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Research

Comparison of Effectiveness of Intrathecal Magnesium Sulphate 100 Mg Plus Inj.Bupivacaine Heavy 0.5% 15 Mg *Versus* Intrathecal Neostigmine 75 Microgram Plus Inj.Bupivacaine Heavy 0.5% 15 Mg in Unilateral Inguinal Hernia

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ABSTRACT

Background: We studied nonopioid intrathecal adjuvants magnesium sulphate and neostigmine to avoid adverse effects of opioids. Our aims were to study change in haemodynamic parameters intra and postoperatively, block characteristics, duration of analgesia and adverse effects intraoperatively and postoperatively.

Settings and Design: A type of prospective, double blinded randomized controlled trial study carried out at Tertiary Care Hospital, during 2018-2019 with 70 adult male patients in the age group of 18-65 years having unilateral inguinal hernia after taking Institutional Ethical Committee clearance (registration number: ECR/6/INST/GUJ/2013) taken and written informed consent were taken in their own language according to institutional protocols and explaining the cause, pathology and consequences of the disease process.

Material and Methods: In this study, 70 patients, after matched inclusion criteria, posted for unilateral inguinal hernia were assessed. They were divided into two, Group M and Group N, 35 each who received Magnesium sulphate (100 mg) and Neostigmine methyl sulphate (75 mcg) respectively ; along with 0.5% Bupivacaine (15 mg). Primary outcome was to study hemodynamic stability and secondary outcome was to study blockage characteristics and adverse effects. Statistical analysis done by using the SPSS Statistical Software version 24.0. Mean and Standard deviation were calculated for analysis. Unpaired 'T' test were applied between Group M and Group N.

Results: Significantly delayed onset of sensory block with neostigmine (2.19 ± 0.40 min, $p < 0.05$), significantly delayed onset (2.85 ± 1.29 min, $p < 0.05$) and longer duration in motor block (188.82 ± 14.5 min, $p < 0.05$) observed with neostigmine. Significant bradycardia and hypotension with neostigmine and maximum at 1 min ($P < 0.01$). There was significant hypotension with neostigmine at 10 min and 15 min ($P < 0.05$). Duration of analgesia was longer with neostigmine as compared to magnesium sulphate (Group M = 98.4 ± 30.86 min, Group N = 215.45 ± 17.4 min). Adverse effects were more with neostigmine.

Conclusion: Longer duration of blockage and analgesia seen by Neostigmine methylsulphate with significant hypotension, bradycardia and vomiting.

Keywords: *Spinal Anesthesia, Bupivacaine hydrochloride, Magnesium sulphate, Neostigmine Methylsulphate.*

INTRODUCTION

Regional anaesthesia has overcome risk of general anaesthesia and gave excellent benefits. Spinal anaesthesia is commonly used regional anesthetic technique for lower abdominal surgeries. Regional anaesthesia gives excellent pain relief and facilitates early postoperative mobilization of patients.[1] August Bier (1898) introduced spinal analgesia in clinical practice. Then, it is widely used.[2,3] Bupivacaine Hydrochloride, long acting Amide type of local anaesthetic is most commonly used in the lower abdominal surgeries like inguinal hernia repairs.[4] The duration of action can be prolonged by addition of substances called adjuvants. But no drug yet is ideal having advantage without side effects. We are comparing Nonopioid adjuvants-magnesium sulphate and neostigmine. Magnesium sulphate is non-competitive antagonist to NMDA receptors.[5] Neostigmine acts as analgesic by spinal mechanism[6] reversible inhibitor of the enzyme cholinesterase.

