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Effects of I/V Fentanyl on Post-Spinal Shivering Control in Non-Obstetrics Cases- A Prospective Study in Tertiary Care Hospital

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Abstract

Background: Post-spinal shivering is very distressing for patients and may induce a variety of complications. Spinal anaesthesia altered thermoregulatory response due to widen the interthreshold range. Vasoconstriction and shivering are the principal autonomic mechanisms of preserving body heat and increasing heat production. Various methods are available for the control of shiverinq during anaesthesia. Intravenous administration of fentanyl has been found to be effective in shivering control after spinal anaesthesia.

Objective: The aim of the study was to evaluate the efficacy of IV fentanyl (1.7 µgm/kg) on post spinal shivering control.

Methods: This prospective clinical study was carried out on 100 patients including male and female in the Department of Anaesthesia, Analgesia, Palliative & Intensive Care Medicine, Dhaka Medical College Hospital, Bangladesh from 8th August 2018 to 7th February 2019. Data was entered in MS Excel and statistical analysis was done using SPSS-24.

Results: Patients characteristics in respect of age, gender distribution. Residence, others socio-demographic characteristics and ASA status were similar amongst the study population. Majority of patients (41%) belongs to age 31 to 40 years; 53% were male and 47% were female. 26.0% of patients had ASA physical status I and 74.0% patients had ASA physical status II. After development of shivering Intravenous fentanyl (1.7µgm/kg) was given in stat dose and improvement/worsening was assessed after 15 minute and after 30 minutes. Mean shivering score was 3.2 ± 0.16 at the time of administration, 1.8 ± 0.05 after 15 min and 1.1± 0.03 after 30 min. The difference of the time of administration, 15 min and 30 min was statistically significant ($P<0.05$). In this study rescue medication for shivering (Inj. Pethidine 25 mg) was required only for 13 patients those shivering grade was 3-4.

Conclusion: In this study it is evident that IV fentanyl significantly decreased the shivering and is an effective agent on post spinal shivering control. Since shivering is a common consequence of spinal anaesthesia and it may leads to various complications and discomfort to the patient, proper steps must be taken for its prevention and treatment.

Keywords: *Post spinal shivering; Spinal anaesthesia; Thermoregulation; Vasoconstriction; Shivering grade*

Introduction

Perioperative shivering is a common experience for the patients undergoing regional anaesthesia. The incidence is estimated to be around 60%. Thermoregulation is a multilevel, multiple-input system with the spinal cord, nucleus raphe magnus and locus subcoeruleus involved in both generating afferent thermal signals and modulating efferent thermoregulatory responses. The impairment of autonomic thermoregulatory control is observed while the patient is under anaesthesia, cold environment of the theater and cold intravenous fluids may contribute to fall in body temperature and hence shivering [1]. Post-anesthetic shivering is spontaneous, involuntary, rhythmic, oscillating and tremor-like muscle hyperactivity that increases metabolic heat production

