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Original Research Article

EFFECT OF DIFFERENT DOSES OF INTRATHECAL DEXMEDETOMIDINE WITH HYPERBARIC BUPIVACAINE ON SHIVERING DURING LOWER SEGMENT CAESAREAN SECTION UNDER SPINAL ANAESTHESIA

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ABSTRACT:

INTRODUCTION: Shivering associated with spinal anaesthesia during Caesarean delivery is an uncomfortable experience for the parturient, which may also cause adverse effects. In this prospective, randomized, double-blind, placebo-controlled study, we sought to evaluate the effect of intrathecal dexmedetomidine, administered as an adjunct to hyperbaric bupivacaine for Caesarean delivery, on the incidence and severity of shivering associated with spinal anaesthesia.

AIMS AND OBJECTIVES: The present study aims to assess the effect of different doses of intrathecal dexmedetomidine with hyperbaric bupivacaine on shivering caesarean section under spinal anaesthesia.

MATERIALS AND METHOD: Patients undergoing Caesarean delivery were randomly allocated to three groups of 30 patients each. Experimental treatments were added to hyperbaric bupivacaine as follows: Patients in group I (control) were administered isotonic saline. Patients in groups II and III received dexmedetomidine (2.5,5 µg, respectively), mixed with isotonic saline.

RESULT: Shivering was observed in 11, 10 and 2 patients in groups I, II and III, respectively. The incidence of shivering in group III was significantly lower than that in groups I ($p=0.005$) and II ($p=0.01$). The severity of shivering was significantly different between the three groups
($p=0.01$). There were no significant inter-group differences with respect to mean arterial pressure and heart rate at any time point after administration of intrathecal local anaesthesia ($p>0.05$).

CONCLUSION: Intrathecal dexmedetomidine (5 µg) administered as an adjunct to hyperbaric bupivacaine during Caesarean delivery significantly reduced the incidence and intensity of shivering associated with spinal anaesthesia.

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KEY WORDS: Shivering, Caesarean section, dexmedetomidine

1. INTRODUCTION:

Spinal anaesthesia (SA) is widely used for covering elective or emergency Cesarean delivery as it provides adequate anaesthesia and analgesia for this purpose while avoiding risks associated with general anaesthesia [1]. Shivering is a common and distressing side effect which is associated with increased oxygen consumption, carbon dioxide production, and metabolic rate. Shivering may also interfere with intraoperative monitoring of electrocardiogram, blood pressure (BP), and pulse oxygen saturation [2]. Moreover, it is an uncomfortable experience for the parturient [3]. Multiple studies have demonstrated that intravenous (i.v.) dexmedetodine, 0.5 or 1.0 μg/kg body weight provides effective prophylaxis against post-anaesthetic shivering [4]. However, a recent meta-analysis of clinical trials demonstrated that intravenous dexmedetomidine was not optimal for prevention of shivering due to its potential side effects [5]. More importantly, the use of i.v. dexmedetomidine to facilitate Cesarean delivery in the parturient population has been reported in several case reports, including in a woman with primary pulmonary hypertension [6], and in another with spinal muscular atrophy [7]. On the contrary, many studies showed that dexmedetomidine was an effective adjuvant to intrathecal local anaesthetics for prolonging the duration of analgesia for lower abdominal surgeries, lower limb surgeries and Cesarean delivery [8,9]. However, the preventive effect of intrathecal dexmedetomidine on shivering has not been evaluated. We designed a double-blind, randomized, placebo-controlled study to determine whether intrathecal dexmedetomidine, administered along with hyperbaric bupivacaine for covering Cesarean delivery decreases the incidence of shivering associated with spinal anaesthesia.

2. MATERIALS AND METHODOLOGY

The present study entitled “Effect of different doses of intrathecal dexmedetomidine with hyperbaric bupivacaine on shivering during lower segment caesarean section under spinal anaesthesia” was conducted in the Department of Anaesthesiology, Shyam Shah Medical College & associated Sanjay Gandhi Memorial and Gandhi Memorial Hospitals, Rewa (M.P.) from January 2023 to December 2023 (12 Months) after approval by institutional ethics committee and obtaining written informed consent. Pre-anaesthetic examination of the patients was done. Each patient was subjected to complete general physical and systemic examination and detailed history was taken. Basic demographic characteristics such as age, height, sex, weight and BMI were noted. The patient was explained about the procedure and shifted to the operation theatre.