MATERIAL AND METHODS

This study was done with 70 adult patients of ASA grade 1,2,3 after considering inclusion and exclusion criteria in 18-65 years age group having unilateral inguinal hernia after taking Institutional Ethical Committee clearance (registration number: ECR/6/INST/GUJ/2013) and written informed consent in their own language according to institutional protocols and explaining the cause, pathology and consequences of the disease process. Patients were equally divided into 2 groups given same volume of drug in both groups. Magnesium sulphate 100 mg and Neostigmine 75 microgram added to Inj. Bupivacaine heavy (0.5%) 15 mg intrathecally by Group M and Group N respectively. Patients were kept nil by mouth 8 hours prior to procedure for solids. Venous access was done. Multipara monitor attached and NIBP, pulse oximetry, ECG and vitals were recorded. Patients were pre-loaded with 15 ml/kg of appropriate iv fluid. Premedication given with Inj.Ondansetron 60 mcg/kg, Inj. Glycopyrrolate 4 mcg and Inj. Midazolam 20 mcg/kg. After proper preparation subarachnoid block was given Inj.0.5% Bupivacaine heavy (15mg) + Inj. Magnesium sulphate 100 mg in Group M and Inj.0.5% Bupivacaine heavy (15mg) + Inj. Neostigmine methyl sulphate 75 µg in Group N intrathecally, with a 25 G Quince spinal needle in L3-L4 intervertebral space in lateral decubitus position under all aseptic and antiseptic precautions after clear and free flow of cerebrospinal fluid. Then patients were immediately placed in supine position. After giving subarachnoid block, we observed. Time of onset of sensory block, Time of onset and duration of motor block, Hemodynamic changes, total Duration of analgesia, adverse effects. Hypotension (MAP < 20% of baseline systolic blood pressure) were treated with appropriate fluid (ringer lactate solution/colloid) and then Inj. Me phentermine 6 mg intravenous in incremental doses if needed. Bradycardia (HR < 50/min) were treated with Inj. Glycopyrrolate 0.5 mg intravenous (up to maximum of 3 doses). Inj. Atropine 0.2 mg/kg given if needed. Onset of sensory block was defined as the time from intrathecal injection to lack of pain with pin prick test at L1 level. Motor block was evaluated by Modified Bromage Scale. Onset of motor block was defined as the time from intrathecal injection to impossibility of knee flexion. When the score was zero in Modified Bromage Scale, it was considered as recovery from complete motor block. After motor and sensory recovery, patient was shifted from recovery room to ward.

Postoperative Pain assessment done by VAS score, when it was more than 3, first dose of analgesic given in form of Inj. Diclofenac sodium 75 mg intramuscularly and duration of analgesia by intrathecal drug had been completed. After study completed, data were collected and Statistical analysis done by using the SPSS Statistical Software version 24.0. Mean and Standard deviation were calculated for analysis. Unpaired 'T' test were applied between Group M and Group N. Associations with p value less than 0.05 was considered significant and less than 0.001 highly significant.

RESULTS

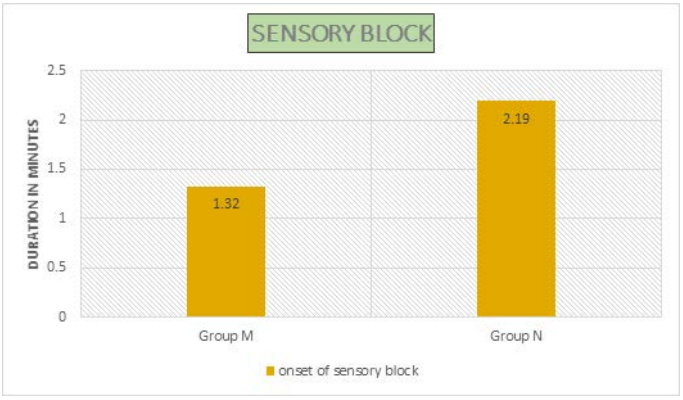
In our study, the mean age of patient in Group M is 48.26 ± 13.39 years and in Group N is 42.2 ± 13.22. This difference in age is not statistically significant as shown in Table 1. Onset of sensory block was significantly delayed ($P < 0.05$) in Group N (2.19 ± 0.40) as compared to Group M (1.32 ± 0.41) as shown in Table 2. Onset of motor block was faster and duration of motor block was longer in neostigmine as compared to magnesium sulphate (Table 2). Variation in duration of analgesia among both groups. Mean duration of analgesia was highly significant ($p < 0.0001$) in Group N (215.25 ± 17.49) as compared to Group M (98.4 ± 30.46) as shown in Table 3. We studied perioperative pulse rate changes from pre induction stage to 90 mins in both the groups. There was significant bradycardia in Group N ($p < 0.05$). No significant pulse rate changes in Group M as shown in Table 4. Significant hypotension was noted at 10 min (80.10 ± 4.78, $p = 0.0066$) and 15 min (87.41 ± 4.13, $p = 0.0010$) in Group N as shown in Table 5. Cases of nausea, vomiting, hypotension were more with neostigmine and shivering observed more with magnesium sulphate as shown in Table 6.

