Original Research Article

Effect of temperature variation of intrathecal Bupivacaine on shivering in parturients undergoing spinal anaesthesia

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Abstract

Introduction: Shivering associated with neuraxial anesthesia is a frequent complication that occurs in up to 55% of patients. Shivering is uncomfortable for the patient and may interfere with the monitoring of electrocardiogram, blood pressure (BP), and oxygen saturation. The metabolic and hemodynamic consequences of shivering include increased disbursement of cardiac and systemic energy, increased oxygen consumption and carbon dioxide production, and increased cardiac work.**Materials and Methods:** After obtaining institutional ethics committee approval and written informed consent from patients, this prospective randomised double blind study was conducted on 80 parturients posted for elective Caesarian Section (CS) at a tertiary care centre from January 2019 to January 2020. 80 patients randomized into Group I and Group II with 40 members in each group, Group I receiving 2 ml of 0.5% heavy Bupivacaine at 22°C and Group II 2 ml of 0.5% heavy bupivacaine at 37°c for spinal anesthesia. Sample size was calculated on the basis of observed shivering proportion during CS in our hospital.**Results:** Shivering was present in 57.5 % of patients in group I and 32.5 % in group II and this difference was statistically significant and overall shivering percentage was 45 %, although difference in mean onset of time was not significant in two groups. The grades of shivering were comparable in both groups. There was no significant difference in incidence of bradycardia, hypotension, nausea and vomiting in two groups.**Conclusion:**Shivering remains a common concern in patients operated for caesarean section under neuraxial anaesthesia causing discomfort to parturients. Several pharmacological and non-pharmacological measures have been tried to prevent and treat it and there is no gold standard treatment defined for it. The present study demonstrates lesser incidence of shivering with warm local anaesthetic solution injected intrathecally without any difference in incidence of level of blockade and incidence of adverse effects.

Keywords: Shivering, neuraxial anaesthesia, electrocardiogram, blood pressure (BP), and oxygen saturation.

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Introduction

Shivering associated with neuraxial anesthesia is a frequent complication that occurs in up to 55% of patients. Shivering is uncomfortable for the patient and may interfere with the monitoring of electrocardiogram, blood pressure (BP), and oxygen saturation[1]. The metabolic and hemodynamic consequences of shivering include increased disbursement of cardiac and systemic energy, increased oxygen consumption and carbon dioxide production, and increased cardiac work. Those effects are particularly bothersome in the obstetrical population[2].The mechanisms chiefly responsible for shivering in patients undergoing surgery are Intraoperative temperature loss; increased sympathetic tone, pain, and systemic release of pyrogens; and the direct effect of local anesthetic temperature on temperature-sensitive neurons in the spinal cord[3]. The central nervous system (CNS), including the spinal cord, receives thermal signals from the body and plays an essential role in the regulation and maintenance of body temperature. Although many studies have been undertaken to treat shivering after spinal anesthesia, little is known about the exact etiology of shivering and the best way to prevent it[4].Spinal anesthesia for cesarean section continues to be a popular technique, as it provides many advantages, such as rapid onset, high success rate, minimal maternal and fetal drug exposure, and minimal maternal discomfort. Mehta et al**.** confirmed that the combined use of warm parenteral fluids and warm local anesthetics significantly reduced the incidence of shivering Some researchers have studied the effects of local anesthetic temperature after injection into the epidural space on shivering[5]. The result of another study suggested the existence of thermo sensory mechanisms in the human spinal canal and the effect of warming epidural anesthetic solutions prior to injection to reduce the incidence of shivering but in another study Ponte et al**.** tested the hypothesis that cooling the extradural space may provoke shivering and concluded that shivering in extradural anesthesia does not result solely from cooling of the extradural space[6]. However, there is some controversy and no definite answer. Hence, we planned to conduct the study with hypothesis that intra-operative shivering is less with injection bupivacaine (heavy 0.5 %) at 37^0C as compared to injection bupivacaine (heavy 0.5 %) at 22^0C when used for SA in patients posted for elective CS.

