Section: Anaesthesiology

Original Research Article

COMPARISION OF DEXAMETHASONE AND MAGNESIUM SULPHATE AS AN ADJUVANT TO INTRATHECAL BUPIVACAINE IN SPINAL ANESTHESIA FOR LOWER ABDOMINAL SURGERIES

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Abstract

Background: The objective of study is to compare the effect of dexamethasone and magnesium sulphate as an adjuvant to intrathecal bupivacaine in spinal anaesthesia for lower abdominal surgeries. **Materials and Methods:** After obtaining institutional research and ethical committee approval, this randomized, prospective, double-blind study was conducted in Indira Gandhi Institute of Medical Sciences, Patna. Patients admitted for lower abdominal surgeries were enrolled and pre anaesthesia evaluation was done. 50 patients in each group were studied. Detailed pre-anesthetic checkup was done for all patients who were included in this study. All patients were pre-loaded with 10ml/kg crystalloid before spinal anesthesia. Spinal anesthesia was administered under strict aseptic precaution. All hemodynamic parameters were recorded every 5 minutes till 30 mins and then every 15 mins till skin closure. Spinal anesthesia was performed at the L2-L3 or L3-L4 with a 25 G Quincke needle and patients were received 3ml of 0.5% hyperbaric bupivacaine with 4mg of preservative free dexamethasone(1ml) or 50mg of magnesium sulphate(1ml) as an adjuvant(total of 4ml). All data analyzed with student T-test and Chi square test. **Result:** The groups were comparable with respect to age, sex, ASA classification, and type of surgery. There was early sensory and motor block as well as greater duration of block in patients who were given dexamethasone and there was late sensory and motor block as well lesser duration of block in patients who were given magnesium sulphate. **Conclusion:** Dexamethasone was better than magnesium sulphate with respect to onset and duration of sensory and motor block. However, use of magnesium sulphate should also be encouraged as it is cheap and available in most operating theatres.

INTRODUCTION

Spinal anaesthesia is most commonly used for infraumbilical surgeries. Spinal anaesthesia avoids the risk of general anaesthesia such as aspiration of gastric contents and difficulty with airway management. Dexamethasone relieve pain by reducing inflammation and blocking transmission via type C- fiber and by suppressing ectopic neural discharge. It has been shown that the duration of postoperative analgesia is prolonged when dexamethasone is given as an adjunct for peripheral nerve blocks. Magnesium, a non-competitive N-methyl-D-aspartate (NMDA) receptor antagonist, whose efficacy or safety as an intrathecal adjuvant has been studied in recent years. Magnesium blocks calcium influx and causes non-competitive NMDA channel antagonism. The antinociceptive effect of magnesium seems to be effective in management of chronic and post operative pain. The addition of magnesium as intrathecal adjuvant to LA has been reported to improve the post- operative analgesia.[1] Shivering is defined as involuntary repetitive skeletal muscle activity. The mechanisms of shivering in surgical patients are primarily intra-operative heat loss, rise in sympathetic tone, pain, and release of pyrogens in systemic circulation.[1]

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Hypothermia and chills are common complications of SAB (Sub-arachnoid block) in Uroscopic surgery in which there is large volumes of intraluminal irrigation.[2] Spinal anaesthesia (SA) is a very reliable and convenient technique for short procedures such as urological surgery, especially for procedures that require the patient to remain conscious to detect intra-operative complications, like transurethral resection of the prostate (TURP) syndrome along with infraumbilical abdominal surgeries and lower limb surgeries.[3]

However, spinal anaesthesia act against tonic vasoconstriction and causes a redistribution of core heat from the trunk to the peripheral tissues leading to greater risk of additional hypothermia and shivering in patients.[4] Shivering tamper with adequate monitoring and is associated with many side effects, as it cause rise in the circulating catecholamine, heart rate, cardiac output, minute ventilation, oxygen consumption by patients, CO2 production from metabolism, rise in lactic acid level, rise in intraocular and intracranial pressure, and rise in postoperative pain from surgical incision stretching.[5]

Various opioid and non-opioid agents, such as meperidine, ketamine, tramadol, and clonidine, have been used to prevent shivering, but they have many side effects and the results are inconclusive.[6]

Dexamethasone is a specific and selective agonist of α2- adrenoceptor in the brain and spinal cord. The effects of activation of these receptors are fall in sympathetic tone with inhibition of the neuro-endocrine and hemodynamic adjustments to anaesthesia and surgery. So, dexamethasone can counteract with both beneficial and undesirable effects of hypothermic shivering, including rise in catecholamine levels, increase in oxygen consumption, rise in mean blood pressure, and heart rate.[7-9]