Table 1. Demographic data

Demographic data	Group M (MgSO4)	GROUP N (Neostigmine)	P value
Age (Mean ±SD)	48.26±13.39	42.2±13.22	0.0621
Weight (Mean ±SD)	59±4.9	55±6	0.0657

Table 2. Sensory and Motor block

		Group M (Mean ±SD)	Group N (Mean ±SD)	P value
Sensory Block	Onset in minutes	1.32±0.41	2.19±0.40	0.0001
Motor Block	Onset in minutes	1.52±0.69	2.85±1.29	0.0007
	Duration of motor block	103.42±11.44	188.82±14.05	0.0001



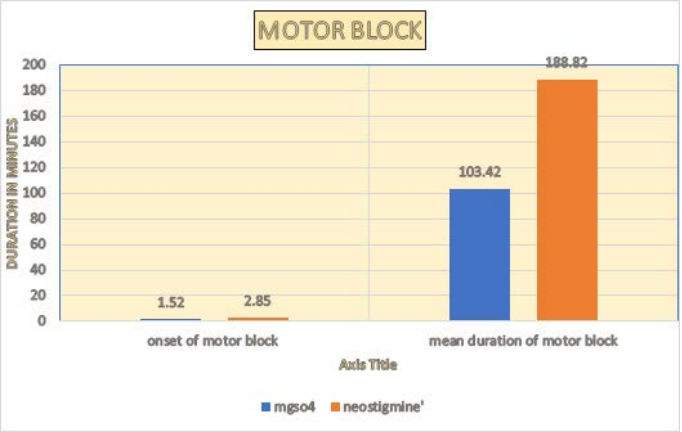


Table 3. Duration of analgesia

	Group M	GROUP N	P value
Total duration of analgesia in minutes (mean ± SD)	98.4±30.46	215.25±17.49	0.0001