Materials and methods

This prospective randomised double blind study was conducted on 80 parturients posted for elective CS at a tertiary care centre from January 2019 to January 2020. Sample size was calculated on the basis of observed shivering proportion during CS in our hospital.All participants with singlet on pregnancy of American Society of Anaesthesia (ASA) grade I and II, who were age group of 18 to 40 years posted for elective CS were included in study. Parturient who refuse to participate in study, age >40 years, ASA grade III & IV, presenting with acute foetal distress for CS, having fever, pregnancy induced hypertension (PIH), obesity with body mass index (BMI)>

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35 Kg/m^2 and requiring blood transfusion /received blood transfusion within 24 hours before CS, failure of spinal anaesthesia (SA) requiring conversion to general anesthesia were excluded from the study. Computer generated randomization was used to allocate patients in two groups as group-I receiving injection bupivacaine 2 mL (heavy 0.5 %) stored at 22 ^{0}C temperature and group-II receiving injection bupivacaine 2 mL (heavy 0.5 %) stored at 37 ^{0}C temperature for SA posted for CS. Separate anesthesiologist were allocated for preparation and injection of drug while another anesthesiologist was involved in observation of parameters and data collection. Operating room(OR) temperature was maintained at 23 ^{0}C and all intravenous fluids were warmed at 37 ^{0}C. After taking parturient to OR, all standard monitors were attached and preoperative pulse rate, blood pressure, oxygen saturation (SpO2) & basal temperature of parturient were noted. Intravenous access was established with 20G intracath at upper extremity 10 mL/ kg of Ringer's lactate was infused at least 5-10 min prior the subarachnoid block. With all aseptic precautions, the lumbar puncture was done at L3 -L4 or at L2 -L3 inter-vertebral space in left lateral or right lateral decubitus position with 25G spinal needle and study drug was injected into subarachnoid space. This time was considered as time zero. Patient was made supine and wedge pillow was placed underneath the right buttock. Separate anesthesiologist was given the task of performing SA and assessment of shivering post spinal anaesthesia. Sensory block was assessed with pin prick test at every one minute for 15 minutes and 5-minute interval for 40 minutes where score 0 was sharp pain, score 1was touch sensation and 2 was no sensation at all and motor block was assessed using Bromage Scale where score 0 is no block, 1 is ability to flex knees but not the hips, score 2 is unable to flex knees, ankle movement present and score 3 is no movement possible in any of the lower extremities. Time to reach maximum sensory block height (duration in minutes), level of maximum sensory block dermatomal height, and time to achieve Bromage score 3 were noted. A rectal thermometer probe was used to note core body temperature at an interval of 5 minutes for initial 30 minutes and for every 10 minutes there after till surgery concluded. Crossly and Mahajan scale was used to grade post spinal shivering where score 0 = no shivering, score1= no visible muscle activity, but one or more of piloerection, or peripheral cyanosis (other causes to exclude), score 2= muscular activity in only one muscle group, score 3= moderate muscular activity in more than one muscle group, but not generalized shaking, score 4= violent muscular activity that involves entire body. Duration of time between "time 0" and score 1 was defined as shivering onset time. Parameters such as onset time and the grading of the shivering were noted. Systolic blood pressure & heart rate were noted preoperatively, after administration of spinal drug in to subarachnoid space & patient was made supine, then every 1-2 min till baby was being delivered and later every 5min till the completion of surgery. The patients who developed shivering, bradycardia, hypotension were managed & treated as per hospital protocol (i.e. covering the patient with warming blankets, injection atropine, injection mephentermine etc). The nausea or vomiting or any other intra-operative observations were noted. Hypotension was defined as a fall in systolic blood pressure (SBP) >20 % or fall in SBP to <90mm / Hg from the pre-anaesthetic value was treated with injection mephentermine & crystalloids. If there was profuse blood loss during surgery, the blood transfusion was given to patient but such patients were excluded from the study. Bradycardia was defined as decrease in heart rate < 60 beats / min and was treated with injection atropine 20 mcg / kg intravenously. Apgar score of baby was noted at1, 5 and 10 minutes interval and was managed by paediatrician as per the need.

Statistical Analysis: All data was presented as mean ± SD (Standard Deviation) and Proportion. Demographic data was analysed by Student's t test and chi-square test was used to analyse changes over time. The statistical software Statistical Package for the Social Sciences (SPSS) version 21.0 was used for the analysis of the data and Microsoft Word and Excel have been used to generate graphs and tables.

Results

80 parturient posted for CS were included in study and divided into two groups of 40 each. Group I received 0.5 % hyperbaric bupivacaine at 22^{0}C of temperature and group II received 0.5 % hyperbaric bupivacaine at 37^{0}C of temperature. Demographic and surgical parameters were comparable in two groups (Table 1). Onset time of sensory blockade, maximum sensory blockade, time to achieve maximum sensory and motor blockade were comparable in both groups (Table 2). Shivering was present in 57.5 % of patients in group I and 32.5 % in group II and this difference was statistically significant and overall shivering percentage was 45 %, although difference in mean onset of time was not significant in two groups (Table 3). The grades of shivering were comparable in both groups. There was no significant difference in incidence of bradycardia, hypotension, nausea and vomiting in two groups.

