Original Research Article

Comparison of Effectiveness of Dexmedetomidine and Tramadol in the Treatment of Post-Neuraxial Anaesthesia Shivering

Usma Jabeen[1*], Suhail Banday[2], Saba Wani[3]

[1]Assistant Professor, Department of Anaesthesiology & Critical Care, GMC Rajouri, Jammu & Kashmir, India
[2]Assistant Professor, Department of Anaesthesiology & Critical Care, GMC Rajouri, Jammu & Kashmir, India
[3]Senior Resident, Department of Anaesthesiology & Critical Care, GMC Rajouri, Jammu & Kashmir, India

Received: 24-09-2021 / Revised: 19-11-2021 / Accepted: 30-11-2021

Abstract

Background: Shivering is a common problem encountered after neuraxial anaesthesia and is most likely due to altered afferent thermal input from the blocked region. Tramadol a centrally acting analgesic drug, is effective in the treatment of post-anaesthetic shivering after general and neuraxial anaesthesia, by inhibiting the neuronal reuptake of noradrenaline and 5-hydroxytryptamine (5-HT), facilitates 5-HT release and activates the μ-opioid receptors. Dexmedetomidine, a potent alpha 2-adrenergic receptor agonist, acts by decreasing the vasoconstriction and is known to reduce the shivering threshold. **Materials & Methods:** This was a prospective, randomised, double-blinded study included 100 patients of either genders, aged 20–65 years with ASA status I-II scheduled to undergo elective surgery under spinal anaesthesia. They were then randomly allocated to receive either intravenous dexmedetomidine 0.5 μg/kg or tramadol 0.5 mg/kg. The response rate to treatment, the degree of sedation and the side-effects were recorded. **Results:** The response rate to treatment and bradycardia was more in the dexmedetomidine group, whereas, nausea and vomiting were observed more in tramadol group and diferrence was significant when compared between groups. Sedation score was comparable between two groups. **Conclusion:** Dexmedetomidine is superior to tramadol for shivering treatment, due to higher effective rate of shivering control, earlier onset of action and lesser recurrence of shivering and lower incidences of nausea and vomiting. However, dexmedetomidine is also associated with higher incidences of hypotension and bradycardia than tramadol.

Key words: Dexmedetomidine, Tramadol, Postanesthesia shivering

Introduction

Shivering is a common perioperative complication and incidence of shivering has been found to be quite high, approximately 40-50% in different studies.[1] Shivering is a physiological response to core hypothermia in an attempt to raise the metabolic heat production. The main causes of intra/post-operative shivering are temperature loss, increased sympathetic tone, pain, and systemic release of pyrogens.[2] Spinal anesthesia has impairment of shivering in the block area and greater heat loss than general anesthesia because of abnormal heat loss owing to vasodilatation and also causes a redistribution of core heat from the trunk (below the block level) to the peripheral tissues.[3,4] Shivering can cause severe consequences, such as arterial hypoxia and myocardial ischemia by increasing oxygen consumption.[5, 6]

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. The most frequently reported pharmacological interventions include clonidine, pethidine, tramadol, nefopam and ketamine.[7] Unfortunately, no gold standard treatment is known for shivering as the administration of all the available drugs is associated with various adverse effects.

Tramadol is commonly used for the treatment of shivering in clinical practice. However, tramadol can lead to nausea, vomiting and diziness which is very distressing for the patient.[1,8] Therefore, it is necessary to find a better drug with fewer side effects. Dexmedetomidine, a centrally acting alpha 2 adrenergic agonist, has been used as a sedative agent and is known to reduce the shivering threshold. Various studies have been performed using dexmedetomidine in the prophylaxis of postoperative shivering.[9]

*Correspondence
Dr. Usma Jabeen
Assistant Professor, Department of Anaesthesiology & Critical Care, GMC Rajouri, Jammu & Kashmir, India
E-mail: usmajabeen2016@gmail.com

Objective: The purpose of this study was to compare the efficacy of intravenous dexmedetomidine 0.5 μg/kg with that tramadol 0.5 mg/kg in the treatment of shivering as well as their side effect profile in patients undergoing elective surgery under spinal anesthesia.

Materials & Methods

This was a prospective, randomised, double-blind study, conducted after taking approval from Institutional Ethics Committee and written informed consent from patients. 100 American Society of Anaesthesiologists (ASA) Grade I-II, of either gender aged 20-65 years scheduled for elective lower abdominal, lower limb, orthopaedic and plastic surgeries under spinal anaesthesia were included in the study. Patients with known hypersensitivity to dexmedetomidine or tramadol, cardio-pulmonary, renal or hepatic disease, hyperthyroidism, psychiatric disorder, urinary tract infection, severe diabetes or autonomic neuropathies, known history of substance or alcohol abuse, patients receiving any pre-medication were excluded from the study.

