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COMPARATIVE STUDY OF EFFICACY OF DEXMEDETOMIDINE AND KETAMINE ON POST SPINAL ANESTHESIA SHIVERING

Anesthesiology

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ABSTRACT

Introduction: Shivering is an involuntary, repetitive activity of skeletal muscles. Spinal anesthesia impairs the thermoregulatory system by inhibiting vasoconstriction and results in redistribution of core heat to the periphery from the trunk causing hypothermia and shivering. Shivering increases the oxygen requirement and the metabolic rate. A study of efficacy of Dexmedetomidine and Ketamine is conducted for prevention of post spinal shivering. **Methods:** 90 patients of 18 to 60 years, either sex belonging to ASA grade I, II, III undergoing spinal anesthesia were studied. Pre-anaesthetic evaluation was done and temperature of the operating room was maintained at 24˚C-25˚C. Monitors were connected, intravenous access secured and patients were preloaded with RL. In the right lateral decubitus position/sitting position, after local infiltration, subarachnoid block performed in L3-4 interspace, with 23G Quincke needle of 0.5% hyperbaric bupivacaine (3ml) injected after checking for free flow of clear CSF. 3 groups of 30 are given the following drugs IV: Group D receive Inj. Dexmedetomidine, Group K receive Inj. Ketamine, Group NS receive Inj. NS. Oxygen via face mask at 4L/min administered. Patients were monitored for vitals and shivering was monitored by wrench grading system. **Results:** It was observed that 10% developed shivering in group D compared to 43.3% in group K and 50% in group NS and so the incidence of shivering was less in group D compared with group K and group NS and there was a statistically significant difference between the three groups. (p 0.042). **Conclusion:** Dexmedetomidine is more effective in the prevention of post spinal anesthesia shivering when compared to ketamine.

KEYWORDS

Shivering, Spinal anesthesia, Dexmedetomidine, Ketamine

INTRODUCTION

Shivering is a common distressing experience seen in patients which can occur either during or immediately after the surgery. It is defined as an involuntary, repetitive activity of skeletal muscles. The incidence of shivering varies but is very high and the incidence is approximately 40 – 50%.[1] Mammals are homeothermic and need a nearly constant internal body temperature. Human core temperature normally ranges from 36.5^{0}C to 37.5^{0}C. Preoptic region of anterior hypothalamus integrates thermal inputs from different tissues of the body and compares this peripheral information with a set point or threshold value. Warm signals travels via unmyelinated C fibres and cold signals via Aδ nerve fibres but there is a certain degree of overlap [8]. Temperature lower than the set point will result in responses to warm the body while temperatures higher will trigger reflexes to cool the body .[2]

In patients undergoing neuraxial anaesthesia, shivering is a normal thermoregulatory mechanism. Spinal anaesthesia impairs this by inhibiting vasoconstriction, which plays an important role in temperature regulation. Spinal anaesthesia results in redistribution of core heat to the periphery from the trunk [below the level of block]. Both these effects predispose patients undergoing spinal anaesthesia to hypothermia and shivering.

Shivering during surgery leads to an increase in oxygen consumption and carbon dioxide production. Shivering can also increase catecholamine production, lactic acidosis, intraocular pressure, intracranial pressure.[4] Mild shivering increases oxygen consumption equivalent to light exercise but severe shivering can increase oxygen consumption and metabolic rate to 100 – 600% which can be detrimental to patients with limited cardiac reserve. Shivering also makes monitoring difficult as most of the multi parameter monitors used for anaesthesia show erroneous values.

Temperature monitoring should be accurate. The objective of temperature monitoring is to detect changes in body temperature during anaesthesia. Core temperature can be monitored at nasopharynx, distal part of the oesophagus, tympanic membrane, pulmonary artery.

Treatment of shivering includes both non-pharmacological and pharmacological methods. Non-pharmacological methods include external heating: use of blankets, forced air warmers and warmed IV fluids, maintaining operating room temperature etc. Pharmacological methods for treatment of hypothermia is the next resort to treat all these patients. Most commonly used drugs include fentanyl, meperidine, tramadol, clonidine, dexmedetomidine, alfentanil, magnesium sulphate, nefopam etc.

Dexmedetomidine, the pharmacologically active D-isomer of medetomidine, is highly selective and specific α-2 adrenoceptor agonist located in the presynaptic terminal and inhibits the release of norepinephrine. Activation of α_2 adrenoceptors in the post synaptic terminal in the CNS inhibits sympathetic activity and can cause sedation, anxiolysis, decreases shivering along with reduced heart rate and blood pressure. In addition it also has hypothalamic thermoregulatory effects.