90 obstetric patients (singleton pregnancy; American Society of Anaesthesiologists (ASA) physical status I or II; age range 18–40 years; gestational age ≥37 weeks) who were scheduled for Cesarean delivery under spinal anaesthesia were enrolled in the study. Patients with contraindications to regional anaesthesia, hypersensitivity to amide local anaesthetics or dexmedetomidine, cases of severe preeclampsia, hyperthyroidism, cardiopulmonary disease, and those with a known history of alcohol or substance abuse were excluded from the study. Patients were randomly allocated to three groups (I, II and III; N=30 each) using a computer-generated random number table. Medication was prepared by an anaesthesiologist who was

ISSN: 0975-3583, 0976-2833 VOL15, ISSUE6, 2024

not involved in the study. Prior to administration of spinal anaesthesia, patients were placed under standard monitoring, and received 10 mL/kg ringer lactate. Patients were subsequently maintained on crystalloid fluid infusion at the rate of 10 mL/kg body weight per hour. The preservative-free dexmedetomidine 100 µg/mL was loaded into a 40-unit insulin syringe (2.5 µg/unit). Oxygen was administered during anaesthesia; patients were covered with drapes but not actively warmed. All patients were administered spinal anaesthesia with 2.5 mL of 0.5% hyperbaric bupivacaine. In addition to hyperbaric bupivacaine, patients in groups II and III received 1 unit and 2 units of dexmedetomidine, respectively; patients in group I received an equivalent volume of normal saline. The total volume was 3.0 mL in all the groups (by adding appropriate amount of preservative-free 0.9% saline where necessary). Spinal anaesthesia was administered in the left lateral position, at the L3–4 intervertebral space using a midline approach, with a 25-gauge Quincke spinal needle. The intrathecal injection was given after confirming free flow and positive aspiration for cerebrospinal fluid (CSF). Injection speed in all the groups was maintained at 0.1 mL/s. After spinal injection, parturients were immediately placed in a supine position with left uterine displacement. The level of sensory and motor block was monitored by an independent anaesthesiologist who was blinded to the anaesthetic regimen administered; any shivering episode was documented. Maternal BP was non-invasively measured at the forearm every 2 min subsequent to the administration of spinal anaesthesia. Any episode of hypotension (systolic BP<90 mmHg or >30% drop from the baseline BP) was treated with intravenous ephedrine (10–15 mg). Decrease in the heart rate <50 beats per min was treated with incremental doses of intravenous atropine (0.3–0.5 mg). Respiratory depression (pulse oxygen saturation <90% or >10% drop from the baseline) was treated with face mask oxygen inhalation. The level of sensory block (defined as the loss of pinprick sensation), was recorded bilaterally at the mid-clavicular line. The onset of sensory blockade at highest level was recorded. Shivering was graded using a four-point scale (none=no perceptible tension of muscles observed; mild=slight muscle tonus of masseter muscle; moderate=shivering of proximal muscles; severe=generalized shivering of the whole body) [10]. Intravenous fluids infused were at room temperatures and ambient temperature of the operating room was maintained at 22–28°C. Occurrence of pruritus, nausea, vomiting, dizziness and bradycardia was documented. The duration of surgery was recorded. Apgar scores were recorded at 1 and 5 min. A blinded observer was involved in the data collection. Based on our previous experience, the incidence of shivering was estimated to be 6% after administration of intrathecal dexmedetomidine versus 35% in the absence of dexmedetomidine. Assuming a <5% probability of a type I error, (i.e., significance level α=0.05) and <20% for that of a type II error (i.e., accepting a null hypothesis when it is false, β=0.20), the required sample size in each group was estimated to be 27. However, we recruited 30 patients in each group. Statistical Analysis Statistical analyses were performed using Statistical Product for Social Sciences (SPSS) software v. 18.0. Data pertaining to normally distributed continuous variables (age, weight, height, baseline tympanic temperature, highest segment blocked, time to reach highest block, time of onset of motor block, lowest heart rate (HR), lowest systolic arterial pressure (SAP).) are expressed as the mean ± standard deviation (S.D.); inter-group differences were assessed using one-way ANOVA. Inter-group differences with respect to the incidence and maximal intensity of shivering was assessed using χ^2 test, as appropriate. Data are expressed as the mean ± S.D. or median (range). A value of $p<0.05$ was considered indicative of a statistically significant between-group difference.

