Duration of surgery (min)	55.71 ± 2.97	52.72 ± 1.20	51.80 ± 0.90	51.23 ± 0.68	50.52 ± 0.75	51.63 ± 1.02	51.36 ± 10.51	0.608
Estimated of blood loss (cc)	450.0 ± 59.5	420.36 ± 18.68	415.32± 11.90	413.51 ± 9.91	422.49 ± 10.68	432.64 ± 13.93	419.76 ± 14.62	0.771
Pre cesarean temperature of body (core)	37.44 ± 0.13	37.45 ± 0.05	37.44 ± 0.03	37.44 ± 0.03	37.42 ± 0.03	37.47 ± 0.04	37.44 ± 0.47	0.524
Pre cesarean temperature of body (peripheral)	36.51 ± 0.13	36.45 ± 0.04	36.41 ± 0.03	36.34 ± 0.03	36.35 ± 0.03	36.36 ± 0.04	36.37 ± 0.40	0.451
Post cesarean								
Shivering	3 (42.86)	18 (32.73)	42 (30.22)	30 (11.95)	43 (22.28)	27 (24.55)	163 (21.59)	<0.001
Post cesarean temperature of body (core)	36.57 ± 0.08	36.47 ± 0.05	36.41 ± 0.03	36.49 ± 0.02	36.45 ± 0.02	36.51 ± 0.03	36.47 ± 0.34	0.902
Post cesarean temperature	35.75 ± 0.12	35.66 ± 0.05	35.68 ± 0.04	35.71 ± 0.02	35.75 ± 0.03	35.66 ± 0.04	35.70 ± 0.39	0.730

of body (peripheral)								
Nausea	2 (28.57)	17 (30.91)	40 (28.78)	78 (31.08)	92 (47.67)	67 (60.91)	296 (39.21)	<0.001
Vomiting	0 (0)	4 (7.27)	2 (1.44)	14 (5.58)	10 (5.18)	9 (8.18)	39 (5.17)	0.163
Pruritus (Itching)	0 (0)	0 (0)	1 (0.72)	6 (2.39)	0 (0)	0 (0)	7 (0.93)	0.138
Drowsiness	0 (0)	1 (1.82)	0 (0)	6 (2.39)	2 (1.04)	0 (0)	9 (1.19)	0.238
Headache	0 (0)	0 (0)	7 (5.04)	4 (1.60)	5 (2.59)	3 (2.73)	19 (2.52)	0.351
Infant characteristics								
Neonatal Apgar score								
Under 7	3 (42.86)	10 (18.18)	38 (27.34)	40 (15.94)	14 (7.25)	20 (18.18)	125 (16.56)	<0.001
Over 7	4 (57.14)	45 (81.82)	101 (72.66)	211 (84.06)	179 (92.75)	90 (81.82)	630 (83.44)	
Neonatal breastfeeding	7 (100)	47 (85.45)	119 (85.61)	221 (88.05)	160 (82.90)	97 (88.18)	651 (86.23)	0.005
Skin to skin contact in 30 min after surgery	5 (71.43)	47 (85.45)	110 (79.14)	207 (82.47)	160 (82.90)	98 (89.09)	627 (83.05)	0.315

Multivariable logistic regression

In addition, our multivariable logistic regression showed that the odds of shivering in participants who received no intervention, warmed cover, fluid therapy, pethidine, clonidine was 6.29 time (95% CI: 1.28, 30.78; P=0.023), 3.97 (95% CI: 1.97, 7.99; P<0.001), 3.29 (95% CI: 1.91, 5.66; P<0.001), 2.06 (95% CI: 1.22,3.47, P=0.007), 2.49 (95% CI: 1.37, 4.49, P=0.003) compare with participants who received tramadol as shivering control, respectively. Also, the odds of shivering in our participants were decreased by 0.97 (95% CI: 0.94, 0.99; P=0.040) time in participants with higher pulse rates. In addition, the odds of shivering in patients who had higher blood loss was increased 1.002 times, which was statistically significant (95% CI:1.001, 1.003; P=0.001). Also, the odds of neonatal breastfeeding and skin-to-skin contact (30 min after surgery) in patients who had shivering were 0.53 (95% CI: 0.33, 0.85; P=0.009), and 0.52 (95% CI: 0.34, 0.82; P=0.004) time of patients without shivering that was statistically significant (table 3).

Table 3: multi-variable (adjusted) logistic regression of potential factors and shivering

Variable	Odds Ratio	Std. Err	Z	P-value	95% Confidence Interval (lower, upper)
Intervention (tramadol as reference)					
Without intervention	6.29	5.09	2.27	0.023	1.28, 30.78
Warmed blanket	3.97	1.42	3.85	<0.001	1.97, 7.99
Fluid therapy	3.29	0.91	4.31	<0.001	1.91, 5.66
Pethidine	2.06	0.55	2.70	0.007	1.22, 3.47
Meperidine	2.49	0.75	3.02	0.003	1.37, 4.49
Pulse rate	0.97	0.01	-2.06	0.040	0.94, 0.99
Estimated of blood loss (cc)	1.002	0.001	3.47	0.001	1.001, 1.003
Neonatal breastfeeding	0.53	0.13	-2.63	0.009	0.33, 0.85
Skin to skin contact in 30 min after surgery	0.52	0.12	-2.84	0.004	0.34, 0.82

Discussion

This study was conducted to determine the incidence of shivering and compare the effectiveness of shivering management methods in patients with spinal anesthesia during cesarean delivery in Iraq. To the best of our knowledge, our study is the first to provide the incidence of shivering and compare the management method in Karbala hospitals (Iraq).

