Original Article

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A Comparative Study of Intrathecal Magnesium Sulphate with or without Intrathecal Fentanyl to 0.5% Hyperbaric Bupivacaine in Parturients Undergoing Elective Lower Segment Caesarean Section

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Abstract

Background: Prolongation of analgesia in Neuraxial anaesthesia is achieved by adding various adjuvants intrathecally along with local anaesthetic agent. Using two adjuvants together in lower doses will prolong the duration of analgesia without causing much side effects.

Aims: To compare the efficacy and safety of Intrathecal Magnesium v/s Fentanyl with Magnesium sulphate as an adjuvant to 0.5% Bupivacaine in terms of onset and duration of Sensory and Motor Blockade and Duration of Postoperative analgesia.

Material and Methods: Prospective randomized double blinded study was conducted on 70 ASA 1 & 2 patients undergoing elective caesarean section. They were randomly divided into two groups (35 each). All patients received spinal anaesthesia. Group M received 1.7 ml of 0.5% bupivacaine, 0.1 ml (50 mg) magnesium sulphate and 0.2 ml of normal saline intrathecally. Group FM received 1.7 ml of 0.5% bupivacaine, 0.1 ml (50 mg) magnesium sulphate and 0.2 ml (10microgram) of fentanyl intrathecally.

Results: Onset of sensory block was similar in Group M and Group FM. Duration of sensory block was prolonged in group FM (191±45.60) compared to Group M (178.12±38.06). Duration of analgesia was significantly prolonged (p value <0.001) in group FM (256.13±58.61) compared to Group M (231.28±36.58).

Conclusion: We conclude that, the addition of both intrathecal magnesium sulphate and fentanyl to bupivacaine for spinal anesthesia, in parturients undergoing elective LSCS results in prolonged duration of analgesia.

Keywords: Neuraxial anaesthesia; Bupivacaine; Magnesium sulphate; Fentanyl; Analgesia.

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Introduction

Spinal anaesthesia is the most common technique of regional anaesthesia used for elective lower segment caesarean section (LSCS). Bupivacaine is the commonest local anaesthetic agent used for spinal anaesthesia but its relatively shorter duration of action may lead to early analgesic intervention in post operative period.[1] The combination of adjuvants to local anaesthetic is synergistic for producing prolonged duration of analgesia without measurably increasing sympathetic and motor blockade.

Intrathecal administration of magnesium has been reported to potentiate opioid nociception & prolong duration of anaesthesia. Intrathecal magnesium used as a sole anaesthetic adjuvant in single dose is also shown to strengthen analgesic effect of spinal anaesthesia.[2]

Opioids are commonly used as intrathecal adjuvants to improve the quality of intraoperative analgesia and prolong it in post operative period. Various opioids such as Morphine, Fentanyl have been used as adjuvants to hyperbaric bupivacaine to enhance the clinical efficiency and duration of action of local anaesthesia drugs but they are associated with many side effects. Fentanyl is an opioid agonist and acts on mu receptors.[3] Addition of intrathecal magnesium sulphate to bupivacaine and fentanyl led to prolonged duration of analgesia significantly without increasing the incidence of side-effects.[4] This study was undertaken to compare intrathecal magnesium sulphate with or without intrathecal fentanyl as an adjuvant to 0.5% bupivacaine in spinal anaesthesia.

Objectives of the Study

To compare the efficacy and safety of Intrathecal Magnesium v/s Intrathecal Fentanyl with Magnesium sulphate as an adjuvant to 0.5% Bupivacaine in terms of

- Time of Onset of Sensory and Motor Blockade
- Duration of Sensory and Motor Blockade
- Duration of Postoperative analgesia
- Haemodynamic Parameters

Materials and Methods

A Prospective Randomized double blind study was conducted on patients undergoing elective lower segment caesarean section in hospitals attached to Bangalore Medical College and Research Institute, Bangalore, after obtaining clearance and approval from Institutional Ethical Committee.

Inclusion Criteria

- Patient who has given written informed consent
- Patients of age 18 - 40 years
- ASA grade I and II
- BMI 18.5-24.9
- Patients undergoing Elective LSCS.