Dexamethasone exerts its binary action by inhibiting vasoconstriction and causing rise in the level of the shivering threshold. Dexamethasone has demonstrated its efficacy in the pharmacotherapy and prevention of shivering after spinal anaesthesia when used intrathecally due to its agonistic action on central alpha 2 receptors.[6,10- 12]

MgSO4 use can lead to peripheral vasodilatation, that has potential to improve cutaneous circulation, consequently causing fall in frequency of shivering.[4] Beside it, MgSO4 also has inhibitory action to calcium and has non-competitive antagonism on N-methyl-D-aspartate receptors, and its efficacy on analgesia, especially symptoms of neuropathic pain and increase in duration of motor block, has been established in many studies.[2,13,14] This mechanism of action of MgSO4 has also been reflected on its anti-shivering effects, but there is need for further pre-clinical and clinical studies.

Magnesium sulphate (MgSO4), which has been found to inhibit postoperative shivering, showing that the agent reduces the shivering threshold.[15] It has a good safety as there are no adverse effects associated to the use of the drug intrathecally and no significant disturbance in hemodynamic parameters was found.[16] Intravenous (IV) MgSO4 has been successfully examined in many studies in management of post operative shivering, but there are limited number of studies that have investigated the efficacy of intrathecal MgSO4 in reducing shivering.[2,4]

The objective of study is to compare the effect of dexamethasone and magnesium sulphate as an adjuvant to intrathecal bupivacaine in spinal anaesthesia for lower abdominal surgeries.

Aims and Objectives

The objective of study is to compare the effect of dexamethasone and magnesium sulphate as an adjuvant to intrathecal bupivacaine in spinal anaesthesia for lower abdominal surgeries.

1. Onset time of sensory and motor block
2. Duration of sensory and motor block
3. Duration of analgesia
4. Hemodynamic parameters
5. Any side effect

MATERIALS AND METHODS

After obtaining institutional research and ethical committee approval, this randomized, prospective, double-blind study was conducted in Indira Gandhi Institute of Medical Sciences, Patna. Patients admitted for lower abdominal surgeries was enrolled and pre anaesthesia evaluation was done.

Sample size and study design:

- 50 patients in each group were studied.
- Prospective randomized double - blind controlled clinical study.

Inclusion criteria:

- Patient aged between 20 - 50 yrs with weight 50-70 kgs.
- Patient posted for lower abdominal surgery (e.g. inguinal hernia repair) under spinal anesthesia.
- ASA physical status I & 2.
- Patients informed consent for participation in spinal anesthesia.

Exclusion criteria:

- Patient refusal.
- Patient with co-morbidities such as hypertension, diabetes etc.
- Pregnant and lactating females.
- Bleeding disorder.
- Organ dysfunction, cardiac arrhythmia or congenital heart disease.
- Mental retardation.
- Patients with history of drug allergy to study drugs.
- Patients with known contra-indications to spinal anesthesia.

Procedure & intervention plan:

Detailed pre-anesthetic checkup was done for all patients who were included in this study. Patients were NPO for 6 hours before surgery. Upon shifting

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to OT, basic standard monitors were attached which include ECG, SPO2 and NIBP. Baseline vitals were recorded.

All patients were pre loaded with 10ml/kg crystalloid before spinal anesthesia. Spinal anesthesia was administered under strict aseptic precaution. With patients in the sitting position, spinal anesthesia was performed at the L2-L3 or L3-L4 with a 25 G Quincke needle and patients were received 3ml of 0.5% hyperbaric bupivacaine with 4mg of preservative free dexamethasone(1ml) or 50mg of magnesium sulphate(1ml) as an adjuvant (total of 4ml). Immediately after drug administration patients were lay supine. Surgery was started as soon as the T6 dermatome was anesthetized and patients who fail to reach at least this level was excluded from the study.

All hemodynamic parameters were recorded every 5 minutes till 30 mins and then every 15 mins till skin closure. Hypotension, defined as a decrease from baseline values of ≥20% in systolic arterial pressure or SAP < 90 mmHg, was treated by an infusion of crystalloids (100 mL) and injection mephentermine bolus (6 mg) until restoration of baseline values. Bradycardia, defined as a 30% drop in HR or ≤60 bpm. IV atropine 0.5 mg was given for treatment. Adverse effects such as bradycardia, hypotension, nausea and vomiting, shivering were noted and compared.

