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Effect of Intrathecal Fentanyl on Shivering During Spinal Anesthesia

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ABSTRACT

Introduction

Perioperative shivering is a common complication following spinal anesthesia. Apart from the obvious discomfort, shivering is associated with a number of potentially deleterious sequels. The objective of this research is to study the effect of intrathecal fentanyl on shivering.

Methods

Retrospectively two hundred patients were included and divided into two equal groups. In group A, 3.5 ml of 0.5% heavy bupivacaine was mixed with 25 mcg (0.5 ml) of fentanyl to make 4 ml solution out of which the enrolled patients received 3.5 ml of the mixed solution. Group B received 3.5 ml of 0.5% plain heavy bupivacaine. Modified bedside shivering assessment scale was used to score the intensity of shivering.

Results

In group A, 16 patients (16%) had severe shivering, 30 patients (30%) had moderate shivering and 46 (46%) had mild shivering. Rest of the patients (8%) did not experience shivering. In group B, all the patients had shivering. Severe shivering was observed in 28 patients (28%), moderate shivering was observed in 62 patients (62%) and mild shivering in 10 patients (10%).

Conclusions

Fentanyl as an adjuvant to heavy bupivacaine during spinal anesthesia decreases the incidence and severity of shivering compared to bupivacaine alone.

Keywords: fentanyl; spinal; shivering; incidence.

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INTRODUCTION

The maintenance of normal temperature is an important function of autonomic nervous system in homoeothermic mammals. Even minor deviation from normal core body temperature may result in cellular and tissue dysfunction. In human beings, core body temperature is maintained within normal limits of 36.5 to 37.5 degree centigrade.[1] The central control mechanism situated in the hypothalamus where afferent signals are integrated and compared with a predetermined "set point". [2] The efferent responses are behavioral and autonomic. The responses result in changes in cutaneous vascular smooth muscle tone, shivering and non-shivering thermogenesis when increased heat production is indicated and sweating when heat loss is indicated.[3] Shivering is a spontaneous, involuntary and unpredictable muscular activity affecting up to 65% after general anaesthesia and 33% after regional anesthesia.[4] Apart from the obvious discomfort, post anaesthesia shivering is associated with increased oxygen consumption and carbon dioxide production, catecholamine release, increased cardiac output, tachycardia, hypertension and raised intraocular pressure.[5] Different intravenous agents like ketamine, ondansetron, tramadol and pethidine have been found to be effective in treating shivering during anesthesia.[6-9] Different studies have also be found that intrathecal fentanyl not only increases the duration of analgesia but also decreases the incidence and severity of shivering during anesthesia.[10,11] The objective of this research is to study the effect of intrathecal fentanyl on shivering.

METHODS

A retrospective comparative study was conducted in the Department of Anesthesiology and Critical after getting ethical approval from institutional review committee (IRC), (Ref No. COMSTH-IRC/2023-12) Care, College of Medical Sciences and teaching hospital. Two hundred ASA I and II patients aged 18 – 45 years old, posted for elective surgery under spinal anesthesia over a period of six months were included. Patients who were ASA more than II, aged less than 18 or more than 60 years, posted for emergency surgery, heart rate more than 100 or less than 50, grade III hypertension or blood pressure less than 90/60 mm of Hg. Sample size calculation was based on the study by Techanivate et al. The sample size is calculated by using the following formula:

$$n = \frac{r+1}{r} \frac{(p)(1-P)(z\beta + z\alpha/2)^2}{(p_1 - p_2)^2}$$

Where

n = Number of sample

r = ratio of control to cases

$p^* = (p_1 + p_2)/2$

p_1 = Prevalence of shivering in study group was 20% (i.e 0.2)

p_2 = Prevalance of shivering in control group was 50% (i.e 0.5)

Z_β = standard normal variate for power (for 80% it is 0.84)

$Z_{\alpha/2}$ = standard normal variate for the level of significance (for 5% it is 1.96)

The sample size in each group comes to be more than 39.2. We decided to take 100 patients in each group. So the total sample size would be 200. Under aseptic precautions all the patients received spinal anesthesia. In Group A (n=100) 3.5ml of 0.5% heavy bupivacaine was mixed with 25 mcg (0.5 ml) of fentanyl to make 4 ml solution from which they received 3.5 ml of prepared solution. Group B (n=100) received 3.5 ml of 0.5% plain heavy bupivacaine. All the patients were observed for shivering and its severity during the intraoperative period. Level of block, hypotension, vomiting, pruritus and duration of postoperative analgesia were noted

and recorded in all the cases. Modified bedside shivering assessment scale[5] was used to score the intensity of shivering.

Table 1. Modified bedside shivering assessment scale.

Grade	Type	Location
0	No	No shivering
1	Mild	Shivering localized to the neck and/or thorax; or fine artifact on cardiac rhythm.
2	Moderate	Shivering involves gross movement of the upper extremities (in addition to neck and thorax)
3	Severe	Shivering involves gross movements of the trunk and upper extremities

RESULTS

Following table provide the demographic profile of the patients. This showed that the mean age of patients in group A was 36.08±10.50 years while in group B was 37.72±11.68 years. The weight of patients in group A was 66.14±8.79 kg while in group B was 67.18±10.24 kg (Table 2).