Exclusion Criteria

- Patients refusing to participate in the study
- Patients with any contraindications for neuraxial blockade
- Allergy to the study drug
- Coagulation disorders
- Cardiogenic or hypovolemic shock
- Respiratory insufficiency
- ASA grade III and IV

The patients fulfilling all inclusion criteria were divided into two groups of 35 each.

- Group M (n= 35) – Bupivacaine (0.5%H) 1.7ml with 0.1ml (50mg) magnesium sulphate 50% plus 0.2ml normal saline.
- Group FM (n=35) – Bupivacaine (0.5%H) 1.7ml with 0.1ml (50mg) magnesium sulphate 50% plus 0.2ml (10mcg) Fentanyl.

All patients were kept fasting for 8 hours. Tab Alprazolam 0.25mg and Tab Ranitidine 150mg was given night before the day of surgery. Inj. Ranitidine 50mg and Inj. Metoclopramide 10mg intravenously was given half an hour preoperatively.

On arrival to the operating room, patients were preloaded with 10ml/kg of Ringer lactate. Non Invasive Blood Pressure, Pulse oximetry and electrocardiogram were connected. The baseline Systolic and Diastolic blood pressures (SBP, DBP), Heart Rate (HR) and Oxygen Saturation (SpO2) were recorded. Under strict aseptic precautions Subarachnoid Block was performed using 25G/26G Quincke Babcock spinal needle in the L3 – L4 space with patient in left lateral position. The study drug was injected over 10-15 seconds. The time at which injection completed was considered as zero time of the study and all measurements were recorded from this point. Following Subarachnoid Block, patients made to lie down supine.

Sensory testing was assessed by loss of pinprick sensation to 23 G sterile hypodermic needle for onset and dermatome levels were tested every 2 minutes until the highest level has been achieved and stabilized for four consecutive tests. Time of onset of Motor block was assessed using Modified Bromage Scale.

Data regarding the time to reach highest dermatome level of sensory blockade from the time of injection, time for two segment sensory regression were collected. In cases of failure of Subarachnoid Block and conversion to General Anaesthesia, we planned to exclude such patients from the study. Haemodynamic variables were recorded every minute for first five minutes, at 5 minutes for next half an hour after the administration of subarachnoid block and every 10 minutes thereafter up to 120 minutes after the block. Postoperatively patients were monitored every 1hr for the first 4 hours. Hypotension was defined as 20% fall in Systolic Blood Pressure from baseline and treated with intravenous fluids and intravenous Inj. Mephentermine 6mg. Bradycardia was defined as 20% fall in heart rate from baseline and treated with intravenous Inj. Atropine 0.6 mg.

After the surgery, patients were shifted to the post anaesthesia care and recovery unit and were monitored for haemodynamic variables and oxygen saturation until complete recovery of sensory and motor blockade was achieved. Post-operatively, pain was assessed using visual analog score when the patient complains of pain (Visual analog score>3). Rescue Analgesia was given in terms of Inj. Diclofenac sodium 75 mg as intravenous infusion. Time to Rescue Analgesia was noted.

The incidence of any adverse effects such as hypotension, bradycardia, shivering, nausea, vomiting, pruritus, respiratory depression and ECG changes were recorded. Time to gain back the motor function of lower limb, defined as time to reach modified Bromage 0 was noted. Time for complete sensory regression i.e perception of pinprick sensation at the sole of foot and time to mobilize were recorded.

Statistical Analysis

Results obtained were analysed by descriptive statistics. Chi-Square study, Fisher exact test, student t-test were adopted for data analysis using SPSS version 21.0. P<0.05 was considered significant.

Results

Demographic data were similar in both groups (Table 1)

All parturients were haemodynamically stable throughout intra-operative and post-operative period. There was no significant difference in intra-operative HR and MAP in both the groups (Table 2). Between the groups, there was no significant difference in post-operative HR and MAP (Table 3).

Table 1: Demographic data of group M and group FM.

Demographic Data	GP M	GP FM
Age (yrs)	22.25±6.56	21.94±4.09
Weight (Kgs)	53.19±9.96	55.44±8.24
Height (Mts)	1.64±0.15	1.59±0.20
BMI (Kg/sq Mts)	22.41±2.67	21.92±3.22
Duration of surgery (mins)	65.75±15.57	68.13±18.46

Table 2: Comparison of Intra-op HR and MAP among group M and FM.