Upon arrival in the operation theatre, standard monitors were attached and all the baseline parameters such as heart rate (HR), non-invasive blood pressure (NIBP), oxygen saturation (SPO2), electrocardiography (ECG), and body temperature (axillary) were recorded. 20G venous cannula was inserted and preloading done with Ringer's Lactate solution 10 ml/kg before giving spinal anaesthesia and maintained at 5 ml/kg/h after spinal anaesthesia. Under all aseptic conditions spinal anaesthesia was administered with 3ml of 0.5% heavy bupivacaine (15 mg) at L3-4 or L4-5 interspace using 26G Quincke's spinal needle. All operation theatres were maintained at an ambient temperature of around 24°C-25°C. Supplemental oxygen was administered to all the patients at the rate of 5 l/min with face mask and patients were covered with drapes but not actively warmed. 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 and axillary temperature monitoring was done.

All patients who fulfilled the inclusion criteria and developed post-spinal anaesthesia shivering were enrolled and randomised into either of the two groups by simple randomization.

Group D (n = 50) received intravenous dexmedetomidine 0.5 µg/kg diluted in 5ml syringe (10:1 concentration) over 10 min, if there was shivering in patient after initiation of subarachnoid block, and

Group T (n = 50) received intravenous tramadol 0.5 mg/kg diluted in 5 ml syringe (10:1 concentration) given over 10 min, if there was shivering in patient after initiation of subarachnoid block.

Anaesthesia resident who prepared study drugs was not a part of the study. The anaesthesiologist conducting the case as well as recording the data were unaware of the drug being administered.

Grading of shivering was done as follows:

- Grade 0: No shivering
- Grade 1: One or more of the following: Piloerection, peripheral vasoconstriction, peripheral cyanosis without other cause, but without visible muscle activity
- Grade 2: Visible muscle activity confined to one muscle group
- Grade 3: Visible muscle activity in more than one muscle group
- Grade 4: Gross muscle activity involving the whole body.
- Patients who developed either Grade 3 or Grade 4 of shivering were included in the study and received study drugs. Same criteria were used for grading shivering during recurrence and patients with Grade 3 or 4 shivering were included.

The attending anesthesiologist would record:

- The time of onset of shivering after SA and the time of recurrence, if present (defined as the time between cessation of shivering after the first dose of the drug and recurrence of shivering)
- Severity (grade) of the shivering
- Response rate (shivering ceased within 15 min after treatment)
- Time to disappearance of shivering (in seconds).

Duration of surgery was recorded and duration of spinal anaesthesia was noted by assessing spontaneous recovery of sensory block using the pin-prick method and observing spontaneous movements of limbs in the post-operative period.

If the shivering did not subside by 15 min, the treatment was considered to be not effective. Recurrence of shivering was also noticed. Patients who did not respond or in whom recurrence of shivering occured were treated with additional dose of dexmedetomidine (0.25 µg/kg IV) or tramadol (0.25 mg/kg IV) in the respective groups. If some patients did not respond to the additional dose, they would be regarded as treatment failure. This would be used to calculate the response rate.

Adverse effects such as nausea, vomiting, bradycardia and hypotension (20% of baseline), sedation score and respiratory depression were noted. The degree of sedation was graded on a four point Ramsay sedation scale as,

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

Bradycardia, hypotension, and vomiting were treated with Inj atropine 0.6 mg i/v, Inj ephedrine in 6 mg boluses i/v titrated until blood pressure (BP) reached within 20% of baseline BP and Inj metoclopramide 10 mg i/v, respectively, when required.

Postoperatively, after shifting patients to postanesthesia care unit (PACU), patients were not actively warmed and were given fluids at room temperature. The end point for the study was either sensory (using pin prick method) and motor recovery from subarachnoid block or the patient was given either of the two drugs twice for the treatment of shivering.

For motor recovery from subarachnoid block, the Bromage scale was used:

- Bromage 3: Unable to move feet or knees
- Bromage 2: Able to move feet only
- Bromage 1: Just able to move knees
- Bromage 0: Full flexion of knees and feet.

All the results were analyzed using Student's t test and Chi square test. Data were expressed as mean ± SD or percentage. A $p < 0.05$ was considered statistically significant. A $p < 0.001$ was considered highly significant.