Ketamine, a competitive NMDA receptor antagonist has a role in thermoregulation at various levels. By binding to these receptors it also modulates noradrenergic and serotonergic neurons in locus ceruleus. [12]

MATERIAL AND METHODS

After obtaining institutional ethical approval from Institutional ethical committee, BJ Medical college and civil Hospital, Ahmedabad. 90 patients aged 18 – 60 years of either sex having ASA PS I, II,III who are undergoing spinal anesthesia are selected. Patients who refused for study, patients with atrial/ventricular arrhythmias, second/third degree A-V conduction block, known case of bronchial asthma, hypertension, IHD, Congestive heart failure and terminal valvular insufficiency, severe hemodynamic instability, thyroid disease, history of allergy to the drugs to be used, patients with an initial core temperature >37.5ºCor <36.5ºC, patients with a known history of alcohol use, use

of sedative-hypnotic agents, patients on beta adrenergic antagonist therapy/calcium channel blockers, patients having contraindications to spinal anesthesia were excluded from the study.

All patients were thoroughly examined preoperatively. Routine investigations were advised and verified on the day of surgery. After getting the written informed consent, patient were taken on OT table with the OT temperature kept at 21-25 Celsius and standard monitors (NIBP, ECG, pulse oximetry) and thermometer for axillary temperature were attached, baseline vitals were recorded. 18 gauge IV cannula was secured followed by preloading with RL at 10ml/kg over 15 minutes. In the right lateral decubitus position/sitting position and under strict aseptic precautions, subarachnoid block performed in L3-4 interspace after infiltrating skin with 2 ml of 2% lignocaine. 23G Quincke spinal needle was inserted intrathecally and 15mg of 0.5% hyperbaric bupivacaine (3ml) injected after checking for free flow of clear CSF.

Infusion of the study drug in 10ml NS by a blinded observer over 10 minutes in a three way adapter along with IV fluid administration at 6ml/kg/hr was done as follows.

Group D will receive Inj. Iv Dexmedetomidine 0.5 µg/kg in 10ml inj. NS, slowly over 10 min.

Group K will receive inj iv ketamine 0.5mg/kg in 10ml inj NS slowly over 10min.

Group NS will receive 10 cc Inj. Iv NS injected slowly over 10 min.

Oxygen via face mask at 4L/min was administered to all the subjects. Surgery commenced when the level of sensory block reaches T8. Patients were monitored for a period of 120 minutes or the end of the surgery whichever was longer.

Patient's baseline heart rate, blood pressure, Spo_2, respiratory rate, axillary temperature were recorded.

Shivering was monitored by a grading system as described by wrench [24]:
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 scale as per Ramsay sedation score [22]

Score	Response
1	Anxious or restless or both
2	Cooperative, orientated and tranquil
3	Responding to commands
4	Brisk response to stimulus
5	Sluggish response to stimulus
6	No response to stimulus

Side effects such as hypotension, bradycardia, nausea, vomiting, hallucinations if any were recorded. Bradycardia was treated by 0.5mg atropine IV.

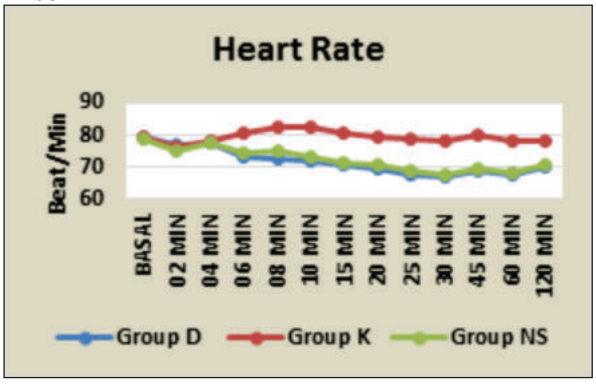
Hypotension was defined as a decrease in the mean arterial pressure (MAP) of more than 20 % from baseline (baseline MAP was calculated from measurements taken in the ward before surgery). Hypotension was treated with Inj. Mephentermine IV bolus and then with further IV. infusion of lactated Ringer's solution as required. If patients developed nausea and vomiting, Inj. Metoclopramide 10mg IV was administered.

DATAAND STATISTICALANALYSIS

The data obtained was coded and entered into Microsoft excel worksheet. The categorical data was expressed as rates, ratios, proportions. The continuous data was expressed as Mean± standard deviation (SD).