after general or regional anaesthesia. It may cause discomfort to patients and aggravate wound pain by stretching incisions and increase intracranial and intraocular pressure. In homeothermic species, a thermoregulatory system coordinates defenses against cold and heat to maintain internal body temperature within a narrow range, thus optimizing normal physiologic and metabolic function [2]. The processing of thermoregulatory response has three components: Afferent thermal sensing, central regulation and efferent responses. Together they work to maintain normal core body temperature. Afferent thermal sensing refers the signals from cold receptors travel along Aδ fibre and signals from warmth receptors are conveyed by C fibres. Thermal inputs get integrated at the level of spinal cord. Eventually it arrives at the hypothalamus, the primary thermoregulatory control center in mammals. Adjacent to the centre in the posterior hypothalamus on which the impulses from cold receptors impinge, there is a motor centre for shivering. It is normally inhibited by impulses from the heat-sensitive area in the anterion hypothalamus, but when cold impulses exceed a certain rate, the motor centre for shivering becomes activated by spillover of signals, and it sends impulses bilaterally into the spinal cord. Initially this increases the tone of skeletal muscles throughout the body. But when this muscle tone increases above a specific level, shivering is observed. Shivering may increase heat production sixfold. The principle defense against hypothermia in humans includes vasoconstriction, nonshivering thermogenesis and shivering. Thermoregulatory shivering is thus a "last resort" defense that is activated only when behavioral compensations and maximal arterio-venous shunt vasoconstriction are insufficient to maintain core temperature. The role of non-shivering thermogenesis in adult is minimal, but play an important role to increase heat production in neonates [3]. Post spinal shivering causes a major distress for patients and may induce some complications [4]. It associated with an increase in intra-abdominal pressure, impaired the surgical procedure and with wound pain. Thus, both the prevention of shivering and the treatment of established shivering should be regarded as clinically relevant medical interventions in the perioperative period. Shivering may happen as a response to hypothermia. This is one reason why patients' body temperature should be kept within a normal range during surgery. However, shivering may also occur in normothermic patients. Moreover, adequate body warming is not always possible. In selected surgical patients, anesthesiologists may therefore wish to prevent shivering by using pharmacological strategies. Indeed, numerous studies have tested the efficacy of a large variety of interventions that are thought to prevent shivering in normothermic or hypothermic surgical patients. Despite the availability of various drugs and technologies to prevent hypothermia it continues to remain an ongoing problem in the perioperative period. First of all, our goal to review the organization of the thermoregulatory system and particularly the physiology of postanaesthetic shivering. Many studies have tried to overcome this ill effect using various pharmacological agents. Several drugs such as pethidine, doxapram, clonidine, ketamine, tramadol, physostigmine have been studied for the treatment of shivering. Of this pethidine is extensively evaluated and is the drug of choice for the treatment of shivering in post anaesthetic period [5]. Fentanyl due to its sedative action on brain decreases shivering. Previous study demonstrated that 25 micrograms of fentanyl or 0.1 mg of morphine added to bupivacaine may prevent shivering during spinal anaesthesia without causing significant hypotension, nausea or vomiting [6]. Performed a prospective, study to compare the effects of morphine and pethidine on shivering. They found that shivering was less frequent in patients receiving morphine and pethidine in addition to local anesthetic as compared to those only receiving local anesthetic. Moreover, shivering was less common in the pethidine group than in the morphine group. In another study, groups receiving morphine and fentanyl were similar in regard to the occurrence of shivering, whereas shivering was less common in these groups than in the group that received only normal saline [7]. Therefore aim of this study was to evaluation of the efficacy of IV fentanyl (1.7 µgm/kg) on post spinal shivering control at our setting.

Methodology

This prospective clinical study was carried out on 100 patients including male and female in the Department of Anaesthesia, Analgesia, Palliative & Intensive Care Medicine, Dhaka Medical College Hospital, and Dhaka, Bangladesh from 8th August 2018 to 7th February 2019. Patients were enrolled in the study after institutional ethics committee approval and written informed consent of the participants. Patients with ASA grade I, II admitted in hospital for the elective operative process (except obstetrics indication) under spinal anaesthesia were selected for study. Spinal anaesthesia was performed with 0.5% bupivacaine heavy 15mg intrathecally at L3-L4 or L4-L5 interspinous spaces with 25 G Quincke's spinal needle. All patients had covered with one layer of surgical drapes over the chest, thighs and calves during the operation and one cotton blanket over the entire body after the operation. All patients were monitored by non-invasive blood pressure and pulse oximetry after arrival to the operating room. Supplemental oxygen (5 liters/min) was delivered via a facemask during the operation. Heart rate, mean arterial blood pressure, peripheral oxygen saturation (SpO2) and occurrence of shivering was graded and recorded. Shivering was described as piloerection & graded used 0=No shivering, 1=Piloerection or peripheral vasoconstriction but no visible shivering, 2=Muscular activity in only one muscle group, 3=Muscular activity in more than one muscle group but not generalized and 4= Shivering all over the body. If shivering grade is II, III or IV, intravenous fentanyl

(1.7µgm/kg) was given in stat dose [8,9]. Following that haemodynamic condition and outcome was assessed at different point of time. After collection, the data were checked and cleaned, followed by editing, compiling, coding and categorizing according to the objectives and variable to detect errors and to maintain consistency, relevancy and quality control. The data for this study had been accumulated from patients' medical information. Statistical evaluation of the results used to be got via the use of a window-based computer software program devised with Statistical Packages for Social Sciences (SPSS-24).