3. RESULTS

ISSN: 0975-3583, 0976-2833 VOL15, ISSUE6, 2024

A total of 90 patients were included in the study. No statistically significant between-group differences were observed between the three groups with respect to age, weight, height, baseline tympanic temperature, gestational age, or ASA class. Further, no significant inter group differences were observed with respect to the time to achieve the highest level of sensory block, the maximal number of segments blocked, duration of surgery and the Apgar scores at 1 and 5 min between the three groups ($p>0.05$, Table-1). The incidence of respiratory depression, pruritus, nausea, vomiting, dizziness and bradycardia was comparable in all the 3 groups with no statistic ally significant between-group differences.

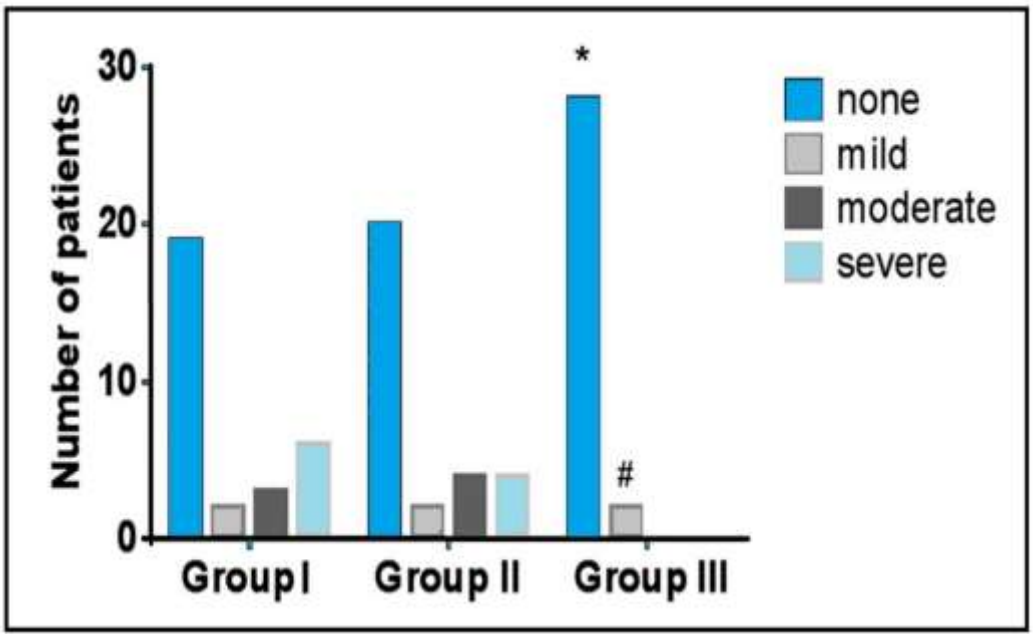
Shivering was observed in 11 (36.7%), 10 (33.3%) and 2 (6.7%) patients in group I, II and III, respectively. The incidence of shivering in group III was significantly lower than that in group I ($p=0.005$) and II ($p=0.01$) (Graph-1). In group II, 2, 4 and 4 subjects experienced mild, moderate, and severe shivering, respectively. In group III, mild shivering was observed in 2 subjects, while none of the subjects experienced shivering of moderate or severe intensity. The intensity of shivering in group III was significantly lower than that in group I ($p=0.000$) and II ($p=0.000$) (Fig. 2). There were no significant inter-group differences with regard to heart rate (HR) or mean arterial pressure (MAP) at any time-point after administration of intrathecal local anaesthesia ($p>0.05$, Fig. 2 and 3).

Variables*	Group I	Group II	Group III
Age (year)	29.5±3.8	30.0±3.1	31.1±3.7
ASA (I:II)	20:10	21:9	20:10
Weight (kg)	69.9±7.2	69.9±6.0	70.1±6.5
Height (cm)	161.7±5.3	159.4±3.8	160.9±4.4
Gestational age (week)	38 (37–41)	38 (37–40)	38 (37–41)
Baseline tympanic temperature (°C)	36.7±0.24	36.9±0.19	36.8±0.20
Highest segment sensory blocked (dermatome)	T4 (T4–T5)	T4 (T4–T5)	T4 (T4–T5)
Time to reach highest sensory block (min)	7.3±1.4	6.8±1.3	6.7±1.1
Apgar 1 min	10 (8–10)	10 (8–10)	10 (8–10)
Apgar 5 min	10 (9–10)	10 (9–10)	10 (9–10)
Duration of surgery (min)	53.3±6.3	52.1±7.1	55.1±6.8
Nausea/vomiting	1/1	2/1	1/1
Dizziness/bradycardia/pruritus	1/0/0	1/0/0	1/0/0
Respiratory depression	0	0	0

*Data expressed as the mean±S.D.