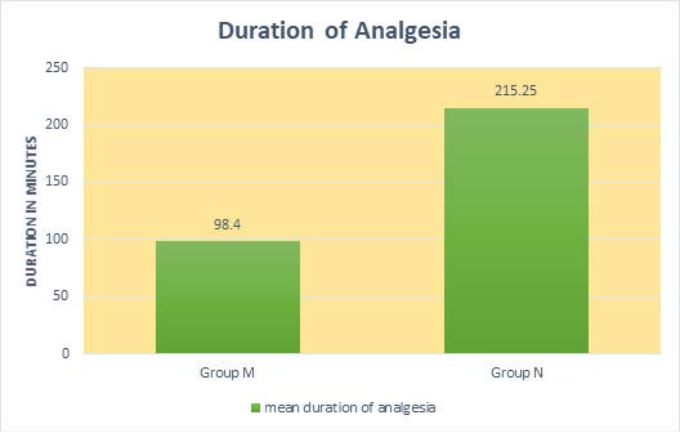


Table 4. Pulse rate variation

	Group M	GROUP N	P value
Pre induction	80.45 ± 11.9	86.28 ± 7.21	0.1598
1 min	79.65± 11.24	90.11±11.40	0.1213
3 min	78.40±11	90±11.61	0.0003
5 min	77.42±10.29	60.37±10.09	0.0005
10 min	77.88±10.43	85.08±9.03	0.0017
15 min	77.14±9.8	82.62±8.18	0.0076
30 min	82.11±9.52	72.11±7.1	0.0003
45 min	79.14±8.94	75.14±6.46	0.0196
60 min	80±10.13	72.8±6.16	0.0003
90 min	76.29±9.71	73.02±5.4	0.0313

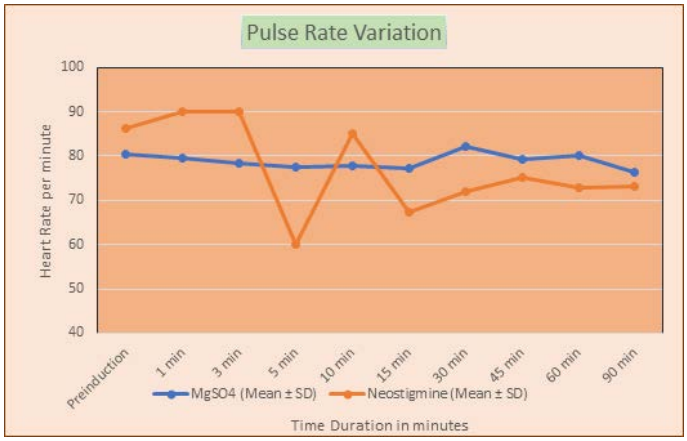


Table 5. Mean Arterial Pressure variation

	Group M (MgSO4)	GROUP N (Neostigmine)	P value
Premedication	95.94 ± 7.31	92.05 ± 5.21	0.4899
1 min	94.43 ± 5.89	90.05 ± 6.04	0.1095
3 min	92.22 ± 5.49	90.57 ± 5.31	0.2251
5 min	90.45 ± 6.48	88.87 ± 4.98	0.1329
10 min	90.13 ± 5.40	80.10 ±4.78	0.0066
15 min	90.13 ± 4.16	87.41 ±4.13	0.0010
30 min	90.72 ± 4.35	90.34 ±3.78	0.3502
45 min	89.58 ± 4.21	88.87 ± 2.79	0.2105
60 min	89.33 ± 4.89	86.70 ± 4.59	0.294556101
90 min	85.88 ±15.26	82.72 ± 4.54	0.06291

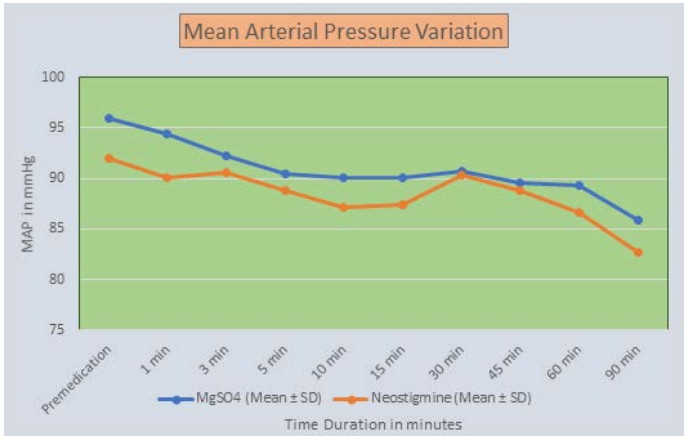
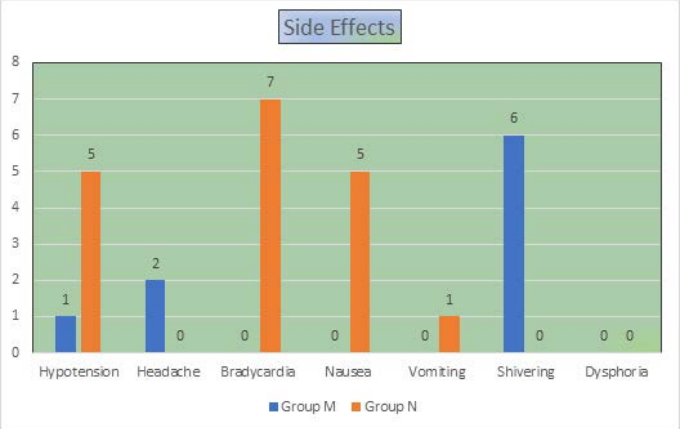