Table 2. Demographic information of patients (n=200).

Variables	Group A	Group B
Age (Years)	36.08±10.50	37.72±11.68
Sex (M:F)	44:56:00	52:48:00
Weight (kg)	66.14±8.79	67.18±10.24

All the patients in group B had shivering contrary to group A. Incidence of moderate and severe shivering was more in group B (Table 3).

Table 3. Incidence of shivering during the study (n=200).

Group	No shivering	Mild	Moderate	Severe
A	8%	46%	30%	16%
B	0	10%	62%	28%

As shown in table no. 4, incidence of vomiting and hypotension which required pharmacological interventions was more common in group B. Incidence of pruritus in group A was higher (Table 4).

Table 4. Incidence of common complications after spinal anesthesia (n=200).

Variables	Group A	Group B
Vomiting	16(16)	28(28)
Hypotension (> 20mmofhg from baseline MAP)	46 (46)	88(28)
Pruritus	36 (36)	0

The highest level of sensory block was observed in group A as compared to group B. Duration of Analgesia in group A was longer as compared to group B (Table 5).

Table 5. Level and duration of sensory block (n=200).

	Group A	Group B
Level of sensory block after 30 mins	T6:T5:T4=48:10:42	T6:T5:T4=10:62:28
Sensory block (Duration of regression to L1)	191±7.23 minutes	164±8.66 minutes

DISCUSSION

Spinal and epidural anesthesia are known to decreases the shivering thresholds to a comparable degree but by a lesser amount of around 0.6 degree centigrade, than general anesthetics.[12] The mechanism of this phenomena during regional anesthesia is unknown though is consistent with the effects of regional block on afferent thermal information and core body hypothermia.[13] With reduced gain and maximum intensity, shivering induced by core body hypothermia regional anesthesia is ineffective protective mechanism to increase the temperature[14,15] Shivering is associated with a number of potentially deleterious squeals which includes increased oxygen consumption and carbon dioxide production, catecholamine release, increased cardiac output, tachycardia, hypertension and increased intraocular pressure thus necessitates early treatment.[16]

Different studies have been published regarding the incidence and preventive measures of intraoperative shivering during spinal anesthesia. [6-9] Different adjuvants have been added with local anesthetics to reduce the incidence of shivering during regional anesthesia. [17-19] Fentanyl, when it is administered intrathecally, the reduction of shivering may be attributable to the effect on the thermo-regulator and spinal affect afferent thermal inputs at the spinal cord.[4]

Techanivate et al[20] observed that incidence of shivering was 50% in plain bupivacaine group and 20% in fentanyl group. In another study by Sadegh et al[4], they also observed incidence of shivering decreases from 75% to 4% when fentanyl is added. Safavi et al[21] observed that 30 mcg intrathecal fentanyl was superior to 10 and 20 mcg intrathecal fentanyl to prevent post spinal shivering. In our study, we observed that incidence of absence of shivering was 8% in fentanyl group and all the patients in plain bupivacaine group developed shivering. Intrathecal fentanyl, due to the high lipid solubility has less tendency to migrate to the cervical region. [22] Sadegh et al[4] observed that addition of fentanyl increases the likelihood of achieving higher sensory block. During our study we observed similar results which may be due to changes in baricity of bupivacaine caused by mixing fentanyl. Khanna et al[23] and biswas et al[24] observed that the duration for sensory level to regress to L1 dermatome were prolonged in fentanyl group compared to plain bupivacaine group. During our study we had similar observation. The most common complication of spinal anesthesia is hypotension. The incidence of hypotension is recorded as high as 99.2%.[25] We observed that incidence of hypotension was more common in plain bupivacaine group which may be due denser sympathetic blockade by higher dose of bupivacaine. Similar rational was put forward by bogra et al in their study.[26] Vomiting is another common complication following spinal anesthesia. It is an eminent sign of decreased global perfusion of the brain. The incidence of vomiting has been recorded as low as 6.8% to as high as 30% following spinal anesthesia without adjuvants.[27,4] It is noticed that there is decease in incidence of vomiting in studies where fentanyl was used as an adjuvant.[4] Intrathecal fentanyl have been advocated to be superior to ondansetron in preventing nausea

following spinal anesthesia.[28] In our study, we observed that incidence of vomiting was lower in fentanyl group as compared to plain local anaesthetic group. Pruritus is a common and distressing side effect of intrathecal opioids. Some studies have found that the addition of fentanyl intrathecally leads to pruritus in all patients.[29] Whereas in another study incidence of pruritus was nil.[30] In another study by kuusniemi et al[31], they observed that pruritus was the most common adverse effect, occurring in 22.5% of all patients after intrathecal fentanyl. In our study, pruritus was a common adverse event following spinal anesthesia in fentanyl group. The incidence in our study was 36% in fentanyl group whereas none had pruritus in plain group.

CONCLUSIONS

We conclude that use of fentanyl as an adjuvant to heavy bupivacaine during spinal anesthesia decreases the incidence and severity of shivering, hypotension and vomiting compared to heavy bupivacaine alone.

Intrathecal fentanyl is recommended for routine use not only to prolong analgesic effects but also to reduce incidence and degree of adverse events like hypotension and shivering.

Limitations: Study was done in a small population.

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