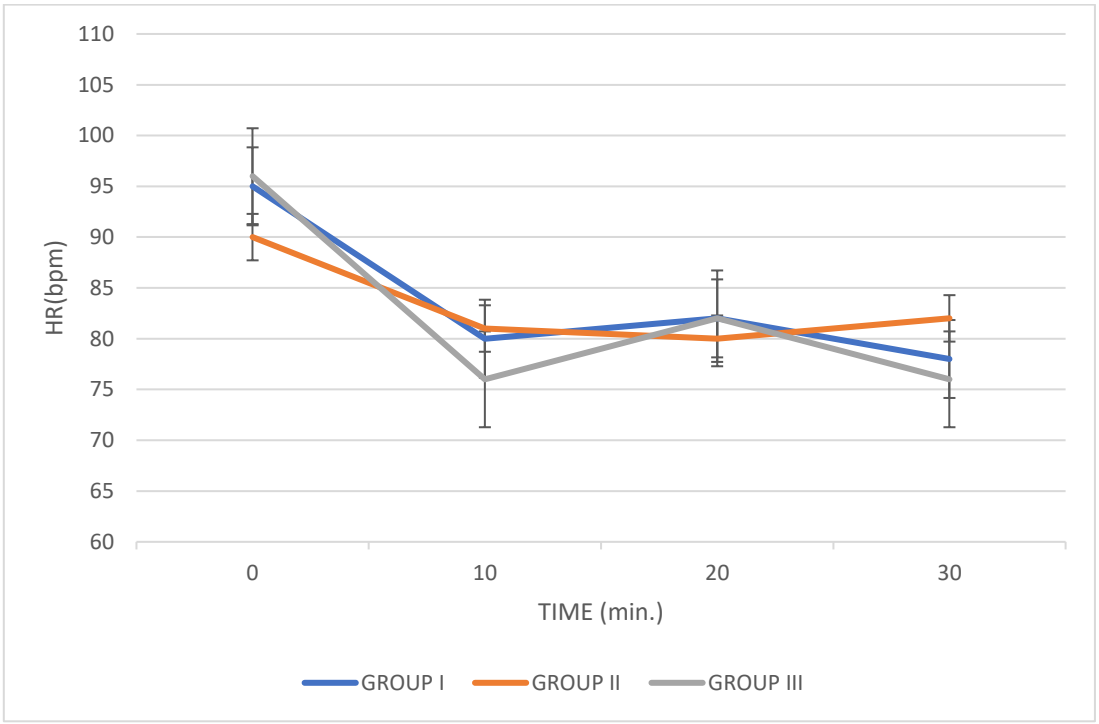
Table 1. Demographic and Anaesthetic Variables in between all the study groups.

ISSN: 0975-3583, 0976-2833 VOL15, ISSUE6, 2024



* Compared with group I, p<0.001 (incidence of shivering). # Compared with group I, p<0.001 (severity of shivering).

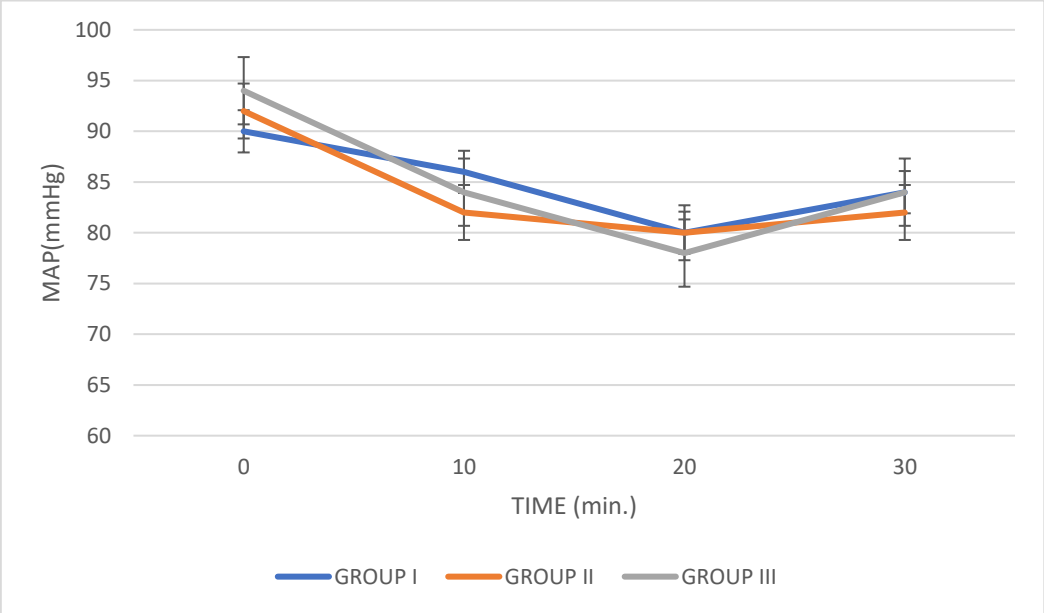
Graph-1. Incidence and Severity of Shivering Associated with Spinal Anaesthesia by Study Group



No statistically significant inter-group differences were observed.

