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Original Research Article

Comparative Analysis of Tramadol, Ketamine and Dexmedetomidine in the Prevention of Intraoperative Shivering in Patients Undergoing Surgery underneath Subarachnoid Blockade

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Abstract:

Background and Aim: Shivering is a common postanesthesia adverse effect with a variety of causes. Core neuraxial blockade blunts the thermoregulatory mechanism by limiting vasoconstriction, resulting in the transfer of core heat from the trunk to the periphery. To manage intraoperative shivering, many pharmacological and non-pharmacological approaches are used. In this study, we employed Tramadol, Ketamine, and Dexmedetomidine to investigate the efficacy of avoiding intraoperative shivering in patients having spinal anaesthesia.

Methods and materials: The current study was conducted at the Tertiary Care Institute of India's Department of Anaesthesia. The patients were divided into three groups, each with 50 participants: Group T (Tramadol 0.5 mg/kg), Group K (Ketamine 0.25 mg/kg), and Group D (Dexmedetomidine 0.5g/kg). Shivering was detected using Wrench's grading system.

Results: The Tramadol group exhibited the highest incidence of shivering with a shivering grade greater than two at 15 minutes and 30 minutes, with p values of 0.045 and 0.003, respectively.

Conclusion: When compared to Tramadol and Ketamine, Dexmedetomidine at 0.5 g/kg successfully prevents intraoperative shivering in patients undergoing surgery under subarachnoid blockade.

Keywords: Dexmedetomidine, Ketamine, Shivering, Tramadol.

Introduction

Shivering is characterised as an involuntary, repeated activation of skeletal muscles and is a common post-anaesthesia event. Shivering has been reported to be quite common, ranging from 40-50% in various studies.[1] It has the potential to quadruple or perhaps triple oxygen consumption and carbon dioxide output.[2] Shivering also raises intraocular and intracranial pressure, which may lead to greater wound pain, delayed wound healing, and post-anaesthetic care release delays.[3,4]

Apart from being an unpleasant experience, its negative consequences demand primary prevention and prompt control when it occurs. Shivering is a physiological reaction to core hypothermia that tries to increase metabolic heat generation. Temperature loss, elevated sympathetic tone, discomfort, and systemic pyrogen release are the primary reasons of intra/post-operative shivering.[5] By blocking tonic vasoconstriction, which plays an important role in temperature regulation, spinal anaesthesia greatly damages the thermoregulation system. It also causes core heat to be redistributed from the trunk (below the block level) to the peripheral tissues. These variables make patients more prone to hypothermia and shivering.Various methods have been used to prevent and treat postanesthesia shivering. Dexmedetomidine is a centrally acting alpha 2 adrenergic agonist that has been used as a sedative and has been shown to lower the shivering threshold. Several studies have been conducted to investigate the use of dexmedetomidine in the prevention of postoperative shivering.[5] However,

there have been few investigations on the use of dexmedetomidine in the treatment of postoperative shivering. Tramadol, an opioid receptor agonist, inhibits serotonin (5-hydroxytryptamine) and norepinephrine reuptake in the spinal cord. This promotes the release of 5 hydroxytryptamine, which modulates thermoregulatory regulation. It is currently a frequently used medication for the treatment of shivering. However, tramadol can cause nausea and vomiting, which can be quite stressful for the patient. As a result, there is a need to develop a better medicine that is as effective as tramadol while having fewer negative effects.

For many years, pethidine has been used as a therapy for shivering.[6] In this study, we employed Tramadol, Ketamine, and Dexmedetomidine to investigate the efficacy of avoiding intraoperative shivering in patients having spinal anaesthesia.

Material and Methods

The current study was conducted at the Tertiary Care Institute of India's Department of Anaesthesia. This study was conducted after receiving Institutional Human Ethics Committee approval and informed written consent from all patients who participated in the trial. It is a prospective randomised control study, with a sample size estimated using a 95% confidence interval and a research power of 80%. Each group had a sample size of 50 people, with a one-to-one allocation ratio.

This study will include 150 patients aged 20 to 65 years old with ASA 1 and 2 who have been scheduled for elective surgery with subarachnoid blocking. The patients were divided into three groups, each with 50 participants: Group T (Tramadol 0.5 mg/kg), Group K (Ketamine 0.25 mg/kg), and Group D (Dexmedetomidine 0.5g/kg). Patients were assigned to one of three groups at random using a computer-generated random table number, and the matching number was represented by the research drug's concerned group. It is a double-blind study in which the performer is likewise uninformed of the drug's group until the end of the trial.

Patients with known hypersensitivity to dexmedetomidine or tramadol, cardiopulmonary, renal, or hepatic disease, hyperthyroidism, psychiatric disorder, urinary tract infection, severe diabetes, or autonomic neuropathies, a history of substance or alcohol abuse, or patients receiving any pre-medication were excluded from the study.Routine pre-operative evaluations were performed, and patients were kept nil per oral from 10 p.m. the day before surgery. Written informed consent was obtained.