Results

A total of 100 patients were evaluated. All groups were comparable with respect to the demographic and operational factors. Demonstrates that majority of patients (41%) belongs to age 31 to 40 yrs. Next group of patients (37%) observed in 41 to 50 yrs of age group. Mean age of the patient was 38.9 ± 11.2. Out of 100 cases 53% were male and 47% were female patients came from both urban and rural areas with urban (68%) preponderance. The difference was statistically not significant (P>0.05) (Table 1). Distribution of patients according to type of surgery revealed that, Orthopedic (e.g., ORIF CRIF, prosthesis) cases were predominant (45.0%), followed by gynaecological surgery- hysterectomy, adenomyomectomy, repair of perineal tear & VVF were performed in 34.0% of cases and urological surgery in 13.0% of cases under spinal anaesthesia. shows the American Society of Anesthesiologist (ASA) physical status. In this study 26.0% of patients had ASA physical status I and 74.0% patients had ASA physical status II (Figure 1) (Table 2).

Table 1: *Distribution of the patients according to the demographic profile (n=1 00).*

Age	n=100	%	Mean ± SD
20-30	11	11.0	38.9 ± 11.2
31-40	41	41.0	
41-50	37	37.0	
51-60	11	11.0	
Gender			
Male	53	53	
Female	47	47	
Residence			**P value**
Urban	68	68	0.726
Rural	32	32	

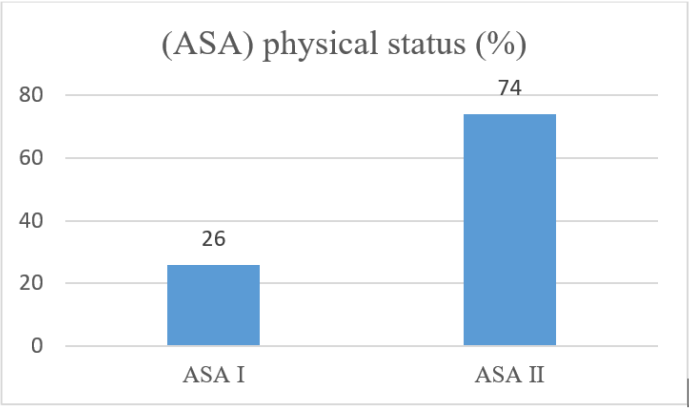

Figure 1: *American Society of Anesthesiologist (ASA) physical status (n=100).*

Table 2: *Distribution of patients according to type of surgery (n=100).*

Types	n=100	%
Gynaecological surgery	34	34.0
Urological	13	13.0
Plastic surgery	8	8.0
Orthopedic surgery	45	45.0

Table 3: *Assessment of shivering status amongst the study subject (n=100).*

Time (after admission of drug)	Grade of Shivering				Mean ±SD	P value
	0	1	2	3-4		
At the time of administration	**0**	**0**	**17**	**83**	**3.2**±0.16	**0.0001**
At 15 min after administration	**5**	**24**	**58**	**13**	**1.8**±0.05	
At 30 min after administration	**12**	**65**	**23**	**0**	**1.1**±0.03	

Shows the shivering status amongst the study subject. After development of shivering (grade 2, 3 or 4), intravenous fentanyl (1.7 µgm/kg) was given in stat dose and following the heart rate, BP, oxygen saturation and alleviation of shivering was observed. After 15 minute of time 58 patients had found grade 2 and 24 patients detected grade 1 and 13 patients had grade 3-4 with mean score as 1.8±0.05 (Table 3). It was found that shivering was admirably controlled after administration of fentanyl. Mean shivering score was 3.2±0.16 at the time of administration, 1.8±0.05 after 15 min and 1.1±0.03 after 30 min. The difference of the time of administration, 15 min and 30 min was statistically significant (P<0.05). Shows the grade of Shivering 15 minutes after medication. After 15 min of administration of intravenous fentanyl, 87.0% of patients responds found well and shivering was attenuated. These patients had not required other medication. According to operational definition, grade 3 or 4 was considered

severe shivering and rescue treatment in the form of IV 25 mg of pethidine was given (Figure 2).

