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A STUDY TO COMPARE THE EFFECT OF MAGNESIUM SULFATE AND FENTANYL AS ADJUVANT TO BUPIVACAINE FOR SUBARACHNOID BLOCK

Anaesthesiology

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ABSTRACT

BACKGROUND: To Compare the effect of magnesium Sulphate and fentanyl as adjuvant to bupivacaine for subarachnoid block. **MATERIAL METHOD:** This is a randomised study conducted out on 150 patients of either sex, aged 18-65 years, ASA grade I and II scheduled for lower abdominal surgery, hips, and lower extremity surgeries. **RESULT** From the present study we concluded that the supplementation of 100 mg preservative free magnesium sulphate to 1cc 0.5% hyperbaric bupivacaine though significantly delays the onset time of sensory and motor block but prolongs the duration of sensory block, motor block and postoperative analgesia as compared to 25µg preservative fentanyl when added to intrathecal 1cc 0.5% hyperbaric bupivacaine without any side effects. The haemodynamic parameters and SpO_2 are comparable in both the groups. Postoperative analgesic consumption in 24 hrs is less in magnesium group than in fentanyl group.

KEYWORDS

INTRODUCTION

Pain can be defined as a neurologic response to unpleasant stimuli. Pain is derived from the Latin Word "poena" or penalty. Pain is an individual, subjective and complex bio psychosocial process whose existence cannot be proved or disproved. Unrelieved pain is a major psychologic and physiologic stress for patients. For scientific and clinical purposes, pain is defined by the International Association for the Study of Pain (IASP) as "an unpleasant sensory and emotional experience associated with actual or potential tissue damage, or describe in terms of such damage". . Pain is one of the most common experience and stressors in patients. Pain controlling has become a priority in current ages.[1]

A multidisciplinary team approach (eg, acute pain service) is beneficial for framing a strategy for pain relief, mainly in difficult patients, such as those who have gone through extensive surgery, constantly use narcotics, or have medical co morbidities that could escalate their risk of analgesia-related complications or side effects. Spinal anaesthesia was the first major regional technique introduced into clinical practice. Spinal anesthesia was first performed by August Bier on 16th august 1898. He injected 3ml of 0.5% cocaine intrathecally into a 34year old labourer.[2]It is a safe, reliable and inexpensive technique with the advantage of providing surgical anesthesia and prolonged post-operative pain relief by using various local anesthetic agents. Spinal anesthesia blunts intra-operative pain, autonomic, somatic and endocrine responses. It provides a faster onset and effective sensory and motor blockade. Spinal anesthesia is a commonly used technique in anesthetic practice for gynecological, lower abdominal, pelvic, and lower limb surgeries.

Bupivacaine is an amide anesthetic that is more potent and has a longer duration of action than lidocaine mepivacaine , and procaine., [3,4]The increases in potency and duration of action are related to prolonged binding of sodium channels. Thus, if systemically absorbed, bupivacaine has a higher risk of major toxicity (eg, seizures, intractable cardiac arrhythmias) than lidocaine and most other local anesthetics. Bupivacaine is appropriate for procedures lasting for 2 to 2.5 hours. Several intrathecal adjuvants such as opioids, clonidine, neostigmine, ketamine, magnesium and benzodiazepines used in order to prolong analgesia, improve quality of subarachnoid block and to reduce the incidence of side effects.

Fentanyl is a synthetic opioid in the phenylpiperidine family, was developed by screening chemicals similar to pethidine (meperidine) for opioid activity.[5] The widespread use of fentanyl triggered the production of fentanyl citrate (the salt formed by combining fentanyl and citric acid in a 1:1 stoichiometric ratio). Fentanyl citrate entered medical use as a general anesthetic in 1968, manufactured by McNeil Laboratories under the trade name Sublimaze. [6]Fentanyl is a highly lipid soluble drug when administered intrathecally it diffuses into the spinal cord and binds to dorsal horn opioid receptors rapidly. This produces a rapid onset of analgesia with minimal cephalic spread. Although opioids are associated with many side effects such as respiratory depression, nausea and vomiting, pruritus , urinary retention , and hemodynamic instability, they don't delay motor recovery.[7]

Magnesium is called as “Nature's physiological calcium channel blocker”. It is a NMDA (N methyl D aspartate) antagonist. It blocks NMDA channel in a voltage dependent way producing reduction in NMDA induced currents. Magnesium, the fourth most common cation in the body, has been used in medicine and anaesthesia for a range of applications including seizure prevention in preeclampsia, tocolysis, asthma management, and dysrhythmias.[8,9]Safety of intrathecal magnesium has been evaluated and it was proved to prolong the opioid analgesia in both rats and humans.[10]Numerous clinical investigations have demonstrated that Mg infusion during general anaesthesia reduced anaesthetic requirement and postoperative analgesic consumption,[11-13]Safety of intrathecal magnesium has been evaluated and it was proved to prolong the opioid analgesia in both rats and humans. The present study was undertaken as an attempt to compare the effect of magnesium sulphate and fentanyl as adjuvant to bupivacaine for subarachnoid block

METHODS

AIM

- A study to compare the effect of magnesium sulfate and fentanyl as adjuvant to bupivacaine for subarachnoid block.