Shivering is one of the side effects of spinal anesthesia. while, the occurrence of shivering has a benefit on thermoregulatory; it may be placed the patients under physical and physiological stress, especially in patients who had a cesarean delivery, shivering is an unpleasant experience. The shivering could increase the pain of surgery, increase stress and anxiety, and increase the oxygen consumption 2-5 times. In addition, it interferes the clinical monitoring such as electrocardiogram (ECG), Non-invasive Blood Pressure (NIBP), and pulse oximeters (17, 18, 22).

The mechanism of shivering during the spinal anesthesia was not established completely (22). However, previous studies suggested that the main risk factor of shivering in patients is that body heat loss was higher than body heat production. It may occur due to loss in thermoregulatory, and compliant in the internal redistribution of heat from the core body to the peripheral. The result of De Witte et al. study reported core body temperature is the best indicator of a human's thermal status (23). Also, Hynson et al. suggested that the body heat loss was due

to redistribution and transfer of core body heat to peripheral and environmental (24).

In our study, the result showed that core body temperature was not statistically significant between treatment sub-groups (Table 2; P= 0.107) which was consistent with the result of Vasanthy.j et al. (25). However, the study of Igweagu et al. (26) and Matsukawa et al. (27) showed the core body temperature of participants was decreased after anesthesia. Our result showed that the incidence of shivering was 21.59% in participants which was 31.34% in participants who received no intervention, warmed cover, and fluid therapy; and 18.05% in participants who received tramadol, pethidine, or clonidine.

Previous studies reported various values for the incidence of shivering after cesarean delivery. The results of our study were consistent with the study of Techanivate et al. (28) that reported the incidence of shivering was 20% in the treatment group (fentanyl) and 50% in the control groups; the study of Agrawal et al. (29) reported the incidence of shivering was 10% in the treatment group (fentanyl) and 30% in the control groups. The study of Sadegh et al. (30) reported the incidence of shivering is 10% in the treatment group (fentanyl) and 75% in control groups, and the study of Qian et al. (31) reported the incidence of shivering was 20% in the treatment group (fentanyl) and 60% in the control groups. While some studies reported that the incidence of shivering is about 0% in treatment groups (32, 33), others reported that the incidence of shivering is higher than 30% in patients who received the pharmacological intervention (34-36). In addition, most of the studies reported the incidence of shivering was higher in the control (untreated) group, which was consistent with the results of our study, however, the study of Abdollah-pour et al. reported the incidence of shivering was higher in the treatment group (48% in treatment, and 40% in control).

Our result showed that the lowest shivering occurred in patients who received tramadol (11.95%, n=30); that was consistent with the results of previous studies (37-41). To justify this association, we can say previous neurophysiological and physiological experiments conducted in animals showed that noradrenaline and serotonin affect the control of body temperature of animals due to nucleus raphe Magnus activation. The anti-shivering effect of tramadol may be due to its effect on these receptors (42, 43). Also, tramadol is a synthetic drug with an opioid-like effect that affected the mu-receptor, and lower effect on delta and kappa receptors, it can have an anti-shivering effect with the inhabitation of synaptosome noradrenaline or inhibition of 5- HT3 and promote it to release (42).
Duration of surgery, and estimated blood loss was not statistically significant between the different method of intervention; our result was consistent with the result of Kranke P et al study that reported the difference in heart rate, blood pressure, respiratory rate (RR), spo2, and level of sedation was not statistically significant (44).

The incidence of nausea and vomiting in our population was 39.21%, and 5.17%, respectively. The high incidence of nausea and vomiting in our study may be due to high dose of drug that used to control the shivering. in addition, some participants are on emergency status that have high risk of nausea and vomiting.

The result of study of Yu et al. (45) Was consistent with the result of our study however the incidence of nausea and vomiting was lower in the study of Roy et al. (46) and study of Igweagu et al. (26) This difference may be due to difference in drug that used to treatment of shivering, dose of the intervention, or participants of the study. the study of Igweagu and Roy, that had lower incidence of nausea and vomiting used low dose of pethidine for shivering control while in our study, the clonidine group had higher incidence of nausea and vomiting.

Conclusion

Our result showed that the shivering is one of the important problem that occurred after cesarean delivery that undergoing with spinal anesthesia. Using the Tramadol, Pethidine, and Clonidine have significant association with decrease the incidence of shivering. Also, most of the patients who received pharmacological intervention had nausea or vomiting. We suggest to health politicians to update the protocol of shivering control in pregnant patients. Strength and limitation.

This study has some strengths and limitations, the strength of this study was the design of the study which was multi-center and covered about 90% of deliveries. The sample size of this study was relatively large that have enough power to detect the association. Most of the recorded documents have no missing data; hence it seems that this study has lack of selection, information bias. Hence, the reliability, and generalizability of our result seemed to be acceptable. However, our study has some limitations, and our results need to be used with the following caveats: 1: longer period of monitoring may have allowed us to find more side effects or other conditions in patients, 2: the sample size in some non-pharmacological method was low. Finally, the last but not least limitation of the study was the issue of the placebo effect, since this study was not a blinded randomized controlled trial, the placebo effect in some participants that received drugs for shivering control may occur.

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Conflict of interest
The author of this study has no conflicts of interest to report that's.

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