Results

Both groups were comparable with respect to age, gender, ASA grade, duration of surgery and the duration of spinal anaesthesia. [Table 1].

Table 1 Demographic profile of patients of both groups

Parameter	Group D (n=50) (Mean ± SD)	Group T (n=50) (Mean ± SD)	P value
Age (years)	36.04±10.02	38.06±10.09	0.69
Gender (male/female)	24/26	29/21	0.34
Duration of surgery (min)	60.00±15.65	64.60±15.52	0.36
Duration of spinal anaesthesia (min)	123.40±14.20	127.50±15.26	0.28

All the patients had Grade 3 shivering. There was no statistically significant difference in time for the onset of shivering after spinal anesthesia between the two groups. However, the difference in the time interval between administration of drug after the onset of shivering and cessation of shivering was significantly shorter in the dexmedetomidine group when compared to tramadol group. There was recurrence of shivering in 1 patient in dexmedetomidine group and 5 patients in tramadol group. The patients were given rescue doses of dexmedetomidine or tramadol, respectively [Table 2].

Table 2 Parameters for post-spinal anaesthesia shivering

Parameter	Group D (n=50) (Mean ± SD)	Group T (n=50) (Mean ± SD)	P value
Onset of shivering (min)	22.40±12.55	23.20±12.23	0.62
Time for cessation of shivering after drug (min)	2.44±0.55	5.52±0.51	0.0022
Response rate (%)	100	100	-
Recurrence	1/50	5/50	0.121

Nausea and vomiting was observed only in tramadol group, and there was no incidence in the dexmedetomidine group. Almost similar number of patients were sedated in both groups and the sedation score in all the patients was 2. Hypotension and bradycardia observed more in patients received dexmedetomidine. There was no evidence of respiratory depression in both groups. [Table 3].

Table 3 Pattern of adverse reactions in both groups

Adverse effects	Group D (n=50)	Group T (n=50)
Nausea	0	8
Vomiting	0	3
Hypotension	1	0
Bradycardia	4	0
Respiratory depression	0	0

Discussion

Prioperative shivering is a distressing experience for the patients. Potential risk factors for hypothermia in spinal anaesthesia include ageing, level of sensory block, temperature of the operation theatre and IV solutions. Shukla et al.[1] have reported 40–70% incidence of shivering in patients undergoing surgery under regional anesthesia. In this study, all operation theatres (OTs) maintained an ambient temperature of 24-25°C, and all fluids and drugs were at room temperature during the surgery.

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.

Tramadol is a well-established agent in the treatment of post-anaesthesia shivering. The anti-shivering action of tramadol is probably mediated via its opioid or serotonergic and noradrenergic activity or both.[10-12]

Dexmedetomidine is a α2 adrenoceptor agonist, with antihypertensive, sedative, analgesic, and anti-shivering properties.[13] The role of dexmedetomidine in the treatment of shivering has been evaluated in a few studies.[14-16] it may be a good choice because of its dual effects related 'anti-shivering' and sedation.

In this study, we evaluated the efficacy of dexmedetomidine in the treatment of post-spinal anesthesia shivering in patients undergoing various elective surgeries and compared its efficacy with tramadol for the treatment of shivering after spinal anesthesia. Although tramadol is an established drug in the treatment of shivering, in this study, we found that dexmedetomidine is equally effective as tramadol in treating post-spinal anesthesia shivering with minimal adverse effects.

In our study cessation of shivering occurred in 2.44±0.55 mins in group D compared to 5.52±0.51 mins in group T and difference was found to be statically significant (p=0.0022) (Table 2). Our study results were consistent with Blaine Easley et al[9] who studied the role of dexmedetomidine in the treatment of postoperative shivering in children.

In the present study one patients in dexmedetomidine group and 5 patients in tramadol group had recurrence of shivering (Table 2). Thus, the incidence of recurrence of shivering with dexmedetomidine was less as compared to tramadol, but the difference was not statistically significant (P = 0.121).However, none of the patients had recurrence of shivering after receiving dexmedetomidine in earlier study conducted by Blaine Easley et al.[9] this could be due to the fact that in the study conducted by Blaine Easley et al. the surgeries were conducted under general anesthesia, while in our study the surgeries were performed under spinal anesthesia. While in general anesthesia patients, shivering occurs only on awakening, in spinal anesthesia patients it can occur at any time post spinal anesthesia. This may lead to a higher incidence of shivering and recurrence of shivering in patients undergoing spinal anesthesia as compared to patients undergoing surgeries under general anesthesia. The difference could also be due to the fact that the patients studied in Easley's study were children in the age group of 7–16 years. The incidence of shivering has been reported to be less in children as compared to adults.[17]

Postoperative nausea and vomiting is a very unpleasant experience for the patient. In this study, the incidence of nausea and vomiting was highly significant in tramadol group compared to the dexmedetomidine group (P < 0.001). Incidence of bradycardia and hypotension was more in group D compared to group T, but difference was not significant. Sedation score was similar in both groups. None of the patients developed respiratory depression. (Table 3).