All patients were pre-medicated with Pantoprazole 40 mg and Alprazolam 0.25 mg tablets taken orally the night before surgery and Pantoprazole 40 mg at 6 a.m. on the day of operation. Patients were randomised to one of three groups based on a computer-generated random table number.

Tramadol (n=50) group 0.5 mg/kg in 100 millilitre NS for 10 to 15 minutes

Ketamine (n=50) group 0.25 mg/kg in 100 millilitre NS for 10 to 15 minutes

Dexmedetomidine (n=50) group 0.5 g/kg in 100 millilitre NS for 10 to 15 minutes

An 18G intravenous cannula was implanted in the pre-operative room, and an infusion of Plasmalyte solution began at 2ml/kg/hr. When the patient arrived in the operating room, pre-induction monitors such as ECG, NIBP, and SpO2 were connected, and monitoring of these parameters began after the baseline values were noted. The operation room temperature was kept at 25oC. The patient was put in the right lateral position, and sterile painting draping was performed in accordance with conventional universal precautions. Following skin infiltration with 2 ml of 2% Lignocaine, a 26G Quincke spinal needle was used to try a spinal puncture in the L3L4 or L4 L5 interspace. Following the development of free flow of CSF, a 30-second intrathecal infusion of 15mg 0.5% Bupivacaine Heavy was administered, and the patient was turned supine following the spinal injection. No patients were given a tilt. The blind observer administered the research medication. All patients received oxygen at a rate of 5L/min via Hudson's mask, as well as an injection of Ondansetron 4 mg. When the spinal blockage level reached T7/T8, the surgery began, and patients were watched for 120 minutes, or until the end of the procedure, due to the lengthier duration among them.

The haemodynamic parameters were kept track of. Hypotension was treated with intravenous fluids and vasopressors (injection Ephedrine or Mephentremine 6 mg IV bolus SOS). Glycopyrrolate 0.004 mg/kg IV bolus SOS was used to treat bradycardia. The level of sedation and intraoperative temperature monitoring were also evaluated. Patients who developed shivering during surgery were given injectable Pethidine 0.25 mg/kg as a rescue medication.

Shivering was detected using Wrench's grading system.

Grade 0: No shivering

Grade 1: One or more of the following – Piloerection peripheral vasoconstriction peripheral cyanosis but without visible muscle activity.

Grade 2: Visible muscle activity confined to one muscle group.

Grade 3: Visible muscle activity in more than 1 muscle group.
Grade 4: Gross muscle activity involving the whole body

Sedation was assessed by a four point scale as per Filos et al.

Grade 1: Awake and alert.
Grade 2: Drowsy, responsive to verbal stimuli.
Grade 3: Drowsy, arousable to physical stimuli.
Grade 4: Unarousable

Statistical Analysis

The collected data was assembled and input into a spreadsheet programme (Microsoft Excel 2007) before being exported to the data editor page of SPSS version 15 (SPSS Inc., Chicago, Illinois, USA). The confidence level and level of significance for all tests were set at 95% and 5%, respectively.

Table 1: Demographic data of all three groups

Variables	Group T	Group K	Group D	P value
Age				
Mean Age (Years)	38.80±10.12	39.47±8.12	39.12±5.44	0.12
Gender				
Male	38 (76)	45 (90)	42 (84)	0.65
Female	12 (24)	5 (10)	8 (16)	
Weight (kg)	64.54±8.78	65.78±10.23	64.05±09.10	0.47
Height (cm)	161.7±6.1	166.87±7.32	164.20±5.10	0.23
ASA Grading				
I	40 (80)	40 (80)	39 (78)	0.09
II	10 (20)	10 (20)	11 (22)	

Statistically significance at p≤0.05

Table 2: Incidence of shivering between three groups

Time (mins)	Group T	Group K	Group D	P value
Baseline	0	0	0	-
5	0	0	0	-
10	0	0	0	-
15	8	0	0	0.01*
30	14	3	1	0.02*
45	4	0	1	0.2
60	1	0	0	0.1
75	2	1	0	0.32
90	0	0	0	-
105	0	0	0	-
120	0	1	0	-

* Indicates statistically significance at p≤0.05

Results and Discussion

Shivering is a common complication in patients undergoing neuraxial anaesthesia during surgery. Based on prior research, Shukla et al [7] estimated the rate of shivering in patients undergoing regional anaesthesia to be 40-70%. During central neuraxial blockade, autonomic thermoregulation is impaired, resulting in a fall in central or core temperature. Shivering and vasoconstriction thresholds cephalad to the level of the neuraxial block are reduced by 0.60 C with central neuraxial blockade. The hypothesis of postanaesthesia shivering similar to convulsions or tremors has yet to be verified. According to the hypotheses, tremors could be caused by a decrease in reflex response in the descending spinal reflexes caused by central neuraxial blockage.[8] The two tremor patterns observed might be a tonic pattern like normal shivering with a waxing and waning model of 4 - 8 cycle/min or a phasic pattern with a 5 to 7 Hz shattering pattern comparable to pathologic clonus response. The net consequence of these tonic and phasic patterns is the result of thermoregulatory responses prevailing with temperature decline and arteriovenous shunt vasoconstriction.[9]