Study groups-

Group D- 0.5% Bupivacaine (3ml) + 4mg Dexamethasone (1ml)

Group M- 0.5% Bupivacaine (3ml) + 50mg Magnesium sulphate (1ml)

Statistical analysis: All data analyzed with student T- test and Chi square test.

RESULTS

Our results were presented in frequencies, percentages and mean ± standard deviation (SD). Chi Square test was used to compare proportion of different gender, ASA categories, shivering and other side effects between the groups. Unpaired t test was used to compare mean age, time of onset and duration of sensory and motor block between the groups. Results were considered significant when we obtained p-value less than 0.05. We carried out our analysis on SPSS 21.0 version.

The groups were comparable with respect to age, sex, weight and ASA classification. There was early sensory and motor block as well greater duration of block in patients who were given dexamethasone and there was late sensory and motor block as well lesser duration of block in patients who were given magnesium sulphate.

Table 1: Demographic Characteristics

Characteristic	Group D (n=50)	Group M (n=50)	p-value
Age (years)	35.4 ± 12.6	36.2 ± 13.4	0.75
Gender (Male/Female)	30/20	28/22	0.678
Weight (kg)	60.2 ± 8.4	59.6 ± 9.2	0.73
ASA (1/2)	28/22	27/23	0.845

Demographic Characteristics are similar in both groups (p>0.05).

Table 2: Sensory and Motor block findings and Duration of surgeries

	Group D (n=50)	Group M (n=50)	p-value
Total duration of surgery (min)	107 ± 11.19	109.26 ± 9.92	0.45
Time to reach T6 sensory block (min)	3.47 ± 11.08	6.67 ± 0.97	<0.05
Time to reach bromage 4 motor block (min)	3.89 ± 0.85	8.22 ± 0.88	<0.0001
Duration of sensory block (min)	321 ± 43.31	258 ± 26.09	<0.0001
Duration of motor block (min)	217.66 ± 24.15	204.80 ± 19.72	<0.01

Duration of surgery is similar in both groups (p>0.05).

Time of sensory and motor block in group D is significantly less (p<0.05) compared to group M.

Duration of sensory and motor block in group D is significantly longer (p<0.05) compared to group M.

Table 3: incidence of Adverse Events

	Group D	Group M	p-value
Hypotension	5	6	0.75
Bradycardia	3	4	0.69
Nausea and Vomiting	2	3	0.65
Shivering	2	3	0.65

Incidence of adverse events are similar in both groups (p>0.05)

DISCUSSION

Several experiments demonstrated analgesic effects of steroids in neuroaxial and peripheral block. Movafegh et al. reported that the addition of dexamethasone (8 mg) to lidocaine for spinal anesthesia provided significant prolongation of sensory and motor block in comparison with plain

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lidocaine and there is no difference between dexamethasone-lidocaine 5% and epinephrine (0.2 mg)- lidocaine 5% in sensory and motor block duration. Consequently, the onset time of sensory and motor blockade were similar among these three groups.[8]

Mirzaie et al. reported that corticosteroids and bupivacaine can diminish the incidence of back pain after laminectomy in the immediately postoperative period.[9] Kotani et al. administered methylprednisolone with bupivacaine intrathecally in patients with postherpetic neuralgia. They concluded that this combination induced excellent and long-lasting analgesia.[10]

Taguchi et al. reported that intrathecal injection of betamethasone successfully decreased the pain score in three patients with intractable cancer pain.[11]

Another study reported that epidural dexamethasone (5 mg) reduces postoperative pain score and morphine consumption following laparoscopic cholecystectomy with no apparent side effects.[12]

Atsuhrio reported that intrathecal or epidural methylprednisolone decreased continuous pain and allodynia in patients with postherpetic neuralgia. The analgesia was much greater in the intrathecal group compared to the epidural group. Interleukin 8 in the CSF decreased significantly in the intrathecal group as compared to the epidural group.[13]

Zhong et al, who showed intravenous magnesium sulfate can accelerate the sensory block onset and lengthen the sensory block and spinal anesthesia duration.[14]

Banihashem et al., reported that the intrathecal magnesium sulfate delayed the onset of sensory blockade which was not advisable for cesarean section.[15]

Ozalevli M et al. observed in lower extremity surgery patients, that there was a significant delay in the onset of motor and sensory blockade but prolonged the period of anaesthesia without additional side-effects when intrathecal magnesium sulfate was added to bupivacaine and fentanyl in spinal anaesthesia.[16]