Table 2	Intra OP HR (bpm)			Intra OP MAP (mmHg)		
Time Interval (Mins)	GP M	GP FM	p-value	GP M	GP FM	p-value
	Mean± SD	Mean± SD		Mean± SD	Mean± SD	
0	87.8±10.73	84.5±6.8	0.384	96.3±9.1	94.2±8.8	0.122
1	86.8±9.87	83.6±8.0	0.296	96.5±9.0	93.2±6.9	0.087
2	87.5±11.59	83.4±9.3	0.326	98.2±8.9	91.4±6.6	0.262
3	85.6±11.30	84.0±9.2	0.116	97.6±7.1	94.1±6.7	0.217
4	86.4±10.96	83.4±8.7	0.092	94.5±7.6	92.5±6.5	0.692
5	84.5±11.47	84.1±7.7	0.52	95.6±6.8	93.5±6.5	0.895
10	84.9±10.95	84.8±8.5	0.362	94.2±7.8	94.3±6.5	0.526
20	85.4±11.32	84.4±10.0	0.442	95.1±6.91	96.5±6.1	0.742
30	83.3±10.40	84.3±10.6	0.26	94.8±5.9	93.5±6.6	0.901
40	85.1±8.48	82.8±10.6	0.092	93.8±6.9	92.1±7.3	0.564
50	84.1±7.96	83.5±9.4	344	93.7±4.7	93.5±6.2	0.714
60	82.2±7.29	82.3±8.0	54	94.1±6.8	93.2±5.2	0.619
90	81.4±5.56	81.8±6.3	0.154	93.2±5.5	91.8±3.7	0.733

Table 3: Comparison of Post-op HR and MAP among group M and FM.

Table 3	Post OP HR (bpm)			Post OP MAP (mmHg)		
Time Interval (MINS)	GP M	GP FM	p-value	GP M	GP FM	p-value
	Mean± SD	Mean± SD		Mean± SD	Mean± SD	
BASAL	83.80±7.68	85.81±9.1	0.447	94.9±6.7	92.0±15.4	0.2
2Hr	84.20±6.74	84.31±8.9	0.399	95.1±6.8	93.1±8.3	0.276
4	82.06±5.62	83.69±7.0	0.064	96.4±6.4	91.9±6.4	0.09
8	80.88±4.95	84.13±6.9	0.236	94.1±6.3	94.8±5.6	0.065
12	84.90±3.35	84.06±6.1	0.388	93.1±6.3	93.2±6.0	0.124
16	88.90±4.94	86.80±6.1	0.621	99.8±6.0	91.8±5.1	0.621
20	87.10±5.64	85.90±5.1	0.077	100.2±4.8	92.0±4.1	0.676
24	86.10±5.37	88.60±4.4	0.2	98.1±6.3	100.1±5.6	0.2

Table 4: Comparison of onset and duration of sensory and motor blockade among group M and FM.

Table 4	Group M	Group FM	P Value
Onset of Sensory Block	1.46±0.46	1.52±0.38	0.165
Duration of sensory blockade (mins)	178.12±38.06	191±45.60	<0.05*
Onset of motor block in mins	4.02±0.54	5.16±1.22	<0.05*
Duration of motor blockade	96.27±33.19	131.80±49.16	<0.001*

The mean Onset of sensory block in Group M was 1.46± 0.46 and Group FM was 1.52±0.38 and there was no statistically significant difference (p value 0.165) between the two groups (Table 4). The mean Duration of sensory block was significantly higher (p value <0.05) in Group FM (191±45.60) than Group M (178.12±38.06).

The mean Onset of motor block was significantly (p value <0.05) lower in Group M (4.02±0.54) than Group FM (5.16±1.22). The Mean duration of motor block (time taken to achieve bromage 0) was higher in Group FM (131.80±49.16) than Group M (96.27±33.19) and it was statistically significant (p value<0.001)(Table 4).