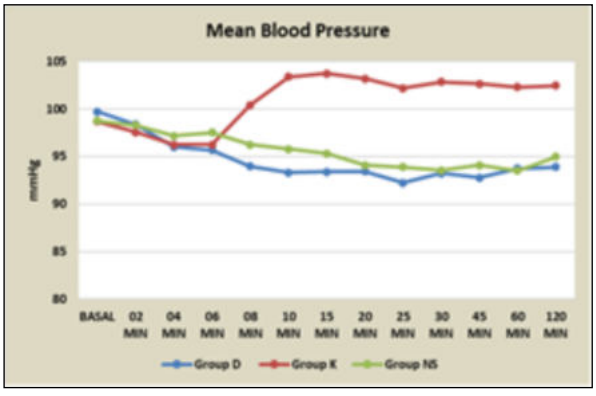
The comparison of categorical data was done using Chi square test and that of the continuous data was done using independent sample 't' test and one way ANNOVA test. A probability value (p value) of less than 0.05 at 95 % confidence interval was considered as statistically significant

RESULT



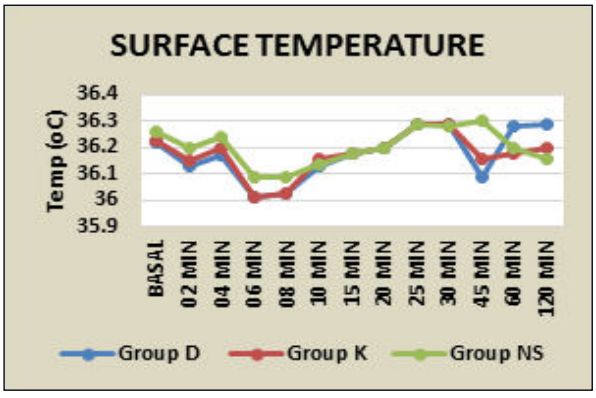
Graph 1: Heart Rate

Mean heart rate is compared between all the three groups and there was a statistically significant difference($p<0.0001$) among the groups starting from 6min to the end of surgery. For most of the observations, the highest(84.53 ± 3.67) and the lowest mean values(66.86 ± 3.54) in heart rate were found in Group K and Group D, respectively.



Graph 2: Mean Blood Pressure

In this study mean blood pressures are comparable between all three groups until 6min after induction under spinal anesthesia and the values are found to be highly significant ($p<0.001$) between the three groups from 8mins. The highest and the lowest MBP values are seen in group K (104.73 ± 5.16) and group D (92.23 ± 5.04) respectively.



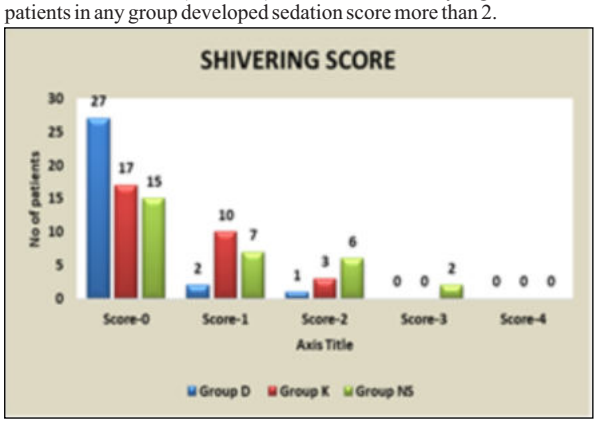
Graph 3: Axillary Temperature

The axillary temperature (surface temperature) was measured during the study in all the three groups and it showed comparable values with insignificant P values.

Table 1: Sedation Score

SEDATION SCORE	Group D (n=30)	Group K (n=30)	Group NS (n=30)
1	10 (33.3%)	14 (46.6%)	21 (70%)
2	20 (66.6%)	16 (53.3%)	9 (30%)
3	0	0	0
4	0	0	0

Patients who developed sedation score 1 in group D was 10(33.3%) and in group K was 14(46.6%) and in group NS was 21(70%). The difference between the three groups was found to be statistically significant (p 0.016). 20 patients (66.6%) in group D ,16 patients (53.3%) in group K and 9 (30%) patients in group NS developed sedation of score 2 (P 0.0161) and was statistically significant. No patients in any group developed sedation score more than 2.



Graph 4: Shivering Score

Overall incidence of shivering between the three groups was statistically significant (p 0.04). No shivering (grade 0) was seen in 27 patients in group D, 17 patients in group K and 15 patients in group NS. Grade 1 shivering was seen in 2 patients in group D and 10 patients in group K, 7 patients in group NS respectively. So, there was significant difference in these three groups (p-0.038). Grade 2 shivering was seen in 1 patient in group D, 3 patients in group K and 6 patients in group NS(P-0.1171). Grade 3 shivering was seen in 2 patients in group NS only. No patients in any groups developed grade 4 shivering in our study.