Table 6. Side effects

	Group M (MgSO4) (n=35)	GROUP N (Neostigmine) (n=35)
Hypotension	1	5
Headache	2	0
Bradycardia	0	7
Nausea	0	5
Vomiting	0	1
Shivering	6	0
Dysphoria	0	0



DISCUSSION

Spinal anesthesia (SA)[7,8] is commonly used anesthetic technique for lower abdominal surgery. Larger dose of analgesic is required to provide effective analgesia when local anesthetic used without adjuvants.[9,10] Need of study of nonopioid adjuvants evolved due to significant adverse effects of Neuraxial opioids. Recent research has focused on nonopioid spinal receptors. Our study is to evaluate effectiveness, hemodynamic stability, postoperative analgesia of two nonopioid adjuvants added to intrathecal local anaesthetic. Use of NMDA receptor antagonists is emerged as significant advances in pain management in the last two decades. Magnesium sulphate is a non-competitive NMDA receptor antagonist and prevents central sensitization from peripheral nociceptive stimulation. Intrathecal magnesium sulphate (1000-2000 mg)had good motor and sensory block without neurological damage in study done by HAUBOLD AND MELTZER5 . Intrathecal magnesium sulphate has good safety profile at a dose less than 3 mg/kg.[11] Saxena, et al. 2004 compared intrathecal magnesium sulphate and neostigmine. Both produced substantial antinociception without neurotoxicity in their study, potentiated analgesia of bupivacaine and opioids.[12]

Our study results showed that onset of the sensory block is faster in group M as compared to group McPeak duration of sensory block more in Group N as compared to Group M. There was significant delay in onset of motor blockade in group Duration of motor and sensory blockade was longer with neostigmine as compared to MgSo4.

S Chaudhry, et al. 2016[13] compared 50 mg and 100 mg MgSo4 as adjuvant in orthopaedic operation. They found prolonged sensory and motor blockade with 100 mg without neurological side effects. So MgSo4 has better therapeutic profile.

In contrast to our study, Seyed Hamid Reza Faiza, et al. 2012[14] study between magnesium sulphate and neostigmine found no significant difference in onset and duration of sensory block.

Efficacy of spinal additives neostigmine and magnesium sulphate on characteristics of subarachnoid block compared by Sucheta Joshi Khadka in 2015.[15] Prolongation of Sensory block was not significantly different in both additives. Onset and duration of motor block were similar in all the groups.

Two different concentrations of neostigmine 50 and 150 microgram taken by Savita Saini in 2006[16] and postoperative analgesia evaluated. Duration of motor block increased with higher concentration. Other characteristics were similar. Neostigmine as an intrathecal adjuvant 25 microgram prolonged only sensory block but 50-150 mics prolonged duration of motor block in study by Liu SS in 1999.[17]

There was significant bradycardia and hypotension with additive neostigmine in our study but reversed with Inj. Glycopyrrolate 0.2 mg intravenously and fast crystalloid injection intravenously and Inj. Mephentermine 6 mg intravenously respectively. Less fluctuations in Mean Arterial Pressure with magnesium sulphate So hemodynamic stability is better found with intrathecal magnesium sulphate than intrathecal neostigmine. Same results were found by Chaudhry done in 2016[13] with magnesium sulphate as our study, no significant hemodynamic instability.