Table 1:Demographic and Surgical Parameters of Patients

Parameters	Group I	Group II	P-Value
	Bupivacaine 22^{0}C	Bupivacaine 37^{0}C	
Mean age (years)	27±3.59	27.05 ± 2.97	0.61
Mean weight (Kg) ± SD	59.75 ± 6.03	58.52 ± 3.22	0.25
Mean height (cm) ± SD	156.57 ± 3.69	156.28 ± 4.7	0.759
Mean Gestational Weeks ± SD	37.65 ± 1.44	37.3 ± 2.17	0.39
ASA Grade I: Grade II	30 : 10	27 : 13	0.458
Mean duration of surgery in minutes	40.65 ± 3.81	45.67 ± 4.71	0.001

Table 2: Characteristics of Sensory and Motor Blockade in Group I and Group II

Parameter	Group I Bupivacaine 22^{0}C	Group II Bupivacaine 37^{0}C	P –Value
Maximum sensory block T4 : T6	23:17	19:21	0.37
Onset of sensory block time in minutes (Mean ± SD)	4.08 ± 0.41	4.05 ± 0.77	0.85
Time to achieve maximum sensory block in minutes (Mean ± SD)	6.33 ± 0.45	6.24 ± 0.21	0.26
Time to achieve motor blockade (Bromage 3)(Mean ± SD)	7.21 ± 0.22	7.17 ± 0.33	0.61

Table 3: Shivering: In Group I and Group II

Sl. No.	Shivering	Group I Bupivacaine 22^0C N = 40 (%)	Group II Bupivacaine 37^0C N = 40 (%)	P-Value
1	Present	23 (57.5 %)	13 (32.5 %)	
2	Absent	17(42.5 %)	27 (67.5 %)	0.24
3	Onset time (Min) Mean ± SD	14.36 ± 3.03	12.47 ± 2.98	0.07

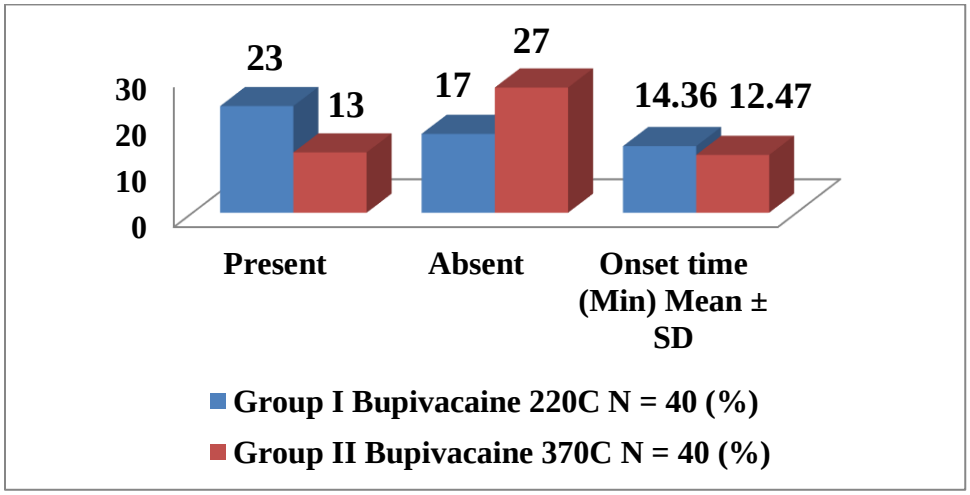

Fig 1: Shivering: In Group I and Group II

Table 4: Grades of Shivering in Group I and Group II

Sl. No.	Shivering Grades	Group I Bupivacaine 22^0 C N = 40 (%)	Group II Bupivacaine 37^0 C N = 40 (%)	P-Value
1	Grade I	9 (22.5 %)	6 (15 %)	0.5679
2	Grade II	8 (20 %)	4 (10 %)	0.3482
3	Grade III	5 (12.5 %)	3 (7 %)	0.7119
4	Grade IV	1 (2.5 %)	0 (0 %)	1.0