The primary goal of our investigation was to see how medicines affected the incidence of shivering in the study group population.[10] Dexmedetomidine had a lower incidence of intra-operative shivering than Tramadol and Ketamine, with only one patient shaking 30 minutes after subarachnoid blocking, which was comparable to Lim fern et al [11] investigations with similar results. 8 patients in the Tramadol group at 15 minutes and 14 patients at 30 minutes had the highest incidence of shivering with a shivering grade greater than two, and this was statistically significant with p values of 0.045 and 0.003,

respectively. Only one subject in the Ketamine group shivered after 30 minutes. In his study, Mittal et al [12] compared dexmedetomidine to tramadol supplementation after the onset of shivering and reported that both medications were similarly efficacious, with dexmedetomidine having a faster onset of action. Bozgeyik et al [13] tested dexmedetomidine and tramadol to a placebo and found that both medications were equally effective at preventing shivering. In their study, Dal et al [14] discovered that the number of patients shivering on arrival in the recovery room, as well as at 10 and 20 minutes after surgery, were significantly lower in Groups P (pethidine 20 mg) and K (ketamine 0.5 mg kg) than in Group S (normal saline), and concluded that the use of prophylactic low-dose ketamine was very useful in preventing postoperative shivering.

Tramadol is an opioid analgesic with an opioid impact that is mostly mediated by the mu receptor and has little effect on the kappa and delta receptors. It also activates the descending spinal inhibitory pain pathway's monoaminergic receptors. Tramadol's anti-shivering impact is most likely mediated by its opioid or serotonergic and noradrenergic activity, or both. [15-17] It is a well-known medication for the treatment of post-anaesthesia shivering.

Alpha-2 adrenergic agonists are commonly utilised in anaesthesia and intensive care settings nowadays. Dexmedetomidine is an antihypertensive, sedative, analgesic, and anti-shivering 2 adrenoceptor agonist.[18] Alpha adrenoceptor agonists' anti-shivering effects are achieved through binding to two receptors that mediate vasoconstriction and the anti-shivering effect. It also possesses hypothalamic thermoregulatory properties.[19] Dexmedetomidine decreases vasoconstriction and shivering thresholds in a comparable manner, implying that it operates on the central thermoregulatory system rather than inhibiting shivering peripherally.[20]

It has been used successfully as an adjuvant to local anaesthetics in spinal anaesthesia and peripheral nerve blocking, for sedation of mechanically ventilated patients in the Intensive Care Unit, and for post-operative analgesic replenishment.[21] A few studies have looked into the role of dexmedetomidine in the treatment of shivering.[22,23] It could be an excellent choice due to its twin effects of 'anti-shivering' and sedative.The secondary goal of the study was sleepiness, and all of the medicines utilized in the study group can cause drowsiness to some level; thus, no sedatives, hypnotics, or anxiolytics were administered to the study population. When compared to the other two medications, dexmedetomidine produced an excellent sedation score of 3 within 5 minutes in the majority of the population and comfortably lasted for roughly 90 minutes without creating haemodynamic abnormalities. Sedation onset was delayed, peaking around 15 minutes for a sedation score of 2 in 40% in the Tramadol group. Ketamine outperformed tramadol in terms of sedation and was nearly identical to dexmedetomidine in terms of peak effect within 15 minutes, generating an excellent sedation score but lacking in the awakening state. In his tests, Mittal et al [12] concluded that drowsiness caused by dexmedetomidine provided greater comfort to the patient. In his work, Bozgeyik et al [13] obtained comparable results of sedation within 5 minutes with dexmedetomidine. Usta B et al [23] found that the dexmedetomidine group provided more convenient sedation for the patient. As observed in Elvan et al experiments, a dexmedetomidine sedated population followed oral orders and remained calm. [24] In all three groups, there was no evidence of respiratory depression, nausea, vomiting, or headache. In all three groups, there was no statistical significance in the measurement of axillary temperatures.

The restriction identified in our research is optimal. The dose of dexmedetomidine must be determined in order to generate negligible haemodynamic instability. When compared to Ketamine and Tramadol, Dexmedetomidine was more effective in preventing shivering, with the added benefit of adequate dependable sedation and steady haemodynamics without any harmful adverse effects.

Conclusion

When compared to Tramadol and Ketamine, Dexmedetomidine at 0.5 g/kg effectively reduces intraoperative shivering in patients undergoing surgery under subarachnoid blockade. More research into multiple dose ranges of dexmedetomidine is needed to solidify its status as an effective anti-shivering medication.

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