Original Article

Prophylactic Administration of Dexmedetomidine for Prevention of Shivering during Spinal Anaesthesia

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Abstract

Background: Shivering is a frequent and distressing complication of spinal anaesthesia. Various drugs and physical methods are used to control shivering. Among pharmacological interventions, dexmedetomidine, a congener of clonidine, is a highly selective α2 adrenoreceptor agonist found to be effective in controlling shivering. The aim of this study is to evaluate the effect of the prophylactic administration of dexmedetomidine for prevention of shivering during spinal anaesthesia. **Materials and Methods:** A prospective, randomised and double-blind study was conducted among patients from either gender, aged 20–60 years, of American Society of Anesthesiologists (ASA) grade I or II who were scheduled for various surgeries under spinal anaesthesia. The patients were randomly divided into two groups of 60 each to receive either dexmedetomidine (Group D) 0.5 μg/kg or saline (Group S) immediately after spinal anaesthesia. Intraoperative incidence and grade of shivering, level of sedation, hemodynamic parameters and adverse reactions such as nausea and vomiting were recorded. **Results:** Seventeen patients in group S (28.3%) and 8 (13.3%) patients in group D experienced shivering ($P = 0.043$). Three patients in group S (3.3%) and 4 patients in group D (6.6%) had bradycardia ($P = 0.69$). Five patients in group S (8.3%) and 8 patients in group D (13.3%) had hypotension ($P = 0.378$). No patients in either group experienced nausea or vomiting. **Conclusion:** Prophylactic administration of dexmedetomidine significantly reduced shivering associated with spinal anaesthesia without any major adverse effect. Therefore, we conclude that dexmedetomidine infusion is an effective drug for preventing shivering and providing sedation in patients during spinal anaesthesia.

Keywords: Dexmedetomidine, shivering, spinal anaesthesia

Introduction

Shivering is a common problem encountered in operation theatres. It is defined as an involuntary, repetitive activity of skeletal muscles. Around 40–50% patients undergoing surgery under neuraxial anaesthesia develop shivering.[1]

Shivering can be very unpleasant and physiologically stressful for patients. It increases metabolic rate and doubles or even triples O_2 consumption.[2] It also increases intraocular pressure and intracranial tension. It interferes with surgery and causes stretch on suture lines.[3,4] Furthermore, it interferes with monitoring such as electrocardiogram (ECG), pulse oximetery, and noninvasive blood pressure measurement.[5]

Shivering is encountered both after regional and general anaesthesia, with slightly higher incidence in patients receiving general anaesthesia.[4] The shivering that occurs during general and neuraxial anaesthesia share the same common pathway. Thus, it seems likely that agents that have proven successful in the treatment of shivering following general anaesthesia might also be useful in the management of shivering during neuraxial anaesthesia.

Several physical and pharmacological interventions have been used to decrease the incidence and severity of shivering. Non-pharmacological methods that use specialized equipment to prevent or control shivering are expensive and not practical in all clinical settings.[2] Many pharmacological agents such as pethidine, clonidine, tramadol and ketamine have been used to control shivering.[6] These drugs have side effects such as respiratory depression, bradycardia and hypotension. Among

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pharmacological interventions, dexmedetomidine, a congener of clonidine, is a highly selective α-2 adrenoreceptor agonist found effective in controlling shivering.[7]

Hence, the present study aimed at evaluating the efficacy of prophylactic administration of dexmedetomidine in the prevention of shivering during spinal anaesthesia.

Materials and Methods

This was a prospective, randomised, double-blind study undertaken at a tertiary care centre during October 2014 to September 2016 after obtaining approval from the institutional ethical committee. One hundred and twenty patients from either gender, aged 20–60 years, of American Society of Anesthesiologists (ASA) grade I or II who were scheduled for various elective surgeries under spinal anaesthesia were included. Patients with significant cardiovascular, renal, hepatic diseases and thyroid disease or those with known hypersensitivity to dexmedetomidine were not included in the study. All patients were visited on the day prior to the surgery and explained in detail about the anaesthetic procedure, and written informed consent was obtained. Patients were kept nil orally from 12 O'clock midnight prior to the day of the surgery.