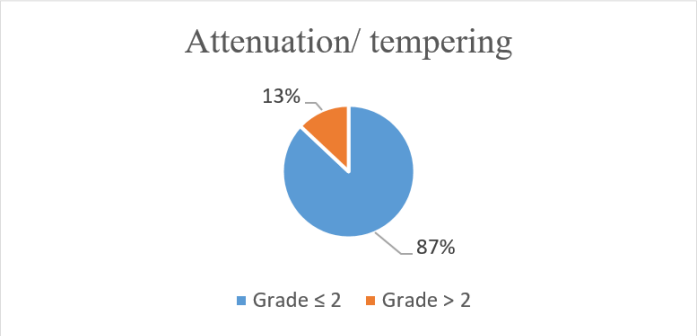

Figure 2: *Grade of Shivering 15 minutes after medication (n=100).*

So, in this study frequency of un-satisfactory (shivering grade >2) responds was in 13.0%. Shows systolic and diastolic blood pressure during follow up it was observed that at 5th min. mean systolic BP was found 91.3±7.8 mmHg. 15 min after; mean systolic blood pressure was 85.3±5.8 mmHg and 30 min after SBP was 82.4±6.2 mmHg. Regarding diastolic blood pressure during follow up, at 5th min after development of shivering mean DBP was 65.7±5.1 mmHg, 15 min after mean DBP 58.5±8.2 mmHg and 30 min after was 62.1±6.5 mmHg (Table 4). During shivering, heart rate was increased by 116 beats/min. But 15 min later of medication, there was significant attenuation of heart rate (91 beat/min) and 86 beat/min after 30 minutes.

Table 4: *Evaluation of blood pressure amongst the study subjects (n=100).*

Time (After administration of drug)	Systolic BP (mmHg)	P-value	Diastolic BP (mmHg)	P-value
	Mean±SD		Mean±SD	
At 5th min	91.3±7.8	0.032	65.7±5.1	0.085
Range (min-max)	85-95		45-80	
15 min after	85.3±5.8	0.054	58.5±8.2	0.073
Range (min-max)	80-95		45-80	
30 min after	82.4±6.2	0.097	62.1±6.5	1.066
Range (min-max)	62-95		45-80	
60 min after	78.2±5.1	0.157	61.5±7.3	0.093
Range (min-max)	80-95		45-80	

Table 5: *Occurrence of complications.*

Complications	Frequency of occurrence	%
Nausea/ vomiting	**23**	**23.0**
Hypotension	**36**	**36.0**
Cardiovascular collapse	**0**	**0**
Bradycardia	**11**	**11.0**
Drowsiness	**6**	**6.0**

Table 6: *Requirement of rescue medication.*

Rescue Medication	Frequency of use	%
Hartmann solution (1.5-2 ml/kg/hr)	36	36.0
Inj. Ephedrine (5 mg-15 mg)	8	8.0
Inj. Pethidine 25 mg	13	13.0
inj. Atropine (0.6 mg)	5	5.0

So it is concluded that heart rate and blood pressure values were less and close to base levels with minimal requirement of rescue medication after administration of intravenous fentanyl and remained stabilized throughout the intraoperative period (Figure 3). Nausea and vomiting were found in 23.0% patients and hypotension was developed in 36 patients. Bradycardia was developed in 11 patients and drowsiness in 6 patients (Table 5). Rescue medication for shivering (Inj. Pethidine 25 mg) required for 13 patient those shivering grade was 3-4. Hypotension was managed by an additional volume Inj. Hartmann solution (1.5-2 ml/kg/hr) in 36 patients, but 8 patients were required Inj. Ephedrine (5 mg-15 mg). For management of bradycardia inj. Atropine (0.6 mg) was given in 5 patients (Table 6).

Discussion

Patients' characteristics in respect of age, gender distribution, residence, others socio-demographic characteristics and ASA status were similar amongst the study population. A total of 100

patients were evaluated. Majority of patients (41%) belongs to age 31 to 40 years; mean age of the patient were 38.9 ± 11.2 years. Out of 100 cases 53% were male and 47% were female. American Society of Anesthesiologist (ASA) physical status revealed that 26.0% of patients had ASA physical status I and 74.0% patients had ASA physical status II. Findings are consistent with result of others study in home and abroad. In a study in tertiary level hospital of Bangladesh showed mean age were 31.46±11.27 years [10]. In this study grade of shivering and other hemodynamic status was evaluated meticulously.