OBJECTIVES:

- To assess onset of sensory and motor blockade.
- To assess duration of sensory and motor blockade.
- To assess changes in pulse rate, blood pressure, saturation and respiratory rate.
- To assess Side effects/Complications if any
- To compare the duration of analgesia and rescue analgesia in 24 hours.

Study Population:

All patients for subarachnoid block of ASA grade 1 and ASA grade 2 presenting to Dept of Anesthesiology National Institute of Medical Sciences & Research, Jaipur comprised the study population.

Study design:

The study was carried out as randomized study.

Study sample
150 patients for subarachnoid block of ASA grade 1 and ASA grade 2 represented study sample.

Sample Size estimation: 150 (50 Patients in each group)

Sampling technique:
Convenient non probability sampling technique was used to select study participants for the study, from all those who are eligible to participate. Table of random numbers used to randomize these cohorts to study groups.

Inclusion Criteria:
- ASA I & ASA II patients undergoing Spinal Anesthesia.
- Patients in the age range 18- 65 years.
- No known history of allergy, sensitivity or other form of reaction to local anesthetics of the amide type.
- Patient willing to sign informed consent.

Exclusion Criteria:
- Patient refusal.
- Patients allergic to any drugs.
- History of seizure disorder.
- Known allergy to trial drug.
- Patients with renal, hepatic, cardiovascular and respiratory diseases.

Patients with neurological disorders and neuropathies or receiving medications known to influence neuromuscular junction.

Anesthetic technique:
On arrival of patient in the operating room standard monitoring were applied; ECG, noninvasive blood pressure, pulse rate and arterial oxygen saturation were monitored. 20-gauge intravenous cannula was secured.

Patients were classified into three groups 50 patients in each group. Blinding was achieved through the use of equal number of drugs (3.5ML) while syringe use will be labeled as 1, 2, and 3 according to their content. Identical coded syringes were prepared by person not involved in study and were randomly handed over to anesthetist who was unaware of the identities of the drug. Three groups labeled as follow

GROUP 1: 15 mg Bupivacaine (heavy).
GROUP 2: 15mg Bupivacaine (heavy) with 25micogram fentanyl.
GROUP 3: 15mg Bupivacaine (heavy) with 100mg magnesium sulfate (total volume 3.5ml) magnesium was taken in insulin syringe and then diluted with 0.5ml with sterile water)

Patients in more than attempts and an approach other than midline was used were excluded from study.

The Spinal Technique Used:
After pre-loading: the spinal anesthesia was performed

Intra Operative:
All patients of both groups were monitored for:
- Pulse rate.
- Systolic &diastolic blood pressure
- Arterial Oxygen Saturation (Sp_{02}).
- Sensory block: Onset, level using pinprick test and duration
- Motor block: Onset and duration of block using modified Bromage scale.

Pulse rate, Systolic blood pressure, Diastolic blood pressure, SpO_2, Respiratory rate were monitored every 5 minutes up to 30 minutes and then every 15 minutes till the end of surgery.

Sedation: Assessed by Ramsay Sedation Scale:
Postoperative
All patients were shifted to recovery room and were watched for pulse, blood pressure, visual analogue scale, sensory level and duration of motor blockade.

Pain score was assessed by Visual Analogue Scale
0BSERVATION
In the present study no statistically significant changes in hemodynamic parameters (heart rate, systolic and diastolic B.P and oxygen saturation) were observed.

Distribution of study groups based on onset of sensory block (n=150)

Onset of sensory block (in minutes)	Group 1 (n = 50)		Group 2 (n = 50)		Group 3 (n = 50)		p value*
	Mean	SD	Mean	SD	Mean	SD	
	3.1	0.6	3.3	0.7	5.0	0.6	<0.001

*Kruskal Wallis test was applied for comparison of means

The mean difference was found to be statistically significant. (p value < 0.001)

Distribution of study groups based on onset of motor block (n=150)

Onset of motor block (in minutes)	Group 1 (n = 50)		Group 2 (n = 50)		Group 3 (n = 50)		p value*
	Mean	SD	Mean	SD	Mean	SD	
	3.8	0.7	4.1	0.8	4.8	0.7	< 0.001

*Kruskal Wallis test was applied for comparison of means

The mean difference was found to be statistically significant. (p value <0.001)

Distribution of study groups based on duration of sensory block (n=150)

Duration of sensory block (in minutes)	Group 1 (n = 50)		Group 2 (n = 50)		Group 3 (n = 50)		p value*
	Mean	SD	Mean	SD	Mean	SD	
	147.8	17.7	156.8	18.2	198.7	16.2	<0.001

*Kruskal Wallis test was applied for comparison of means

The mean difference was found to be statistically significant. (p value< 0.001).

