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Original Research Article.

Study the Effect of a Single Dose of Intravenous Magnesium Sulphate on Postoperative Pain after Lower Abdominal Surgery

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ABSTRACT

Background: Uncontrolled post-operative pain may produce a range of detrimental acute and chronic effects. Relief from severe pain arising from deep or visceral structures, as happens in surgical procedures, requires the use of opioids. The aim of this study to assess the degree and duration of postoperative pain and requirements of rescue analgesia after Intravenous use of magnesium sulphate preoperatively in lower abdominal surgery.

Materials & Methods: This is a hospital based randomized double blind interventional analytic study done on 50 patients admitted in surgery department for lower abdominal surgery at S.M.S. medical college and attached hospital, Jaipur. After taking informed consent and confirming overnight fasting, patient was taken on the recovery room and baseline vitals like B.P., pulse rate, respiratory rate recorded. Patients at rest was evaluated by using a 0 – 10 cm. visual analogue score (VAS) or by using a 0 - 4 verbal rating score (VRS) at emergence from anaesthesia and1/2, 1, 2, 4, 6, 12 and 24 hrs. after surgery.

Results: There was no significant difference in mean age of patients between two groups (P > 0.05). The mean of total dose of analgesia requested was 87.00± 27.49 mg in $MgSO_4$ group and 240.00 ± 30.00 mg in C group. It means that there was clinically and statistically highly significant (P<.001). The mean duration of analgesia was 189.60±18.70 minutes in MgSO4 group and 24.40 ± 5.16 minutes in C group. In our study occurrence of nausea and vomiting were more in C group then the $MgSO_4$ group. But these adverse effects were statistically insignificant in both the groups and did not require any supplementary management.

Conclusion: We concluded that patients receiving Magnesium sulphate during preoperative period have better pain relief, more sedated and fewer requirements of rescue analgesics in the postoperative period, without any major side effects.

Keywords: $MgSO_4$ Group, Pain, VAS, Lower Abdominal Surgery.

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INTRODUCTION

Pain is a dehumanizing experience that destroys the soul. The World Health Organization (WHO) defines pain as “an unpleasant sensory or emotional experience associated with actual or potential tissue damage, or described in terms of such damage”.

Severe post-operative pain has a well-known morbidity and causes distress to patients. It is the most common and the most distressing complication of surgery. Although surgical pain is well controlled, the post-operative pain is still poorly treated. Despite the introduction of new analgesics for pain relief, the advances of post-operative pain relief still depends on the improvement in the delivery of existing drugs to the patients.[1]

Uncontrolled post-operative pain may produce a range of detrimental acute and chronic effects. The transmission of nociceptive stimuli from the periphery to the CNS results in neuro-endocrine stress response resulting in increased sympathetic tone, increased catecholamine levels and catabolic hormone secretion.

Transmission of pain signals evoked by tissue damage leads to sensitization of the peripheral and central pain pathways. Pre-emptive analgesia is a treatment that is initiated before the surgical procedure in order to reduce this sensitization. Owing to this ‘protective’ effect on the nociceptive system, pre-emptive analgesia has the potential to be more effective than a similar analgesic treatment initiated after surgery. Theoretically, immediate postoperative pain may be reduced and the development of chronic pain may be prevented. The only way to

prevent sensitization of the nociceptive system might be to block completely any pain signal originating from the surgical wound from the time of incision until final wound healing.

Appropriate pain relief begins with an understanding of correct drug, route of administration and mode of action. Early administration will achieve effective analgesic concentration and make it easier to maintain the therapeutic levels of drug in blood. Once a satisfactory level of pain relief has been achieved, this can be sustained by regular administration of drugs.[2]

Relief from severe pain arising from deep or visceral structures, as happens in surgical procedures, requires the use of opioids. Commonly used opioids are Morphine, Fentanyl, Pethidine etc. Opioids offer the benefit to relieve strong pain and many options are available if one is causing significant side effects. Other than opioids Magnesium sulfate is also used as pre-emptive analgesic due to its antagonistic effect on NMDA (N- Methyl, D- Aspartate) receptorsand Calcium ion channels.[3] Magnesium sulphate inhibits catecholamine release from adrenergic nerve terminals and adrenal medulla during laryngoscopy and endotracheal intubation. The aim of this study to assess the degree and duration of postoperative pain and requirements of rescue analgesia after Intravenous use of magnesium sulphate preoperatively in lower abdominal surgery.

MATERIALS & METHODS

This is a hospital based randomized double blind interventional analytic study done on 50 patients admitted in surgery department for lower abdominal surgery with mean duration of about 1-1.5 hrs in S.M.S. medical college and attached hospital, Jaipur

Inclusion Criteria

- Male/Female patients aged 15-50 yrs
- ASA grade 1-2
- Undergoing lower abdominal surgery with mean duration of about 1-1.5 hrs.