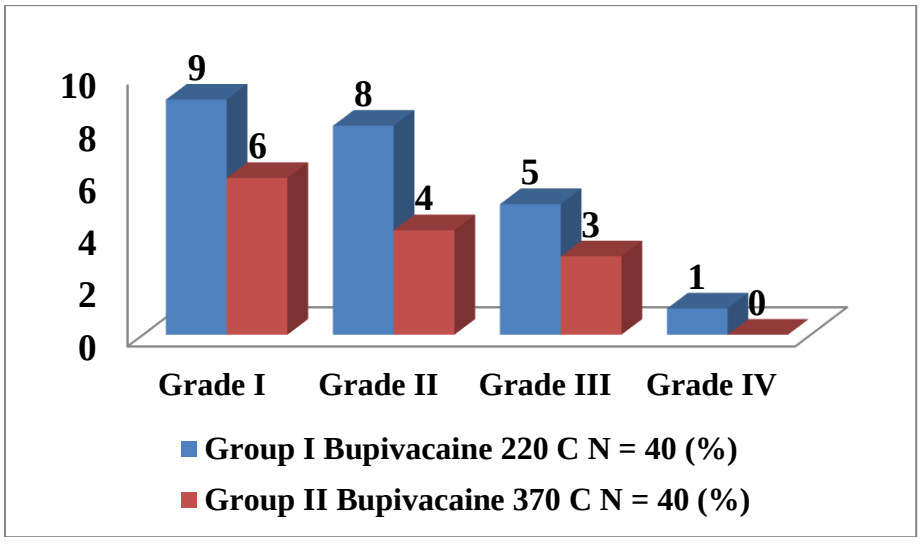

Fig 2: Grades of Shivering in Group I and Group II

Discussion

Shivering is a common side effect of spinal anaesthesia with unclear aetiology with incidence of up to 55 % reported in literature[7]. Many pharmacological options have been tried for its management with different success rate. Though mechanism of shivering remains largely unknown, few of the factors like loss of vasomotor tone above level of block with resultant loss of vasoconstriction to prevent heat loss, redistribution of heat from core body to periphery, and increased sweating threshold and decreased vasoconstriction resulting in altered thermoregulations were few of explanations[8].In present study, we aimed to compare effect of temperature variation of intrathecal bupivacaine on shivering by adjusting temperature at 22^0C and 37^0C. We found average incidence of 45 % with group I having higher incidence (57.5 %) of shivering than group II (32.5 %) and these findings were similar to study conducted by Najafianaraki et al. where difference in incidence of shivering in cold and warm bupivacaine group was significant and cold bupivacaine group had higher incidence.Thermo receptors are present in spinal cord of all mammals, and injecting local anaesthetic solution epidurally that is relatively cool possibly can provoke shivering by triggering local temperature sensors as indicated by previous study[9].

We found that onset of shivering was faster in group I compared to group II and this was statistically significant. Study conducted by Nandkishor et al. demonstrated earlier onsets of shivering in cold bupivacaine group i.e. at 4^0C however there was no statistical difference between group with 22^0C and 37^0C finding which does not correlate with our findings.Intensity of shivering as judged by shivering grades, our study showed 22.5 % of grade I shivering, 20 % of grade II, 12.5 % of grade III and 2.5 % of grade IV in group I (bupivacaine of 22^0C), that in group II, 15 % of grade I shivering, 10 % of grade II, 7 % of grade III and 0 of grade IV in group II (bupivacaine of 37^0C), similar results were shown by study conducted by Ponte et al[10]. where intensity of shivering was comparable in cold group and warm group. We observed similar changes as Ponte et al. where they observed cooling of extradural space had no effect on intensity of shivering and this difference may be the result of difference in site of injection of study drug.We did not find any difference in maximum sensory level and maximum motor level and time required to achieve this level and this was similar to previous study by Nandkishor et al.and Najafianaraki et al. Similarly haemodynamics was comparable in both groups[11]. Although many of previous studies conducted on healthy volunteers and non-pregnant patients demonstrated comparable incidence of shivering irrespective of local anaesthetic solution injected. role of temperature of local anaesthetic solution cannot be neglected as evidenced by present study as well as study by Najafianaraki et al.

Conclusion

Shivering remains a common concern in patients operated for caesarean section under neuraxial anaesthesia causing discomfort to parturients.Several pharmacological and non-pharmacological measures have been tried to prevent and treat it and there is no gold standard treatment defined for it. The present study demonstrates lesser incidence of shivering with warm local anaesthetic solution injected intrathecally without any difference in incidence of level of blockade and incidence of adverse effects.

Conflict of Interest: Nil
Source of support:Nil

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