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Original Article

Effect of Intrathecal Dexmedetomidine on Shivering in Patients Undergoing Transurethral Resection of the Prostate Surgery under Subarachnoid Block

S Bhuvana[1], N Latha[2], P Kanimozhi[3], Heber Anandan[4]

[1]Assistant Professor, Department of Anaesthesiology, Madras Medical College, Chennai, Tamil Nadu, India, [2]Professor, Department of Anaesthesiology, Madras Medical College, Chennai, Tamil Nadu, India, [3]Junior Resident, Department of Anaesthesiology, Madras Medical College, Chennai, Tamil Nadu, India, [4]Senior Clinical Scientist, Department of Clinical Research, Dr. Agarwal's Healthcare Limited, Chennai, Tamil Nadu, India

Abstract

Background: Shivering is a frequent complication of urological procedures done under regional anesthesia, especially in transurethral resection of the prostate (TURP) because of absorption of large volume of irrigating fluids. Various adjuncts have been used with local anaethetics in spinal anesthesia to decrease the incidence of shivering among which dexmedetomidine has promising results.

Aim: To compare the efficacy of dexmedetomidine and fentanyl on intraoperative shivering and post-operative analgesia in patients undergoing TURP surgeries under subarachnoid blockade (SAB).

Materials and Methods: This prospective, randomized double-blind study included 60 patients undergoing elective TURP surgeries under SAB and were allocated into two groups: Group F - injection bupivacaine 2 ml 0.5% (10 mg) with 25 μg of fentanyl (0.5 ml) and Group D - injection bupivacaine 2 ml 0.5% (10 mg) with 5 μg of dexmedetomidine totally made to 2.5 ml. Hemodynamic parameters, shivering score, degree of sedation, and any adverse effects were recorded.

Results: The shivering score was less and the time taken for rescue analgesia was more in group D than group F. Bradycardia was observed three patients (7.5%) in group D which was statistically insignificant (P = 0.241), whereas no patients had bradycardia in group F. Incidence of hypotension was similar in both groups and statistically insignificant (23 in group F versus 24 in group D [P = 0.820]). One more finding was observed that the incidence of sedation was more in group D which was statistically significant (P <0.0001).

Conclusion: To conclude the use of 5 μg of dexmedetomidine to bupivacaine intrathecally is more effective in controlling shivering than fentanyl and also prolongs the duration of post-operative analgesia.

Key words: Bradycardia, Dexmedetomidine, Sedation scores, Shivering, Subarachnoid block

INTRODUCTION

Shivering is a frequent complication of subarachnoid blockade (SAB).[1] The incidence of shivering has been reported to be about 35-85% after spinal anesthesia (SA). It is more common in transurethral resection of the prostate (TURP) which may be due to absorption of large volume of irrigating fluid at room temperature.[2] Shivering may occur as a response to hypothermia, or it can occur in normothermic patients because SA impairs thermoregulation by inhibiting tonic vasoconstriction below the level of anesthesia through sympathetic and somatic neural blockade.[3] With internal redistribution of heat from core to periphery, the loss of thermoregulatory tonic vasoconstriction results in increased heat loss from body surfaces in excess of heat production. Shivering causes patient discomfort, interruption of monitoring, increases O_2 consumption and CO_2 production, and catecholamine secretion that increase cardiac output, heart rate (HR), and blood pressure.

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Corresponding Author: Dr. S Bhuvana, Department of Anaesthesiology, Madras Medical College, Chennai - 600 003, Tamil Nadu, India. Phone: +91-9443471697. E-mail: bhuvanasge@gmail.com

Many medications were tried to prevent or reduce shivering, but the ideal one is still to be determined yet. Meperidine, $MgSO_4$, ketamine, fentanyl, and morphine have been tried with no convincing results.[4] Dexmedetomidine is an S-enantiomer of medetomidine with a higher specificity for α-adrenoceptor (α2:α1, 1620:1) compared to clonidine (α2:α1, 220:1). It is highly selective α-2 adrenergic agonist possessing hypnotic, sedative, anxiolytic, sympatholytic, opioid-sparing, and analgesic properties without producing significant respiratory depression.[5] It acts by inhibiting the release of norepinephrine at locus coeruleus. Small doses of dexmedetomidine (3 μg) used in combination with spinal bupivacaine produce a quicker onset of motor block and a prolongation in the duration of motor and sensory block with preserved hemodynamic stability and minimal side effects.[6] The enhanced antinociceptive effect is said to be related to its lipophilicity.[7] It also decreases the shivering threshold. Premedication with intramuscular (IM) dexmedetomidine reduces the incidence of post-operative shivering.