Patients were randomly divided into two groups using computer generated random numbers. Before spinal anaesthesia, all patients were pre-loaded with 500 ml lactated Ringer's solution. Patients peripheral oxygen saturation, blood pressure (systolic, diastolic, mean arterial pressure), surface temperature and ECG were monitored. Surface temperature was monitored using the temperature probe placed in the axilla. Basal values were recorded. The patients were placed in the sitting position and dural puncture was performed at L3–L4 interspace. Hyperbaric bupivacaine 0.5% was injected intrathecally. The volume of the local anesthetic and use of vasopressors was determined by the attending anesthesiologists, which was not affected by inclusion in the study. Patients assigned to group D were given 0.5 μg/kg of dexmedetomidine in 50 ml of saline in a paediatric burette set over a period of 5 min. Patients assigned to group S were given plain 50 ml normal saline in a burette set. The study drugs were administered just after spinal anaesthesia and were prepared and given by the investigator who was not otherwise involved in the study; thus, the study was double blinded. A blanket was used to cover the chest and upper limb of the patients. All the intravenous fluids, infusions, and drugs were given at room temperature. Forced air warmers were not used. Ambient temperature of operation theatre was maintained at 23–25°C. Shivering was graded using a four-point scale as per Wrench [Table 1].[8]

The attending anaesthesiologist recorded the time of appearance of shivering from the time of administration of spinal anaesthesia. If the shivering score was 3 or 4, the treatment was considered ineffective and 0.5 mg/kg of tramadol was given as the rescue agent.

Degree of sedation was assessed by the attending anaesthesiologist using Ramsay sedation score [Table 2].[9]

Table 1: Shivering scale

Grades	Clinical signs
Grade 0	No shivering
Grade 1	One of the following: piloerection, peripheral vasoconstriction, peripheral cyanosis but without muscle activity
Grade 2	Muscular activity confined to one muscle group
Grade 3	Shivering involving more than one muscle group
Grade 4	Gross muscle activity involving the entire body

Table 2: Ramsay sedation score

Sedation Score	Clinical Response
1	Anxious or restless or both
2	Cooperative, orientated and tranquil
3	Responding to commands
4	Brisk response to a light glabellar tap or auditory stimulus
5	Sluggish response to a light glabellar tap or auditory stimulus stimulus
6	No response to stimuli mentioned in items 4 and 5

Patient's vital parameters were monitored throughout the procedure. Patients were assessed for feeling of nausea, dizziness and pruritus and observed for vomiting. Hypotension (SBP <100 or fall >20% baseline values) was treated with Inj. Ephedrine 6 mg IV and heart rate less than 50 bpm was considered as bradycardia and treated with Inj Atropine 0.6 mg IV.

In an initial pilot study of 40 patients undergoing surgery under spinal anaesthesia, equally divided into control and study arms, we found the difference in the incidence of shivering between the two groups to be 20%. With this hypothesised 20% difference in the incidence of shivering between the two groups, a power calculation showed a sample size of 58 in each group with α of 0.05 and β of 0.9. Hence, we selected 60 patients in each group [Figure 1]. Student *t*-test (two-tailed, independent) was used to determine the significance of study parameters on continuous scale between two groups (intergroup analysis) on metric parameters. Chi-square test was used to determine the significance of study parameters on categorical scale between two or more groups. $P < 0.05$ was considered statistically significant.

Results

The two groups were similar regarding age, weight, height and ASA grade [Table 3]. There was no statistical difference between the two groups in PR, SBP, DBP, temperature and duration of surgery. Seventeen patients in group S (28.3%) and 8 (13.3%) patients in group D experienced shivering ($P = 0.043$) [Table 4]. Sedation scores were higher in Group D than Group S. No patients in either group experienced nausea or vomiting [Table 5]. Three patients in group S (3.3%) and 4 patients in group D (6.6%)

had bradycardia (P = 0.694), which was managed with Inj. Atropine. Five patients in group S (8.3%) and 8 patients in group D (13.3%) had hypotension (P = 0.378) and were managed with Inj. Ephedrine [Table 6].

Discussion

Shivering continues to be a common problem faced by anaesthesiologists during intraoperative and postoperative period. Exact mechanism of development of shivering is not known. Several hypotheses have been raised which include perioperative hypothermia, pain, postoperative heat loss and direct effects of certain anaesthetics.[10]

The exact mechanism of shivering during regional anaesthesia has not been fully established. The possible mechanisms include cessation of sensation to central thermoregulatory system, internal redistribution of body heat and heat loss to the environment.[11] Many neurotransmitter pathways involved in shivering include opioids, α2 adrenergic, serotenergic and anticholinergic receptors. Hence, drugs acting on these systems which include opioids, clonidine and ketamine are utilized in the treatment of shivering. However, adverse effects such as hypotension, hypertension, sedation, respiratory depression, nausea and vomiting limit their use. The search continues for drugs that sufficiently improve the tolerance of thermoregulation without simultaneously producing excessive sedation, respiratory depression or haemodynamic instability.