Exclusion Criteria

- History of chronic disease like hypertension, varying degree of heart blocks, diabetes mellitus, respiratory disease, myopathy, neurological disorders, drugs or alcohol abuse.
- Pregnant women, obese patients (body mass index more than 30 kg./m.)
- Patients treated with calcium channel blockers or magnesium
- Patients with impaired renal or hepatic function
- Any absolute or relative contraindication to study drug.

The study was conducted in following two groups of the patients

Study group ($MgSO_4$): Patients was given 50 mg /kg magnesium sulphate in 250 ml. of isotonic sodium chloride solution IV

Control group (C): Patients was given 250 ml. of isotonic sodium chloride solution IV

Procedure: After taking informed consent and confirming overnight fasting, patient was taken on the recovery room and baseline vitals like B.P., pulse rate, respiratory rate recorded. After a 18 gauge intravenous (IV) cannula have been inserted at the forearm level, inj. Magnesium sulphate 50mg/kg mixed in 250 ml of inj. Isotonic sodium chloride and this drug was infused over 30 minute before induction of anaesthesia. Pulse rate and blood pressure monitored at 10, 20 and 30 minutes intervals during this period. Upon arrival in operating room patient was taken on the operating table and all usual monitoring was established.

General anaesthesia administered by using inj. Glycopyrolate 0.005 mg./kg. , inj. Fentanyl 2microgm./kg. IV, for induction. Inj. Thiopentone 5 mg./kg. and inj.Succinyl choline 1mg./kg. was given to facilitate intubation with appropriate size of ET tube. During surgery anaesthesia was maintained with isoflurane and nitrous oxide in oxygen and Inj. Atracurium basylate 0.1 mg./kg. SOS. During surgery BP,PR, O2 saturation and any fluid and drugs requirement was noted on 5, 10, 20,30,40,50,60,70,80 and 90 minutes after induction of anaesthesia. Postoperatively residual neuromuscular blockade was reversed by using inj. Neostigmine 0.05mg./kg. and inj. Glycopyrolate 0.02mg./kg.

Patients at rest was evaluated by using a 0 – 10 cm. visual analogue score (VAS) or by using a 0 - 4 verbal rating score (VRS) at emergence from anaesthesia and1/2,1, 2, 4, 6, 12 and 24 hrs. after surgery.

Visual Analogue Score (VAS)

The VAS consisted of a 10 cm horizontal paper strip with two endpoints labeled “No Pain” and Worst Imaginable or” Agonizing Pain”.

During first 4 hrs. patient was kept in recovery room and rescue analgesia was given at VAS ≥ 4 in the form of inj. Diclofenac sodium 75mg. IV.

Sedation was monitored by using a four point rating scale:

Score	Criteria
1	Patient fully awake
2	Patient somnolent but response to verbal commands
3	Patient somnolent but response to tactile stimulation
4	Patient asleep but response to pain

Thereafter the patient was sent to ward and inj. Diclofenac sodium 75 mg IM given on demand. The timing and dosage of rescue analgesia and total consumption of inj. Diclofenac sodium during first 24 hrs. after operation was noted.

Statistical Analysis

Unpaired t-test, repeated measure Anova was used for ratio & interval scale data and for nominal data chi – square test was used by SPSS version 16 software.

RESULTS

Our study showed that the mean age of the patients was 36.04 ± 10.38 years in $MgSO_4$ group and 33.16 ± 9.51 years in C group. There was no significant difference in mean age of patients between two groups (P > 0.05) (table 1).

The mean of total dose of analgesia requested was 87.00± 27.49 mg in $MgSO_4$ group and 240.00 ± 30.00 mg in C group. It means that there was clinically and statistically highly significant (P<.001) difference between the total dose of analgesia requested between the two groups. Consumption of total dose of analgesia was less in $MgSO_4$ group (table 2).

The mean duration of analgesia was189.60 ±18.70 minutes in $MgSO_4$ group and 24.40 ± 5.16 minutes in C group. It means that there was clinically and statistically highly significant (P<.001) difference between the post-operative analgesic duration between the two groups; and the post-operative analgesia of Magnesium sulfate was far better (table 2).

Hemodynamic changes at various interval in between groups was shown in graph 1, 2 & 3.

Pain in postoperative period was significantly lower in magnesium sulphate group in comparison to control group at1, 2, 4, 6, 12 and 24 hrs postoperatively [-0.20 vs. -1.64 (P<0.001), -0.64 vs. 1.64 (P<0.001), -1.04 vs. 1.36 (P<0.05), -0.32 vs. 1.96 (P<0.001), -0.68 vs. -0.88 (P<0.05) and -0.92 vs (1.08 P<0.05), respectively] (graph 4).