Aim

To compare the efficacy of dexmedetomidine and fentanyl on intraoperative shivering and post-operative analgesia in patients undergoing TURP surgeries under SAB.

MATERIALS AND METHODS

A prospective comparative study was done in Madras Medical College hospital, Department of Anaesthesiology. Institutional Ethics Committee approval and written informed consent were obtained. 60 patients aged 50-70 years, American Society of Anesthesiologists Physical Status 2 and 3 scheduled for elective TURP surgery under SA, were enrolled in this study. Transrectal ultrasound was done for all patients for detection of prostatic size. Exclusion criteria were patient refusal, allergy to local anaethetics, coagulopathy, systemic or local sepsis, vertebral abnormalities, Parkinson's disease, and patients receiving vasodilators. Patients with unstable CAD and second- and third-degree heart block were also excluded from the study. Under strict aseptic precautions, SAB was performed. Patients were randomly allocated by the use of sealed envelope assignment into two groups; group F patients received - injection bupivacaine 2 ml 0.5% (10 mg) with 25 mic of fentanyl (0.5 ml) made to 2.5 ml and Group D - injection bupivacaine 2 ml 0.5% (10 mg) with 5 mic of dexmedetomidine made to 2.5 ml. The study medications were prepared by a different anaethetics, and data measurements and recording were carried out by different anaethetics. Supplemental O_2 (5 L/min) was delivered during surgery. The sensory and motor dermatome levels were assessed and recorded. Sedation was assessed at 15 minutes interval intraoperatively using Ramsay sedation score. TURP was performed using a continuous flow resectoscope with monopolar cautery using glycine 1.5% as an irrigating solution.

During surgery, shivering score was assessed and recorded at 15 min intervals (Table 1). If shivering score was P3, injection tramadol 25 mg was administered intravenously. Any adverse effects such as bradycardia, hypotension, nausea, and vomiting were recorded. Bradycardia was defined as a decrease in HR 50 beats/min. Bradycardia was treated with intravenous (IV) bolus of atropine 0.6 mg. Hypotension was defined as a decrease in mean arterial blood pressure (MAP) of more than 20% from baseline and was treated with IV boluses of ephedrine 3-6 mg. HR, MAP, oxygen saturation, core body temperature, and shivering scores were recorded in all patients at 15 minutes interval over one hour postoperatively. Pain was assessed by verbal rating scale (VRS) at 2^{nd}, 4^{th}, 6^{th}, and 10^{th} h postoperatively. At VRS >4, injection tramadol 50 mg IM was given and the time of rescue analgesia was also noted. Anesthesia time, surgery time (resection time), and any adverse events were also recorded.

RESULTS

Demographic characteristics of two groups were found no difference (Table 2). Patients in dexmedetomidine group shivered less (Grade 0 in 30 patients in group D versus 16 patients in group F and Grade 1 in 7 patients in group D versus 12 patients in group F). Shivering Grade 3 occurred in one patient in group D and four patients in group F and received injection tramadol 50 mg IM and no patients had Grade 4 shivering (Table 3). Bradycardia was observed three patients (7.5%) in Group D and received injection atropine 0.6 mg, whereas no patients had bradycardia in group F. Incidence of hypotension was similar in both groups (23 in group F versus 24 in Group D and all patients were managed with injection ephedrine 3 /6 mg and there was no further hypotension in those patients. Sedation scores were higher in Group D. Score was 1 in 15 patients and 2 in 24 patients in Group D, whereas score was 1 in 13 patients and 2 in 16 patients in Group F (Table 4). Incidence of side effects such as nausea, vomiting, hypotension, bradycardia, and shivering were noted (Table 5).

The time of demand analgesia was also noted among study group, in which Group D had a more prolonged duration of post-operative analgesia (11 h ± 1.5), whereas in Group F, the time for demand analgesia was 5.5 h ± 1 and they were treated with injection tramadol 50 mg IM.

