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Intrathecal Fentanyl for Prevention of Shivering in Spinal Anaesthesia in Lower Limb Surgeries

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Abstract: ***Introduction: Intra-operative shivering is a common complication of regional anaesthesia, affecting 40-70% of patients undergoing surgery. Shivering increases expenditure of cardiac and systemic energy, resulting in increased oxygen consumption and carbon dioxide production, lactic acidosis and raised intraocular and intracranial pressures. It also interferes with haemodynamic monitoring intra-operatively. Regional anaesthesia produces vasodilation which facilitates redistribution of heat from the core to periphery. This predisposes patient to hypothermia and shivering. We studied the effect of intrathecal fentanyl on the incidence of shivering following spinal anaesthesia. Materials & Methods: 50 ASA class-I and II adult patients of either sex, aged 20-60 years undergoing lower limb surgeries under spinal anaesthesia were selected and randomly allocated in 2 groups (n=25) in a randomized, double-blinded manner. Patients in Group A received 3 ml of bupivacaine 0.5% with 0.5ml (25µg) of fentanyl and patients in Group B received 3 ml of bupivacaine 0.5% with 0.5ml of saline intrathecally. We assessed the incidence and severity of shivering following administration of spinal anaesthesia. Observation: There was no difference between the groups with regard to demographic data, duration of surgery, oral temperature and highest sensory level achieved. The incidence and severity of shivering was significantly lower in Group A compared to Group B. The incidence of shivering was 12% in Group A and 60% in Group B, which is statistically significant (P<0.001). Majority of the patients experienced shivering in the first hour following administration of spinal anaesthesia. Conclusion: Intrathecal bupivacaine combined with fentanyl reduces the incidence and severity of shivering following spinal anaesthesia for lower limb surgeries.***

Keywords: Shivering, Spinal anaesthesia, Fentanyl, Lower Limb surgeries

1. Introduction

Intra- operative shivering is a common complication of regional anaesthesia, affecting 40-70% of patients undergoing surgery. Core temperature is maintained within a normal range during exposure to a cool environment because of sympathetically mediated vasoconstriction. Regional anaesthesia produces vasodilatation, which facilitates core-to-peripheral redistribution of heat and the cool periphery is warmed at the expense of the core compartment. Thus, hypothermia from epidural anaesthesia results from redistribution of heat from the core to the periphery.[(1)] This predisposes the patient to shivering.

Shivering interferes with routine intra operative monitoring like ECG, blood pressure and SPO2 [(2,3)]. Shivering is associated with many hazardous effects like increased metabolic rate which may lead to increase in oxygen consumption by 100-600% with increased carbon dioxide production[(3)]. It can cause arterial hypoxemia, raised intracranial and intraocular pressures [(2)]. It can lead to adverse post operative outcomes like increased wound pain and infection which leads to delayed discharge of the patient[(4)].

The treatment of shivering includes both pharmacological and non-pharmacological methods. The non-pharmacological management is by external heating like the use of forced air warming, warming blankets, warmed fluids etc., According to the results of a meta-analysis, the most frequently reported pharmacological interventions include clonidine, pethidine, tramadol, nefopam and ketamine.[(5)]

Here, we studied the effect of intrathecal fentanyl on the incidence of shivering as well as the severity of shivering following spinal anaesthesia.

2. Method

After approval of the institutional ethics committee,this hospital based, randomized,double blind prospective study was conducted on 50 ASA class-I and II consenting adult patients of either gender, aged 20-50 years undergoing lower limb surgeries under spinal anaesthesia of duration 1-4 hours. Patients with contraindication to spinal anesthesia, allergy to the local anaesthetics or fentanyl, pregnancy, chronic opioid use, patients with history of respiratory, cardiac, hepatic and renal disease were excluded. Also, patients on narcotics, sedatives or any medication likely to alter thermoregulation were excluded.

Upon arrival in the operation theatre, an 18G venous cannula was inserted and IV fluid started in the form of Ringer's Lactate solution. Standard monitors were attached and all the baseline parameters such as heart rate (HR), non-invasive blood pressure (NIBP), oxygen saturation (SPO2), electrocardiography (ECG) were recorded. All operation theatres in which the operations were performed maintained constant humidity (70%) and an ambient temperature of around 21 to 23 degree Celsius.

The patients were randomly divided into two equal groups of 25 patients each by sequentially numbered, sealed opaque envelopes. In order to facilitate blinding, the medications were prepared by another person who was not involved in the study. Neither the patient nor the person doing the study knew in which group a particular patient had been allotted.

Under all aseptic precautions, spinal anaesthesia was performed at the L3-L4/L4-L5 interspace with the patient in sitting position using a 25G Quincke needle. Patients in Group A received 3 ml of bupivacaine 0.5% with 0.5ml (25µg) of fentanyl and patients in Group B received 3 ml of bupivacaine 0.5% with 0.5ml of saline intrathecally. Maximum level of sensory block was evaluated by pinprick.

Supplemental oxygen was administered to all the patients at the rate of 5 l/min with face mask and patients were covered with one layer of surgical drapes. IV fluids and anaesthetics were administered at room temperature. Vital parameters such as HR, NIBP, and SPO2 were recorded at intervals of every 5 min for first 30 min and every 15 min for the rest of the observation period. Continuous ECG monitoring was done. Axillary temperature was measured with a single calibrated mercury thermometer 3 minutes before induction, 30 minutes after induction, and in the recovery room.