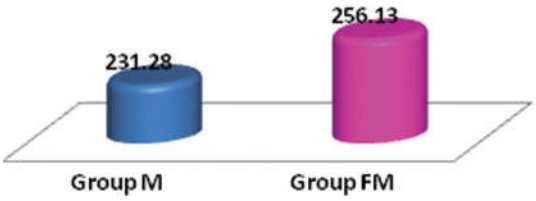

Fig. 1: Chart showing the prolongation of duration of analgesia among group FM compared to group M.

Time for first rescue analgesia (duration of post-op analgesia) was significantly prolonged in Group FM (256.13±58.61) compared to Group M (231.28±36.58) and it was statistically significant (P-value: 0.001) (Figure 1)

Discussion

Postoperative analgesia is most important in all types of surgeries, especially in caesarean section. Because it improves mother comfort and in-turn it helps in overall care of the newborn. Neuraxial anaesthesia is preferred for caesarean delivery because it has its own advantages over general anaesthesia. Prolongation of postoperative analgesia in neuraxial anaesthesia is achieved by addition of variety of adjuvants. Opioids are commonly used adjuvants and their analgesic effects are dose dependant, so side effects will be more if we use opioids in larger dose. Combination of adjuvants in smaller doses will overcome the side effects associated with either of the adjuvant in larger dose alone.

The use of intrathecal magnesium sulphate which has N-methyl-D aspartate (NMDA) receptor antagonist properties in studies[3] have proved its synergistic effect on lipophilic opioids at lower doses in prolonging the duration of analgesia and reduce postoperative analgesic requirements without significant side effects.[5] Magnesium (Mg2+) is a non-competitive NMDA receptor antagonist that blocks ion channels in a voltage dependent fashion in dorsal horn of spinal cord and prevent central sensitization induced by peripheral nociceptive stimuli.[6,7] The present study intended to compare the synergistic effect of magnesium sulphate,

and/or fentanyl added to low dose intrathecal bupivicaine 0.5% in parturients undergoing LSCS under spinal anaesthesia.

In the present study, we found that the onset of sensory block (in minutes) in M group was 1.46± 0.46 and in FM group was 1.52±0.38 and there was no statistical difference between the two groups. The duration of sensory blockade in FM group was significantly prolonged (191±45.60) compared to M group (178.12±38.06) which explains the synergistic effects of magnesium with lipophilic opioids (fentanyl). Rana S. et al[4] (2017) in their study on 90 patients with intrathecal 8.5 mg hyperbaric bupivacaine 0.5% with 20 µg fentanyl added to 50 mg magnesium sulphate showed the onset of sensory block of 2.15 min and duration of sensory blockade of 211 min and our results were comparable with this study.

In our study, the onset of motor blockade in M group was 4.02±0.54 minutes and in FM group was 5.16±1.22. We observed that there was a delay in onset of motor blockade in FM group. With respect to duration of motor blockade, we found that there was significant prolongation of motor blockade in FM group (131.80±49.16) compared to M group (96.27±33.19). Rana S. et al[4] in their study showed the onset of motor block of 5.28 min and duration of motor blockade of 108 min and our results were again comparable with this study.

The duration of analgesia was significantly prolonged in group FM (256.13±58.61) compared to group M (231.28±36.58). Nath et al[3] (2012) in their study on 60 patients with 2.5 mL (12.5 mg) of hyperbaric bupivacaine + 0.5 mL (25 mcg) of fentanyl + 100mg $MgSO_4$ duration of analgesia of 263 min and our results were comparable with this study.

There were no significant side effects with respect to maternal haemodynamics and neonatal outcome which may be due to use of low dose bupivacaine as well as low doses of adjuvants.

Magnesium sulphate can prolong the duration of analgesia when used as adjuvant to 0.5% bupivacaine in neuraxial anaessthesia by blocking the NMDA receptors at the spinal level. It also has the property of potentiating the analgesic effect of lipophilic opioids like fentanyl when we combine them as adjuvants to local anaesthetic in spinal anaesthesia. So, combination of magnesium sulphate and fentanyl will have synergestic effects in prolongation of postoperative analgesia.

Conclusion

We conclude that, the addition of both intrathecal magnesium sulphate and fentanyl to bupivacaine for spinal anaesthesia, in parturients undergoing elective LSCS, results in prolonged duration of analgesia with lower pain scores and better haemodynamic stability.

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