The minimum dose of dexmedetomidine required for cessation of postspinal anesthesia shivering: A prospective observational study

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Abstract

Background and Aims: Shivering is a common postanesthesia adverse event with multiple etiologies. Dexmedetomidine, a centrally acting alpha-2 adrenergic agonist, is known to reduce the shivering threshold. However, the minimum dose at which dexmedetomidine causes cessation of shivering is unknown. The aim of this prospective observational study was to find the minimum dosage of dexmedetomidine required for abolition of post-spinal anesthesia (SA) shivering.

Material and Methods: Thirty patients having shivering after SA were enrolled, who received dexmedetomidine in the dosage of 1 mcg/kg over 10 min. The time-to-cessation of shivering and the dose of dexmedetomidine required were expressed as mean ± standard deviation.

Results: The mean time-to-cessation of shivering after starting dexmedetomidine infusion was 155.88 ± 15.16 s for Grade 3 shivering and 177.71 ± 10.87 s for Grade 4 shivering. Till that time, the mean dose of dexmedetomidine which had been infused was 0.258 ± 0.024 mcg/kg in Grade 3 shivering and 0.295 ± 0.018 mcg/kg in Grade 4 shivering.

Conclusion: The minimum dose of dexmedetomidine required for abolition of shivering was 0.258 ± 0.024 mcg/kg for patients with Grade 3 shivering and 0.295 ± 0.018 mcg/kg for patients with Grade 4 shivering, which is much less than the commonly administered dose.

Key words: Minimum effective dose, postspinal shivering, time-to-cessation of shivering

Introduction

Shivering is defined as an involuntary, repetitive activity of skeletal muscles. It has multiple etiologies in the postoperative period and many prophylactic and treatment regimens have been suggested.

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.\[1-4\] The dosage used in these studies was mostly a loading dose of 1 mcg/kg over 10 min followed by a maintenance infusion.

Blaine Easley et al.\[5\] had used dexmedetomidine in the treatment of postoperative shivering in children undergoing surgeries under general anesthesia, at a dose of 0.5 mcg/kg. This was less than the routinely used dose of 1 mcg/kg. However, even

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at this dose, all children had a cessation of shivering. Clinical observation reveals cessation of shivering at lower doses. Thus we proposed to elucidate the minimum dose of dexmedetomidine needed for treatment of post-spinal anesthesia shivering.

**Material and Methods**

The present study was a prospective observational study conducted on thirty American Society of Anesthesiologists Physical Status I/II adult patients (>18 years) who developed shivering during surgery under SA and received dexmedetomidine for the treatment of shivering after approval from Institutional Ethics committee and informed patient consent.

Monitoring in the form of noninvasive blood pressure, pulse rate, \( \text{SpO}_2 \), and axillary temperature was instituted.

Initiation of subarachnoid block was done by injection bupivacaine (0.5%) at L2–L3 or L3–L4 interspace. There was no active warming of the patients and the fluids were used at room temperature. The room temperature in the entire operation theatre complex, pharmacy area, and surgical recovery room was kept constant between 21°C-24°C.

Dexmedetomidine (1 mcg/kg) in the concentration of 1 mcg/ml was given intravenously over 10 min using a syringe pump if there was shivering after the initiation of subarachnoid block.

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.

The drug was given to those patients who developed either Grade 3 or Grade 4 of shivering.

Based on a pilot study conducted in five patients, mean dose was 0.3 mcg/kg and standard deviation (SD) of 0.05 with margin of error of 0.02 (2%), the sample size required was 27. Hence, a sample size of 30 was decided in this study.

The primary outcome measure of the study was the time taken for cessation of shivering, from which the minimum dose required for cessation of shivering was calculated.

The attending anesthesiologist recorded the time of disappearance of shivering (in seconds), which was defined as return of Grade 3 or 4 shivering to Grade 0 shivering. The time was recorded using a stop watch from the start of dexmedetomidine infusion till the cessation of shivering. From this time, the volume (in ml) of the drug infused by the syringe pump was calculated. Since the concentration of dexmedetomidine used was constant (1 mcg/ml), the dose of dexmedetomidine which caused cessation of shivering was calculated.

This being only an observational study, the full dose of dexmedetomidine as calculated by 1 mcg/kg was given over 10 min and no alteration was made in the dosage protocol.

Side effects were noted at the time of cessation of shivering and also at the time of completion of full dose of dexmedetomidine. Bradycardia and hypotension were treated with intravenous atropine 0.6 mg/kg and 250 ml fluid bolus, respectively. If hypotension persisted, patient was given intravenous boluses of mephentermine 6 mg. Sedation score was also compared at the dosage which caused cessation of shivering and at the completion of the full dose.

The time-to-cessation of shivering and the dose of dexmedetomidine required were expressed as mean ± SD.

**Results**

A total of 67 patients undergoing elective surgery under SA were enrolled in the study until thirty patients developed shivering, making the incidence of shivering as 45%. The mean (SD) age and weight of the patients were 56.6 (6.3) and 72.4 (6.6). There were 16 men and 14 women. Half the patients belonged to ASA physical status I and the rest to ASA II. While 9 patients experienced Grade 3 shivering, 21 patients had Grade 4 shivering. Shivering disappeared in 100% of patients who received dexmedetomidine.