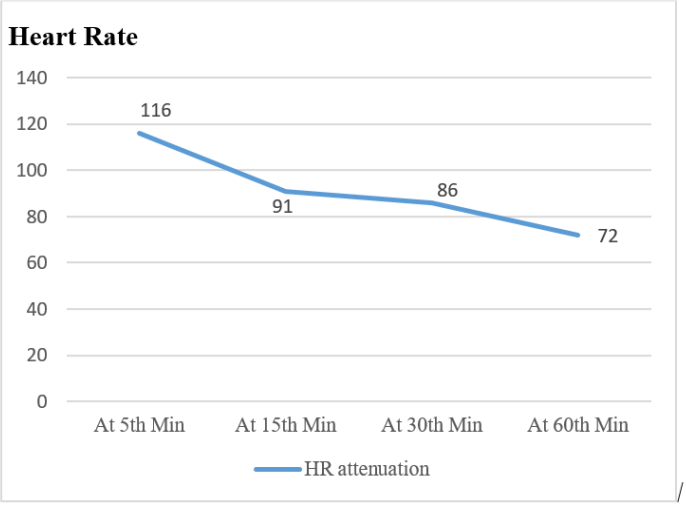

Figure 3: *Evaluation of heart rate (n=100).*

After development of shivering (grade 2. 3 or 4) intravenous fentanyl (1.7 µgm/kg) was given in stat dose and improvement/ worsening was assessed after 15 minute and after 30 minutes. It was found that 58 patients had found grade 2 and 24 patients had grade 1 with mean score as 1.8±0.05. It was found that shivering was admirably controlled after administration of fentanyl. Mean shivering score was 3.2±0.16 at the time of administration, 1.8±0.05 after 15 min and 1.1±0.03 after 30 min. The difference of the time of administration, 15 min and 30 min was statistically significant ($P<0.05$). Another study demonstrated that 25 micrograms of fentanyl or 0.1 mg of morphine may prevent shivering during spinal anaesthesia without causing significant hypotension, nausea or vomiting [11]. In this study during shivering, heart rate was increased by 116 beats/min and systolic, diastolic blood pressure was found 91.3±7.8 mmHg and 65.7±5.1 mmHg. But 15 min later of medication, there was significant attenuation of heart rate (91 beat/min) and SBP (85.3±5.8 mmHg) and DBP (58.5±8.2 mmHg). So, it is concluded that heart rate and blood pressure values were less and close to base levels with minimal requirement of rescue medication after administration of intravenous fentanyl and remained stabilized throughout the intraoperative period. In a study, found that 96% of patients stopped shivering within 2 min and 4% of patients stopped within 2-5 min after treatment with fentanyl and 40% of patients stopped shivering within 2 min and 60% stopped shivering within 2-5 min after treatment with butorphanol [12]. Another comparative study between fentanyl and sufentanil shows that, 25 mcg fentanyl and 2.5 mcg sufentanil was associated with increased sensory block, motor block, duration of analgesia and hemodynamic stability, with no major complication. Considering that the use of fentanyl had a similar duration of analgesia like sufentanil, but it had a faster return of motor block and consequent ambulation, it seems that fentanyl is a preferred opioid compared to sufentanil [13]. So present study established that fentanyl is an effective drug in control of post spinal shivering. Fentanyl is well known for its rapid onset and shorter duration of action following IV administration. Fentanyl is an opioid which is often used for anaesthesia and analgesia. Fentanyl provides some of the effects typical of other opioids through its agonism of the opioid receptors. Its strong potency in relation to that of morphine is largely due to its high lipophilicity. It can more easily penetrate the central nervous system. Intravenous administration has been found to be very effective in minimizing discomfort during and after spinal anaesthesia. In this study rescue medication for shivering (Inj. Pethidine 25 mg) was required only for 13 patients those shivering grade was 3-4. On the basis of this study, it is concluded that fentanyl is effective to control perioperative shivering.

Limitations of the Study

It was a single center study and small sample size of the study population. Only patients admitted in Dhaka Medical College Hospital (DMCH) were taken for the study. So, this will not reflect the overall picture of the country. A large-scale study needs to be conducted to reach to a definitive conclusion. Study was conducted in a tertiary care hospital which may not represent primary or secondary center. Sample were taken by purposive method in which question of personal biasness might arise. Other limitation were short duration of study and limited investigation facility.

Conclusion

Fentanyl is effective medication to control post-spinal shivering. Shivering occurs as a thermoregulatory response to hypothermia or muscle hyperactivity with clonic or tonic patterns and different frequencies have been reported. However, in the post spinal period shivering has been reported in patients with normothermia, suggesting that other mechanisms other than heat loss and subsequent decrease in core body temperature may contribute to the development of shivering. These mechanisms include inhibited spinal reflexes, decreased sympathetic activity, altered thermoregulatory vasoconstriction mechanism. It is impersonating

that fentanyl significantly decreases shivering in patients under spinal anaesthesia.

Recommendation

Further studies can be undertaken by including large number of patients in multiple tertiary level hospitals.

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