Graph-2. Changes in Heart Rate Following Intrathecal Injection of Hyperbaric Bupivacaine Plus Dexmedetomidine among all the study groups.

ISSN: 0975-3583, 0976-2833 VOL15, ISSUE6, 2024



No statistically significant inter-group differences were observed.

Graph-3. Changes in Mean Arterial Pressure Following Intrathecal Injection of Hyperbaric Bupivacaine Plus Dexmedetomidine among all the study groups.

4. DISCUSSION

In this prospective, randomized, double-blind, placebo-controlled study, we sought to evaluate the effect of intrathecal different dose dexmedetomidine in reducing the incidence and severity of intraoperative shivering associated with spinal anaesthesia. We observed that the addition of 5 µg dexmedetomidine to hyperbaric bupivacaine for spinal anaesthesia in parturients reduced the incidence of intraoperative shivering in a dose-dependent manner, and in the absence of any noticeable side-effects, while supplementation of bupivacaine with 2.5 µg dexmedetomidine did not decrease the incidence of shivering. Various pharmacological therapies aim to prevent or treat shivering include opioids, clondine, meperidine, granisetron and tramadol, but some adverse side-effects may occur during drug administration [5]. Dexmedetomidine, a highly selective α-2-adrenoreceptor agonist, is a novel drug for suppression of shivering associated with regional as well as general anaesthesia [11-12]. The mechanism of action by which dexmedetomidine inhibits shivering is complex. Several studies have demonstrated that dexmedetomidine alleviated shivering mainly through its central α2-adrenoreceptor agonist effect [13]. Alpha-2 adrenergic receptors, which are widely distributed in the hypothalamus, are thought to mediate thermoregulatory inhibition. In many studies, dexmedetomidine was shown to increase the temperature range without triggering thermoregulatory defences through stimulation of central α2-adrenergic receptors, thereby decreasing the central thermoregulatory threshold for shivering [14]. It is possible that the anti-shivering effect of intrathecal dexmedetomidine may be caused by decreasing shivering threshold. The route of administration of dexmedetomidine in previous studies was intravenous [15]. Moreover, robust data on safety of use of IV dexmedetomidine in parturients is largely lacking. Callaway et al. reported a decreased incidence of shivering with use of i.v. dexmedetomidine, 1 µg/kg, in normal volunteers; however, this effect was associated with decreased systolic blood pressure [16]. Prevention of shivering by

ISSN: 0975-3583, 0976-2833 VOL15, ISSUE6, 2024

administration of intravenous dexmedetomidine in a parturient may be limited by its principal side-effects, i.e., hypotension and bradycardia [5]. Several studies have shown that use of intrathecal dexmedetomidine as an adjuvant to hyperbaric bupivacaine is associated with prolonged motor and sensory block, while maintaining the hemodynamic stability [17]. Recent studies have shown that dexmedetomidine may be safely used as an intrathecal supplement in Cesarean delivery [8,18]. Respiratory depression is a potential side effect of dexmedetomidine. But, the side effect is just reported to occur by using high doses or prolonged intravenous pumping dexmedetomidine [19]. Many studies demonstrated intravenous optimal dose (0.5–1 μg/kg) or intrathecal 2.5 or 5 μg dexmedetomidine didn't result respiratory depression [20]. Therefore, intrathecal dexmedetomidine might be more appropriate than i.v. dexmedetomidine in reducing the incidence of shivering associated with spinal anaesthesia for Cesarean delivery.

LIMITATIONS OF THE STUDY

The present study's limitation includes single-centric design.

5. CONCLUSION:

In conclusion, intrathecal dexmedetomidine (5 μg) as an adjuvant to hyperbaric bupivacaine for spinal anaesthesia in patients undergoing Cesarean delivery appears to be safe and effective in decreasing the incidence and severity of shivering.

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ISSN: 0975-3583, 0976-2833 VOL15, ISSUE6, 2024

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