The mean time at which cessation of shivering occurred in patients with Grade 3 shivering was 155.88 ± 15.16 s, whereas in patients with Grade 4 shivering, the mean time-to-cessation of shivering was 177.71 ± 10.87 s. From the time taken to cessation of shivering, the mean minimum dose required for cessation of shivering was observed to be 0.258 ± 0.024 mcg/kg for patients with Grade 3 shivering and 0.295 ± 0.018 mcg/kg for patients with Grade 4 shivering.

At this dosage, none of the patients developed bradycardia or hypotension. Sedation score at this time was modified Ramsay Score 2. However, after completion of 1 mcg/kg of
dexmedetomidine, three patients developed hypotension who responded to fluid bolus. Modified Ramsay Sedation Score was 3–4 after completion of the full dose of dexmedetomidine.

Discussion

The primary outcome measure, i.e., the mean time-to-cessation of shivering after starting dexmedetomidine infusion was slightly longer in patients with Grade 4 shivering compared to those with Grade 3 shivering. Consequently the mean dose of dexmedetomidine which had been infused was less in patients with Grade 3 shivering than in patients with Grade 4 shivering.

In a previous study done by Usta et al.,[3] the dose of dexmedetomidine used for prophylaxis of shivering was 1 mcg/kg as a bolus over 10 min, followed by a maintenance infusion of 0.4 mcg/kg/h. This dose effectively decreased the incidence and severity of shivering related to regional anesthesia during elective minor surgeries.

A similar result was found by Aldehayat[4] found that dexmedetomidine in the dose of 1 mcg/kg given as a bolus over 10 min, 20 min before the end of surgery, was effective in preventing postoperative shivering.

Blaine Easley et al.,[5] who studied the role of dexmedetomidine in the treatment of postoperative shivering in children undergoing surgeries under general anesthesia used a dose of 0.5 mcg/kg. All children had a cessation of shivering behavior within 3.5 ± 0.9 min.

Mittal et al.[7] studied 25 patients who were given dexmedetomidine in the dosage of 0.5 mcg/kg for the treatment of postspinal shivering. Dexmedetomidine was found to be effective in this study at this dosage.

The doses used commonly seem to be higher than the required doses for cessation of shivering. The minimum dose of dexmedetomidine required for the treatment of shivering was found to be much lower in the present study than the commonly used doses in majority of the studies.

Dexmedetomidine may lead to hypotension, bradycardia and sedation in the commonly used doses. All these are factors preclude the use of dexmedetomidine in the treatment of shivering in certain high-risk patient groups such as elderly. These can be minimized by using a lower dose of dexmedetomidine. In the present study also, none of the patients developed bradycardia or hypotension at the minimum effective dose of dexmedetomidine in the treatment of shivering. However, three patients developed hypotension after giving a full dose of dexmedetomidine (1 mcg/kg). In addition, the sedation profile was better at the minimum effective dose.

One of the limitations of the present study was that the axillary temperature was measured instead of the core body temperature. However, measurement of core body temperature (in the mid-esophagus or near the tympanic membrane or in the urinary bladder) is both uncomfortable and unacceptable in conscious patients undergoing elective surgeries under SA.

From the present study we conclude that a much lower dose of dexmedetomidine that is being commonly used at present, may be required for treatment of shivering. However, further randomized controlled trials are needed using different doses of dexmedetomidine to validate the minimum dose required to effectively treat shivering with minimal side effects.

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Conflicts of interest
There are no conflicts of interest.

References

1. Elvan EG, Oç B, Uzun S, Karabulut E, Coskun F, Aypar U. Dexmedetomidine and postoperative shivering in patients undergoing elective abdominal hysterectomy. Eur J Anaesthesiol 2008;25:357-64.
2. Bicer C, Esmaoğlu A, Akin A, Boyaci A. Dexmedetomidine and meperidine prevent postanaesthetic shivering. Eur J Anaesthesiol 2006;23:149-53.
3. Usta B, Gozdemir M, Demircioglu RI, Muslu B, Sert H, Yaldız A. Dexmedetomidine for the prevention of shivering during spinal anesthesia. Clinics (Sao Paulo) 2011;66:1187-91.
4. Aldehayat G. Intraoperative dexmedetomidine administration at the end of surgery prevents post anesthetic shivering. Rawal Med J 2011;36:274-6.
5. Blaine Easley R, Brady KM, Tobias JD. Dexmedetomidine for the treatment of postanaesthesia shivering in children. Paediatr Anaesth 2007;17:941-6.
6. Shukla U, Malhotra K, Prabhakar T. A comparative study of the effect of clonidine and tramadol on post-spinal anesthesia shivering. Indian J Anaesth 2011;55:242-6.
7. Mittal G, Gupta K, Katyal S, Kaushal S. Randomised double-blind comparative study of dexmedetomidine and tramadol for post-spinal anesthesia shivering. Indian J Anaesth 2014;58:257-62.