Table 2: Intraoperative Complications

COMPLICATION	Group D (n=30)	Group K (n=30)	Group NS (n=30)	P value
Nausea	0	4(13.3%)	1 (3.33%)	0.175
Hypotension	3 (10%)	0(0%)	2 (6.6%)	0.250
Bradycardia	2 (6.6%)	0 (0%)	1 (3.3%)	0.374

DISCUSSION

Our study was designed to evaluate the efficacy of IV Dexmedetomidine and IV Ketamine in prevention of post spinal anesthesia shivering. The most common surgical procedures done under spinal anesthesia include inguinal hernioplasty, excision and eversion of sac for hydrocele, split skin grafting in lower limbs, appendicectomy, hemorrhoidectomy, etc.

Shivering is a protective response occurring as a part of a centrally mediated thermoregulatory defense mechanism to hypothermia [16]. The shivering is a frequent complication that occurs during spinal anesthesia. This occurs due to decrease in core body temperature. The shivering under neuraxial blockage not only increase O_2 consumption but also cause tachycardia, hypertension and interfere with monitoring of pulse oximetry, electrocardiogram and blood pressure.

Dexmedetomidine reduces threshold for vasoconstriction as well as shivering and acts on the hypothalamus which has high density of alpha $_2$ adrenergic receptors [18]. Hence, it is effective in treating the post spinal shivering. It also has analgesic, sedative, sympatholytic, hemodynamic stabilizing property. Many studies reported that at dose of 0.5 to 1mcg/kg, there is no Respiratory depression. Ketamine, a competitive NMDA receptor antagonist that modulates noradrenergic and serotonergic neurons in locus ceruleus.[12] and has a role in thermoregulation at various levels.

In our study the sample size was calculated as **90** based on previous studies to obtain results of the study with a power of 90% and a significance level of 0.05. We observed that incidence of shivering was reduced in group D(10%) compared to group K(43.3%) and group NS(50%).

In accordance with the above results, dexmedetomidine was found to be superior to other drugs in the prevention of shivering as only 3 patients among the 30 patients who were given dexmedetomidine had shivering.

This result can be supported with the report by **Lim fern et** [20] al who conducted a study which also had a similar outcome. The study included 60 patients with three study groups and twenty patients in each group. the study drugs included dexmedetomidine that was administered at a dose of 0.5µg/kg, pethidine at 0.5mg/kg and tramadol at 0.5mg/kg used in the treatment of shivering after spinal anesthesia. It was found that, response rate was highest in the dexmedetomidine group and was statistically significant with a P value of 0.0012.

In our study, sedation score 2 was seen in 20 patients (66.6%) of group D,16 patients (43.3%) in group K and 9 patients (30%) of group NS (P 0.016) and the result was statistically significant.

Similar to our study, a study conducted by **Monsaur et al**[21] concluded deeper sedation scores with dexmedetomidine when compared to that of ketamine (0.048) when used for post spinal anesthesia shivering.

In group D, 2 patients (6.6%) had bradycardia out of 30 patients, no patients in group K (0%) and 1 patient in group NS (3.3%) had bradycardia (P-0.374). In group D, 3 patients (10%) had hypotension out of 30 patients, no patients in group K, two patients in group NS (6.6%) had hypotension (p 0.250). These events were not statistically significant and were promptly treated. No patient in any group had respiratory depression. 4 patients of group K had nausea out of 30 patients (13.3%), 1 patient (3.3%) of group NS and none in group D developed nausea. Hypotension and bradycardia are known hemodynamic effects of dexmedetomidine but only few patients have those side effects which is acceptable as concluded by **Lim fern et al** [21].

LIMITATIONS

We did not assess different doses of dexmedetomidine and ketamine. We did not assess incidence of shivering in post-operative period. We did not assess core body temperature.

CONCLUSION

This study showed that Dexmedetomidine (0.5mcg/kg) is more effective as compared to ketamine in the prevention of post spinal anesthesia shivering.

Dexmedetomidine (0.5mcg/kg) also has an added advantage of adequate reliable sedation with minimum possible side effects as well as hemodynamic stability.

Ketamine(0.5mg/kg) is also effective in the prevention of post spinal anesthesia shivering and provides sedation but carries the risk of hemodynamic instability in the form of tachycardia, hypertension along with side effects like nausea, dizziness, hallucinations etc.

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