Shivering is protective response of body to defend hypothermia but it leads to pain and discomfort to patient and could be a threat to patient with cardiovascular disorders or respiratory diseases because it leads to rise in the level of catecholamine in systemic circulation, heart rate, respiratory rate, cardiac output, requirement of oxygen, formation of CO2 by metabolic processes and lactic acid level. There is also rise in intracranial, intra-ocular pressure and pain after surgery due to stretch on surgical incision. Shivering can also disturb proper monitoring and care of patients by causing disturbance in ECG, blood pressure and reading shown by pulse oximeter.[5] Moreover, shivering in patients under ASA grades III and IV category may add up to challenges to doctor and raise the intra-operative time.[17]

Hypothermia is a major inducer of shivering, but no definite linear association has been established between temperature of body and frequency of shivering episodes. Shivering is also associated with age of the patient, level of sensory block, operation theatre temperature, and temperature of intravenous solution.[18] Evidence for explaining the mechanism and association of shivering with major risk factors is weak. Some research has suggested that redistribution of internal heat, loss of body heat to environment and disturbance in central thermoregulation could be the reason.[19] Thermoregulatory centre of the hypothalamus is likely to be affected adversely by administration of general and regional anaesthesia leading to various levels of hypothermia.[20] Under regional anaesthesia, there is vasoconstriction and shivering restricted to part of body above the level of block while there is vasodilatation and redistribution of the core body temperature in the part of body below the level of block because there is block on somatic and sympathetic nerve in lower body.[17]

There is complicated relationship between shivering and the neurotransmitter pathways, and there is involvement of several receptors, such as α-2 adrenergic, cholinergic, opioid, and serotonergic receptors in patients. Various trials have been conducted to study the effect of drug interactions on these receptors on frequency and severity of shivering after spinal anaesthesia.[5] The study has been done on opioids like fentanyl, meperidine, tramadol and other drugs like clonidine and ketamine, and various level of efficacy has been established in those study but occurrence of various adverse effects like instability in haemodynamics, decrease in respiratory rate and power, nausea, and vomiting.[21]

The present study has shown that intrathecal injection of both dexamethasone (4 mg) and MgSO4 (50 mg) during spinal anaesthesia lead to fall in the incidence of shivering after spinal anaesthesia significantly.

Like this study, Ellakany et al. have also used intrathecal dexamethasone and found that both intrathecal dexamethasone and meperidine was efficacious in decreasing the frequency of shivering after spinal anaesthesia in patients who have undergone lower abdominal surgery, but there was higher frequency of adverse effect in the meperidine group than the dexamethasone group like itching, nausea and vomiting.[12]

In 60 patients who have undergone lower abdominal surgery, Abdel Hamid et al. found that addition of 5 μg of dexamethasone to intrathecal bupivacaine lead to improvement in the quality of the spinal block, with decreased analgesic requirements after surgery and a decreased frequency of shivering with no sedation or other adverse effects as compared with the placebo group.[22]

Abdel-Ghaffar et al. have compared the clinical effectiveness and safety of three different doses (0.5, 0.3 and 0.2 μg/kg) of intravenous dexamethasone and 0.4 mg/kg dose of intravenous meperidine for the

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therapy of shivering after spinal anaesthesia in 120 patients. They have reported that 0.3 μg/kg dose of dexamethasone was the most effective dose for the optimum therapy of shivering after spinal anaesthesia, with acceptable effects on hemodynamic properties and sedation.[23-25]

Gozdemir et al. have reported that, an intravenous administration of 80 mg/kg of MgSO4 over 30 min, followed by intravenous administration at a maintenance dose rate of 2 g/hr after spinal anaesthesia to the end of intraoperative period led to significant reduction in incidence of shivering after spinal anaesthesia in patients who have undergone TURP.[25]

There was no significant difference between the groups with respect to haemodynamic characteristics during surgery. With respect to the time of onset of sensory and motor block, dexamethasone group had the lowest time of onset of sensory and motor blocks, while MgSO4 group had prolonged time of onset of sensory and motor block than dexamethasone group. The reason for this could be alteration in the pH and baricity of bupivacaine after adding magnesium sulphate. The patients of dexamethasone group have higher durations of both the sensory and motor blocks than the patient of MgSO4 group. Our results were consistent with the findings of two earlier studies in which the efficacy of 10 μg of intrathecal dexamethasone was compared with the efficacy of 50 mg of intrathecal magnesium sulphate which were added to bupivacaine with respect to quality of the spinal block as primary end-point.

CONCLUSION

Dexamethasone and magnesium sulphate both proved to be effective in reducing the incidence of post spinal anaesthesia shivering. Dexamethasone was better than magnesium sulphate with respect to onset and duration of sensory and motor block. However, use of magnesium sulphate should also be encouraged as it is cheap and available in most operating theatres.

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