Ahmad M, et al. 2000[18] studied two different concentration of intrathecal neostigmine 50 microgram and 150 micrograms in two groups respectively. They observed less hemodynamic instability in both groups. Higher dose produced prolonged sensory and motor block. Nausea was more with high dose of neostigmine. Similar results found by Sayed Hamid Reza Faiz, et al. in 2012[14] in study between magnesium sulphate and neostigmine an adjuvant with Inj. Bupivacaine Heavy (0.5%) in lower extremity surgeries.

Contrast results observed in rats studied by Hui Lui Pan, et al.[19] of Intrathecal Neostigmine, Bupivacaine, and Their Combination on Sympathetic Nerve Activity. They found that intrathecal injection of neostigmine increased blood pressure in rats because of increase in splanchnic nerve activity.

Three different concentrations 25,50 and 75 microgram studied by Lauretti, et al. in 1998[20] in patients of vaginal hysterectomy. Adverse effects (nausea) observed only with 75 micrograms but good analgesia in less concentrations than 50 micrograms.

Liu SS, et al., 1999[17] done study on 6.25 to 50 micrograms of neostigmine. Among these, they found 50 micrograms significantly increased the duration of sensory and motor block. In contrast to our study, good hemodynamic stability achieved in their results with dose dependent side effects.

Our study proved effectiveness of analgesia was good with neostigmine. More duration of analgesia with neostigmine than magnesium achieved. Similar results found with study by S. Gupta, et al. done in 2009[21] with neostigmine of 50 and 75 microgram and Sucheta Khadke, et al in 2015 neostigmine used as adjuvant intrathecally. But, Saini, et al. 2006[16] observed greatly enhanced analgesia by intrathecal neostigmine in the 150-µg dose and less consumption of rescue analgesic but ineffective with 50 microgram concentration. Similar results found with study on 50,75 and 150 micrograms. Good analgesia and less side effects with 75 micrograms by Vandana Pandey, et al. at 2013.[22]

Our study showed more incidence of nausea and vomiting with neostigmine and incidences of shivering seen with magnesium sulphate. In contrast to that, study done with caesarean patients for ant shivering effect of Magnesium Sulphate intrathecally by Sayed Hamid Reza Faiz, et al. in 2013.[23,24] They observed less incidence of shivering with Magnesium sulphate 25 mg than normal saline as adjuvant.

In contrast to my study, Suchita Khadke, et al. observed low

incidence of hypotension neostigmine in 2015.[16] Other parameters were similar to our study. Similar findings seen by Naga Seshu Kumari Vasantha, et al. in 2018[25] with 50 microgram neostigmine. They understood Hypotension secondary to α2-agonist can be prevented by stimulation of M2 spinal muscarinic cholinergic receptors and nitric oxide synthesis. Similar hemodynamic outcomes seen when S Gupta, et al. compared 50 and 75 micrograms neostigmine in 2009.[22] In contrast to our study, no significant hemodynamic changes seen when Lauretta GR, et al., studied subarachnoid neostigmine in randomly allocated abdominal hysterectomy patients in 1996.[26]

Opposite results found by D'Angelo, et al. in 2001[26] in United States. There was severe nausea but no prolongation of analgesia found.

Two different doses of magnesium sulphate were studied by S Chaudhry, et al. in 2016.[14] Opposite results about effectiveness of analgesia and adverse effects observed to our study.

LIMITATIONS

Cost effectiveness not analysed in this study. We cannot cover larger samples and all types of surgeries. Study does not cover every age group people, high risk patients.

CONCLUSION

As our study results, onset and duration of motor block significantly longer with intrathecal neostigmine. Analgesia is provided for more longer duration with neostigmine as compared to magnesium sulphate.

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CONFLICTS OF INTEREST

None.

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