There were no significance difference in mean duration of surgery in both the groups (P > 0.05) (Table 3). In our study occurrence of nausea and vomiting were more in C group then the $MgSO_4$ group. But these adverse effects were statistically insignificant in both the groups and did not require any supplementary management (table 4).

Table 1: Comparison of mean value of age in between groups

Group	Minimum age (in years)	Maximum age (in years)	Mean ± S.D.
$MgSO_4$	19	50	36.04 ± 10.38
C	18	50	33.16 ± 9.51
P-value		>0.05	
Significance		Not significant	

Table 2: The comparison of mean value of analgesia parameters in between groups

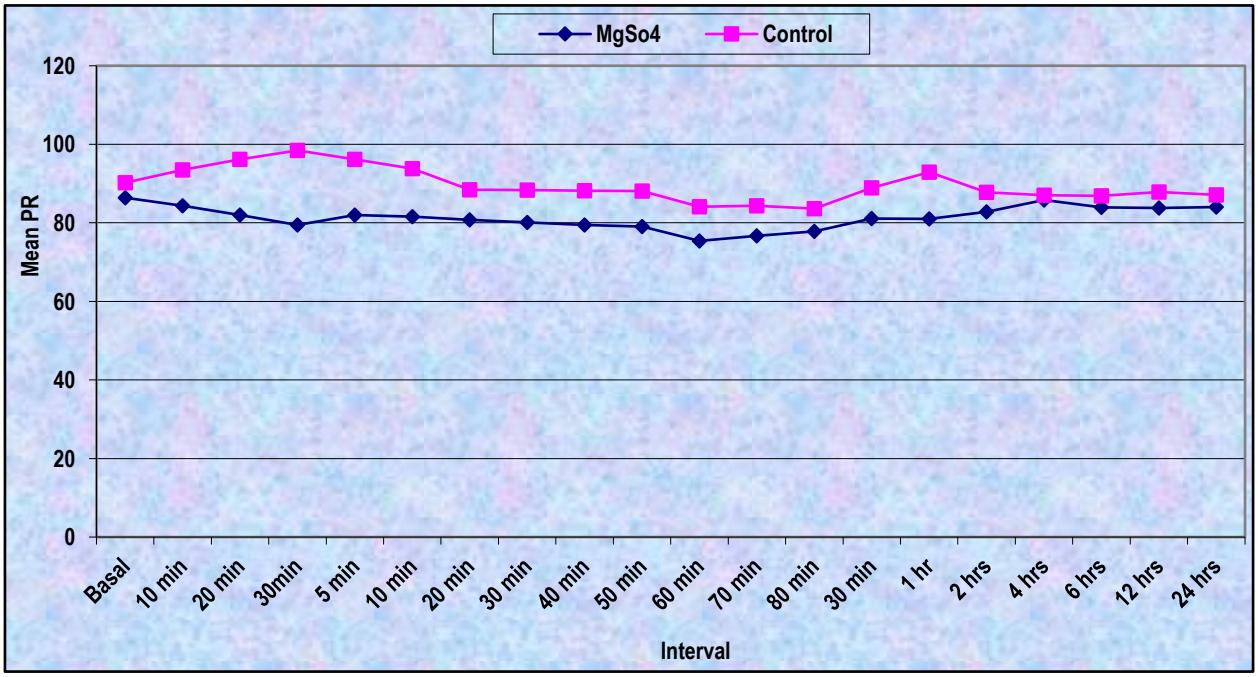
Requirement of analgesia	$MgSO_4$ Group	C Group	P-value	Significance
Rescue of analgesia (in mg)	87.00± 27.49	240.00 ± 30.00	< .001	HS
Duration of Analgesia (in minutes)	189.60 ±18.70	24.40 ± 5.16	< .001	HS

Table 3: Mean ± S.D. of duration of surgery (in minutes)