Table 1: Shivering classification by Crossley and Mahajan scale[8]

Grade	Description
0	No shivering
1	Cyanosis and piloerection
2	Visible tremors in one muscle group
3	Visible tremors in more than one muscle group
4	Intense shivering and tremors of head and arm

Table 2: Distribution of study patient's characteristics

Parameters	Group F	Group D
Age	59.40±7.21	65±7.97
Prostate size	55.56±5	55.7±6.5
Anesthesia time (min)	100±6.5	106±7.2
Surgery time (min)	65±5.4	64±7.8
Irrigating solution (L/pt)	12±3.5	12±4.5

Table 3: Distribution of shivering scores during intraoperative period

Shivering score	Group F	Group D	*P* value
0	6	20	0.012
1	12	7	
2	8	2	
3	4	1	
4	0	0	

Table 4: Distribution of sedation scores during intraoperative period

Sedation score	Group F	Group D	*P* value
1	13	15	<0.0001
2	16	24	
3	1	1	
4	0	0	
5	0	0	
6	0	0	

Table 5: Distribution of adverse events in study patients

Variables	Group F	Group D	*P* value
Bradycardia	0	3	0.241
Hypotension	23	24	0.820
Nausea and vomiting	2	3	0.644
TURP syndrome	0	0	N/A
Tramadol administered	4	1	0.615
Ephedrine administered	22	23	0.822

TURP: Transurethral resection of the prostate

DISCUSSION

The thermoregulatory mechanism in human body is a complex one that normally keeps the temperature within a tight range (36.5-37.5°C) known as "inter-threshold range."[9] If the core temperature decreases below that range, the body responds by vasoconstriction and shivering which increases heat production two-to-five folds.[10] Thus, shivering is a protective mechanism to preserve body heat, but no definite linear relationship exists between body temperature and occurrence of shivering. SA induces the inhibition of vasoconstriction below the level of anesthesia through sympathetic and somatic blockade with subsequent vasodilatation and increases cutaneous blood flow that results in increasing heat loss through the skin. In contrast to these changes, vasoconstriction and shivering are restricted to the upper body during SA. The exact mechanism of shivering during SA has not been fully established. The possible mechanisms include cessation of central thermoregulation, internal redistribution of body heat, and heat loss to the environment. It increases O_2 consumption and CO_2 production with a subsequent increase in basal metabolic rate. Shivering interferes with patient's monitoring, and it may be a problem in old patients who are undergoing TURP as most of them have one or more associated comorbidities with limited cardiac and respiratory reserve. Shivering is mostly a response to hypothermia. However, it may be seen in normothermic patients under SA. Factors which affect the severity of hypothermia in spinal anesthesia are aging, level of sensory block, and temperatures of the local anesthetic, operating room, and IV solutions. Pharmacological therapies such as opioids, tramadol, Physostigmine, clonidine, ketamine, and magnesium sulfate have been used to prevent shivering.[9] Meperidine is among opioids, which is extensively studied due to its anti-shivering effect. Disadvantages of meperidine include nausea, vomiting, pruritus, and respiratory depression. Fentanyl and morphine could control shivering, but it should be given in large doses to be effective with an increase of the incidence of side effects. Tramadol may cause nausea, vomiting, and respiratory depression during and after SA. The hypertensive and tachycardic effects of ketamine limit its use. $MgSO_4$ also has been tried to control post-operative shivering, but its mechanism of action is uncertain, and also it has side effects such as nausea, vomiting, feeling warm, and flushing; it may induce respiratory depression.[11] Dexmedetomidine is a highly selective α-2 adrenergic receptors agonist.[12,13] It has sedative, analgesic, perioperative sympatholytic, anesthetic-sparing, and hemodynamic-stabilizing properties. It is highly lipophilic, the fact that may facilitate its rapid absorption into the cerebrospinal fluid and binding to the spinal cord α-2 adrenoreceptor.[14] The effect of the spinal anesthesia has been reported to be prolonged by the addition of dexmedetomidine with less hypotensive effect and an added sedative effect without respiratory depression.[15,16] Activation of α-2 adrenergic receptors in the brain and spinal cord by dexmedetomidine decreases

sympathetic tone and attenuates the neuroendocrine and hemodynamic responses to anesthesia and surgery.[17] Thus, dexmedetomidine can mediate both the beneficial and unwanted effects of shivering provoked by hypothermia such as increased catecholamine concentrations, oxygen consumption, blood pressure, and HR.[18,19]

CONCLUSION

To conclude the use of 5 μg of dexmedetomidine to bupivacaine intrathecally is more effective in controlling shivering than fentanyl and also prolongs the duration of post-operative analgesia.

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