The incidence and severity of shivering following administration of spinal anaesthesia was assessed. The severity of shivering was graded in accordance with the Bedside Shivering Assessment Scale[6] as follows;

0: None – No shivering is detected on palpation of the masseter, neck or chest muscles
1: Mild – Shivering localized to the neck and thorax only
2: Moderate – Shivering involving gross movements of the upper extremities (in addition to neck and thorax)
3: Severe – Shivering involving gross movements of the trunk, upper and lower extremities.

Side effects and complications such as hypotension, bradycardia, itching, nausea, vomiting and respiratory depression were noted. Hypotension was defined as a decrease in the systolic blood pressure to less than 90 mm Hg or 20% less than the baseline value, which was treated with bolus of fluid and 5 mg to 10 mg of intravenous ephedrine. Bradycardia was treated with atropine 0.5 mg IV. Intravenous metoclopramide 10 mg was used to treat nausea and vomiting.

3. Results

These 50 patients were randomized into two groups of 25 each. Out of the total patients, 26 were male, and 24 were female. There were no differences between the groups regarding the basic data including age, sex, baseline temperature, duration of surgery and maximum level of sensory block.

Variable	Group A	Group B	P Value
Age Distribution	31.6±6.07	32.4±5.59	0.63
Gender (Male/Female)	14/11	12/13	0.777
Duration of Surgery	62.6±12.57	63.88±13.29	0.727
Temperature	37.04±0.26	37.01±0.25	0.741
Median highest blocked segment	T8	T8	

The total incidence and severity of shivering after spinal anesthesia are presented in the following table.

	Group A	Group B	P Value
	N=25	N=25	
Incidence n,(%)	3(12)	15(60)	<0.001
During Surgery n,(%)	3(12)	11(44)	<0.001
First 30mins n,(%)	1(4)	4(16)	
Second 30mins n,(%)	2(8)	7(28)	
During Recovery n,(%)	0(0)	4(20)	<0.001
Severity (1+,2+,3+)	1,2,0	6,7,2	0.006

The total incidence of shivering was significantly lower in Group A when compared to Group B 3 out of the 25 patients (12%) in Group A experienced shivering while 15 out of the 25 patients (60%) experienced shivering in Group B. Shivering started within the first hour of spinal anaesthesia and the rate of shivering in second 30 minutes was higher than first 30minutes.

All patients in Group A experienced shivering during surgery. In Group B, 11 out of the 15 patients had shivering during surgery and 4 at the time of recovery, where the patients were observed one hour following surgery.

The severity of shivering in Group A was significantly lower than Group B. In Group A, one patient experienced mild and 2 experienced moderate shivering, with none presenting with severe shivering. In Group B, the number of patients reported to have mild, moderate and severe shivering were 6,7, and 2 respectively.

There was no significant difference in the side effects such as hypotension, bradycardia or nausea experienced in either group. None of the patients, in either group, had respiratory depression or itching.

4. Discussion

Our study results revealed that intrathecal bupivacaine combined with fentanyl is associated with a lower incidence and severity of shivering.

In a similar study conducted by Sadegh et al[7], it was demonstrated that intrathecal bupivacaine combined with fentanyl is associated with a lower incidence and severity of shivering in women undergoing spinal anaesthesia for elective lower segment caesarean section. (10% in the fentanyl group; 75% in the saline, p< 0.0001).

A study done by Chow et al[8] also showed that the administration of a small dose (1.25 µg) of intrathecal fentanyl had significant influence on the incidence and severity of shivering during transurethral resection of prostate under spinal anesthesia. The incidence of shivering was reported to be 65.8% in the control group and 12.2% in the study group, which was statistically significant. The shivering grade (1.0±0 vs 1.76±0.7) and accumulative shivering scores (2.4±0.8 vs 12.5±5.6) were also significantly decreased in the study group. There was no difference in the incidence of pharmacologic side effects.

Similar results were reported by Techanivate et al[9] who showed that 20 µg fentanyl added to hyperbaric bupivacaine can reduce the incidence and severity of shivering without increasing other side effects such as hypotension, nausea and vomiting; and these side effects were not significantly different from the saline group.

Shivering is a frequent complication of spinal anaesthesia and is a distressing experience for the patient. The exact mechanism of shivering during spinal anaesthesia, however, has not been fully recognized. The neurotransmitter pathways involved in shivering are multiple and involve opioids, α2 adrenergic, serotenergic, and anticholinergic

receptors. Hence, drugs acting on these systems which include opioids (pethidine, nalbuphine, or tramadol), ketanserin, propofol, doxapram, clonidine, ketamine and nefopam are utilized in the treatment of shivering.[10]

Fentanyl is a highly ionized, lipophilic μ-receptor agonist. When it is administered intratecally, the unionized component is rapidly transferred into the spinal cord. The reduction of shivering in the present study may be attributable to the effect of fentanyl that was added into the subarachnoid space on the thermo-regulator and spinal afferent thermal inputs at the spinal cord

Effect of fentanyl is brought about by its action on mu opioid receptors. Its use adjunctively with bupivacaine enhances the effectiveness of anaesthesia; thereby lowering the dose needed to achieve adequate anaesthesia and reducing the risk of adverse effects.

In conclusion, as per results of our study we conclude that Intrathecal bupivacaine combined with fentanyl is associated with a lower incidence and severity of shivering in lower limb surgeries.

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