Conclusion

Both intravenous dexmedetomidine (0.5 μg/kg) and tramadol (0.5 mg/kg) are effective in treating patients with post-spinal anaesthesia shivering, but time taken for complete cessation of shivering was shorter with dexmedetomidine as compared to tramadol, the difference being statistically significant. Furthermore, dexmedetomidine causes fewer adverse effects like nausea and vomiting.

References

1. Shukla U, Malhotra K, Prabhakar T. A comparative study of the effect of clonidine and tramadol on post-spinal anaesthesia shivering. Indian J Anaesth. 2011;55:242–6.
2. Sessler DI. Temperature regulation and monitoring. In: Millar RD, editor. 7th ed. Textbook of Anaesthesia. New York: Churchill Livingstone Inc.; 2010. p. 1533-56.
3. Alfonsi P. Postanaesthetic shivering. Epidemiology, pathophysiology and approaches to prevention and management. Minerva Anestesiol. 2003;69: 438–42.
4. Crowley LJ, Buggy DJ. Shivering and neuraxial anesthesia. Reg Anesth Pain Med. 2008;33:241–52.
5. Giesbrecht GG, Sessler DI, Mekjavić IB, Schroeder M, Bristow GK. Treatment of mild immersion hypothermia by direct body-to-body contact. J Appl Physiol. 1994;76:2373–9.
6. Ciofolo MJ, Clergue F, Devilliers C, Ben Ammar M, Viars P. Changes in ventilation, oxygen uptake, and carbon dioxide output during recovery from isoflurane anesthesia. Anesthesiology. 1989;70:737–41.
7. Park SM, Mangat HS, Berger K, Rosengart AJ. Efficacy spectrum of antishivering medications: Meta-analysis of randomized controlled trials. Crit Care Med 2012;40:3070-82.
8. Reddy VS, Chiruvella S. Clonidine versus tramadol for post spinal shivering during caesarean section: A randomized double blind clinical study. J Obstet Anaesth Crit Care 2011;1:26-9
9. Blaine Easley R, Brady KM, Tobias JD. Dexmedetomidine for the treatment of postanesthesia shivering in children. Pediatric Anaesth. 2007;17:341–6.
10. Lee CR, McTavish D, Sorkin EM. Tramadol. A preliminary review of its pharmacodynamic and pharmacokinetic properties, and therapeutic potential in acute and chronic pain states. Drugs 1993;46:313-40.
11. Mathews S, Al Mulla A, Varghese PK, Radim K, Mumtaz S. Postanaesthetic shivering – A new look at tramadol. Anaesthesia 2002;57:394-8.
12. Tsai YC, Chu KS. A comparison of tramadol, amitriptyline, and meperidine for postepidural anesthetic shivering in parturients. Anesth Analg 2001;93:1288-92.
13. Grewal A. Dexmedetomidine: New avenues. J Anaesthesiol Clin Pharmacol 2011;27:297-302.
14. Bajwa SJ, Gupta S, Kaur J, Singh A, Parmar S. Reduction in the incidence of shivering with perioperative dexmedetomidine: A randomized prospective study. J Anaesthesiol Clin Pharmacol 2012;28:86-91.
15. Usta B, Gozdemir M, Demircioglu RI, Muslu B, Sert H, Yaldiz A. Dexmedetomidine for the prevention of shivering during spinal anesthesia. Clinics (Sao Paulo) 2011;66:1187-91.
16. Karaman S, Gunusen I, Ceylan MA, Karaman Y, Cetin EN, Derbent A, et al. Dexmedetomidine infusion prevents

postoperative shivering in patients undergoing gynaecologic laparoscopic surgery. Turk J Med Sci 2013;43:232-7.

17. AkinA, EsmaogluA, BoyaciA. Postoperative shivering in children and causative factors. Paediatr Anaesth 2005;15:1089-93.

Conflict of Interest: Nil Source of support: Nil