Central adrenergic receptors have an important place in the treatment of shivering due to anaesthesia.[7] The efficacy of clonidine, which is an α-2 receptor agonist, in the treatment and prevention of shivering has been well-established in various studies.[12] Dexmedetomidine, a congener of clonidine, is a highly selective α-2 receptor agonist that exerts its anti-shivering property by reducing the vasoconstriction and shivering thresholds.[13] In addition, it also has hypothalamic thermoregulatory effects. The main advantage of dexmedetomidine is elimination half life is short (2-3hrs) and has a single dose application so long-term postoperative follow-up is found to be not necessary. Different doses have been used to control shivering.[14-17] In the present study, we used dexmedetomidine at a dose of 0.5 μg/kg IV. With this, Grade 4 shivering was significantly reduced. There was a slight increase in bradycardia and hypotension, but it was insignificant and

Table 3: Demographic profile of patients of both groups

Parameter	Group S (n=60)	Group D (n=60)	P
Age (years)	36.90±12.92	38.08±13.61	0.248
Gender (male/female)	47/13	45/15	0.67
ASA grade (1/2)	46/14	44/16	0.67
Height (cm)	162.30±6.44	163.37±5.80	0.34
Weight (kg)	66.37±621	65.52±5.95	0.45
Duration of surgery (min)	52.89±807	54.083±13.57	0.56

Age, height, weight and duration of surgery are presented as mean±SD. Test done was unpaired t-test. n: Number of patients, SD: Standard deviation

Table 4: Perioperative shivering scores of patients

Shivering Grade	Group S		Group D	
	No	%	No	%
0	24	40.0	30	50.0
1	10	16.7	15	25.0
2	9	15.0	7	11.7
3	6	10.0	6	10.0
4	11	18.3	2	3.3
Total	60	100	60	100

Analysis was done by Chi-square test

Table 5: Comparison of sedation scores of patients

Sedation Score	Group S		Group D	
	No	%	No	%
1	27	45.0	30	28.3
2	23	38.3	32	53.3
3	9	15.0	6	10.0
4	1	1.7	5	8.3
Total	60	100	60	100

Analysis was done by Chi-square test

Table 6: Pattern of adverse reaction in both groups

Adverse effects	Group S	Group D
Nausea	0	0
Vomiting	0	0
Bradycardia	3 (3.3%)	4 (6.6%)
Hypotension	5 (8.3%)	8 (13.3%)
Respiratory depression	0	0

Data expressed as percentage

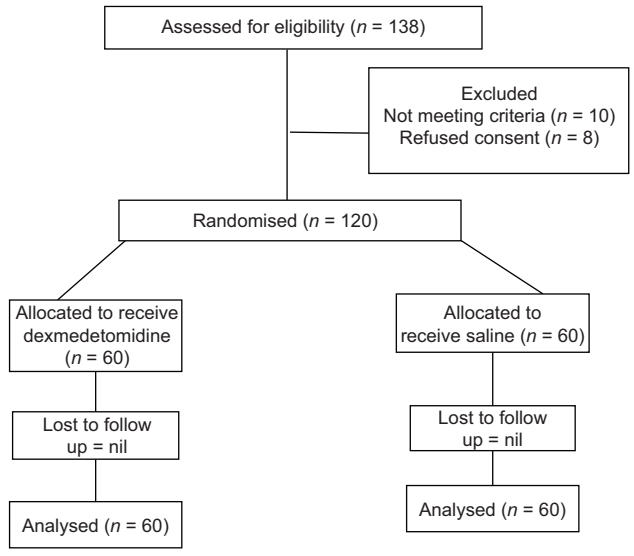

Figure 1: Consort flow chart

amenable to treatment. Patients were also well sedated in dexmedetomidine group.

Semsiitin *et al*.[14] studied the effect of dexmedetomidine 0.5 μg/kg in preventing shivering. In their study, 1 patient out of 30 had shivering. In the present study, the incidence of shivering was much higher.

Karaman *et al*.[15] studied the effect of dexmedetomidine infusion for prevention of postoperative shivering in a patient undergoing gynecological laparoscopic surgery using dexmedetomidine in dose of 1 μg/kg. The incidence of shivering was 10% in the dexmedetomidine group and 46.6% in the placebo group.

Leela *et al*.[16] studied the effect of dexmedetomidine in the prevention of shivering. They used 0.5 μg/kg loading dose and 0.25 μg/kg/h maintenance dose. Incidence of shivering was 10% which is comparable to our study.

Arora[17] studied the effect of dexmedetomidine 0.5 μg/kg in prevention of shivering. In her study, it was found that incidence of shivering was 10% which is comparable to our study.

The main limitation of the study was that core temperature was not monitored. However, we have monitored the surface temperature. This would not have affected the incidence of shivering between the two groups because both groups were in similar environment and statistically similar in terms of patient characteristics and duration of surgery. Furthermore, we did not assess different doses of dexmedetomidine; further studies are needed to evaluate the anti-shivering and haemodynamic effects of dexmedetomidine with various doses.

Conclusion

In conclusion, prophylactic administration of dexmedetomidine infusion significantly reduced the shivering associated with spinal anaesthesia during minor surgical procedures without any major adverse effects. Therefore, we conclude that dexmedetomidine infusion is a safe and good choice for prevention of shivering in patients undergoing spinal anaesthesia.

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Conflicts of interest

There are no conflicts of interest.

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