Distribution of study groups based on duration of motor block (n=150)

Duration of motor block (in minutes)	Group 1 (n = 50)		Group 2 (n = 50)		Group 3 (n = 50)		p value*
	Mean	SD	Mean	SD	Mean	SD	
	158.4	20.2	167.3	21.1	216.2	18.2	<0.001

Kruskal Wallis test was applied for comparison of means

The mean difference was found to be statistically significant. (p value < 0.001).

Distribution of study groups based on duration of analgesia (n=150)

Duration of analgesia (in minutes)	Group 1 (n = 50)		Group 2 (n = 50)		Group 3 (n = 50)		p value*
	Mean	SD	Mean	SD	Mean	SD	
	175.5	24.0	184.5	24.5	340.8	42.9	<0.001

*Kruskal Wallis test was applied for comparison of means

The mean difference was found to be statistically significant. (p value< 0.001).

DISCUSSION

Our study consisted of 150 patients aged between 18 to 65 years falling under ASA grade I or II scheduled for elective surgeries under spinal anaesthesia. They were divided into 3 equal groups consisting of 50 patients in each group in a randomized fashion and were administered magnesium sulphate with bupivacaine, magnesium sulphate with fentanyl and bupivacaine with normal saline.

Similarly in a study done by Ghatak et al [15], 90 patients were considered as sample size and were divided in to 3 equal groups receiving similar

drug combinations as the present study. In contrast to these in studies done by Katiyar S et al[12], Malleeswaran S et al [13]the study participants were divided into 2 group's receiving magnesium sulphate with bupivacaine and magnesium sulphate with fentanyl each group. Maximum of the study participants were in the age group of 21-30 years (40.7). The mean age of the study participants was observed to be 34.4 ± 10.13 years. The distributions of age among groups were found to be statistically significant (p value - 0.00). Majority of the study participants were males (63.3 %), while 36.7 % of them were females. In contrast to these findings, Nath MP et al[14],.

In our study we found the mean time for the onset of sensory block in group 1 (only Bupivacaine) was 3.1 minute while it was 3.3 minute in group 2 (Bupivacaine and Fentanyl) and 5 minutes in group 3 (Bupivacaine and Magnesium sulphate). The mean difference was found to be statistically significant. (p value- 0.000) and the mean time for the onset of motor block in group 1 (only Bupivacaine) was 3.8 minute while it was 4.1 minute in group 2 (Bupivacaine and Fentanyl) and 4.8 minute in group 3 (Bupivacaine and Magnesium sulphate). The mean difference was found to be statistically significant. (p value- 0.000). Our results are in contrast to findings seen by Khezri MB et al[17] who observed that the mean duration of motor block was prolonged in fentanyl group (171.66 ± 13.25 mins) than magnesium group (118 ± 14.65 mins). Yadav M et al also observed that mean duration of motor block was prolonged in fentanyl group (286.2 ± 94 mins) than magnesium group (237 ± 11 mins).

In the present study, the Mean duration of Analgesia in group 1 (only Bupivacaine) was 175.5 minute while it was 184.5 minute in group 2 (Bupivacaine and Fentanyl) and 340.8 minute in group 3 (Bupivacaine and Magnesium sulfate). The mean difference was found to be statistically significant. (p value- 0.000). Mean Post- operative analgesic consumption in group 1 (only Bupivacaine) was 1.5 in 24 hours, while it was 1.4 in group 2 (Bupivacaine and Fentanyl) and 1.3 in group 3 (Bupivacaine and Magnesium sulfate). The mean difference was not statistically significant. (p value- 0.11).

Katiyar S et al[12], also demonstrated similar results With 100 mg of intrathecal magnesium (group B), they observed increased duration of analgesia (328.13 min) without increase in adverse effects as observed with intrathecal fentanyl group. This prolongation of analgesia is consistent with the experimental synergistic interaction between spinal local anaesthetic and NMDA antagonists, like magnesium, which causes anti nociceptive effects via different mechanisms. Group B patients also showed a reduced total consumption of tramadol in the first 24 h after surgery. The above results indicate that in order for total analgesic consumption to be reduced, higher doses of magnesium sulphate are required, similar to the dose used in the study by Arcioni *et al*.[18]

CONCLUSION

From the present study we concluded that the supplementation of 100 mg preservative free magnesium sulphate to 1cc 0.5% hyperbaric bupivacaine though significantly delays the onset time of sensory and motor block but prolongs the duration of sensory block, motor block and postoperative analgesia as compared to 25µg preservative fentanyl when added to intrathecal 1cc 0.5% hyperbaric bupivacaine without any side effects. The haemodynamic parameters and SpO_2 are comparable in both the groups. Postoperative analgesic consumption in 24 hrs is less in magnesium group than in fentanyl group.

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