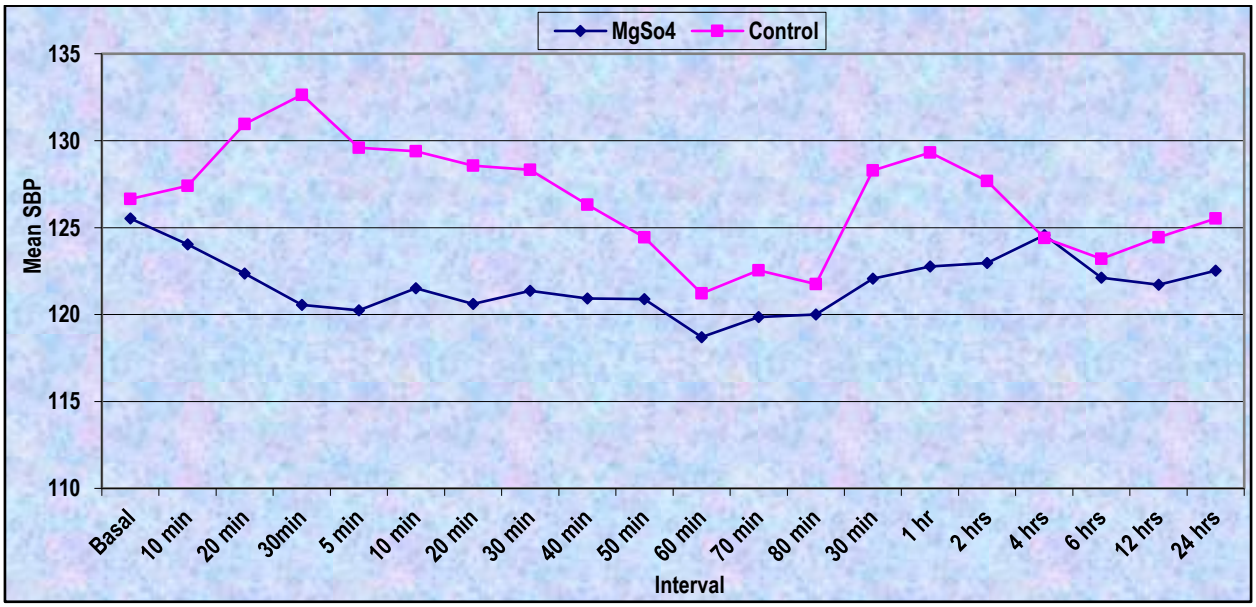
Duration of surgery	Group		P-value	Significance
	$MgSO_4$	C		
Mean ± S.D.	64.40 ± 11.69	63.20 ± 13.18	> 0.05	NS

Table 4: Post-operative Side effects

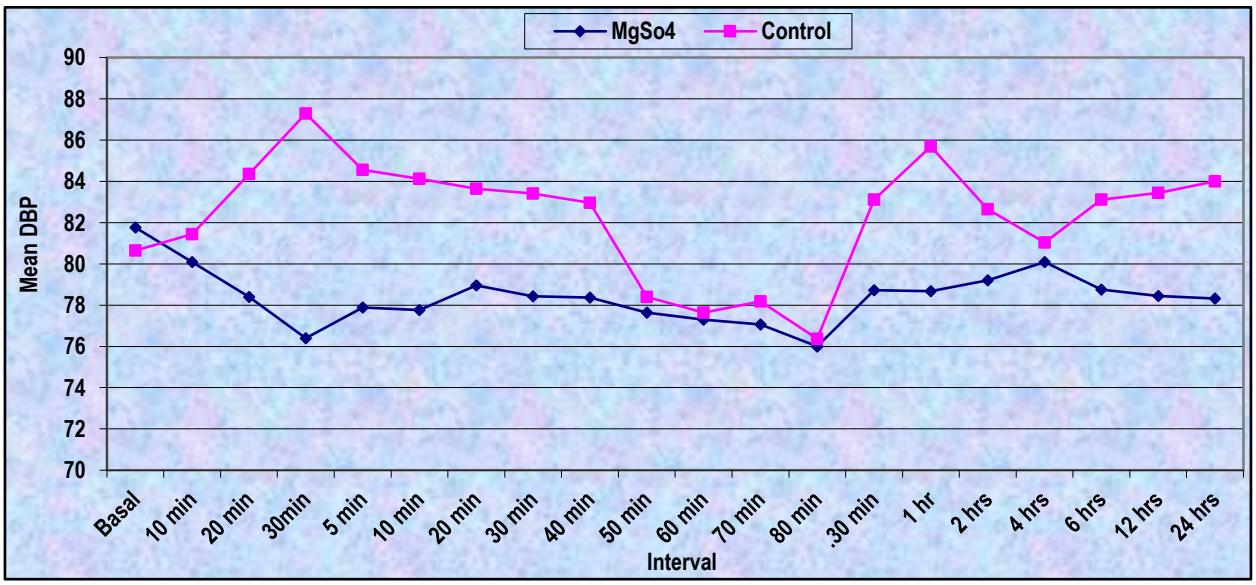
Observation	C Group		$MgSO_4$ Group	
	No. of patients	%	No. of patients	%
Nausea	2	8	0	0.00
Vomiting	2	8	3	12
Others	0	0.00	0	0.00



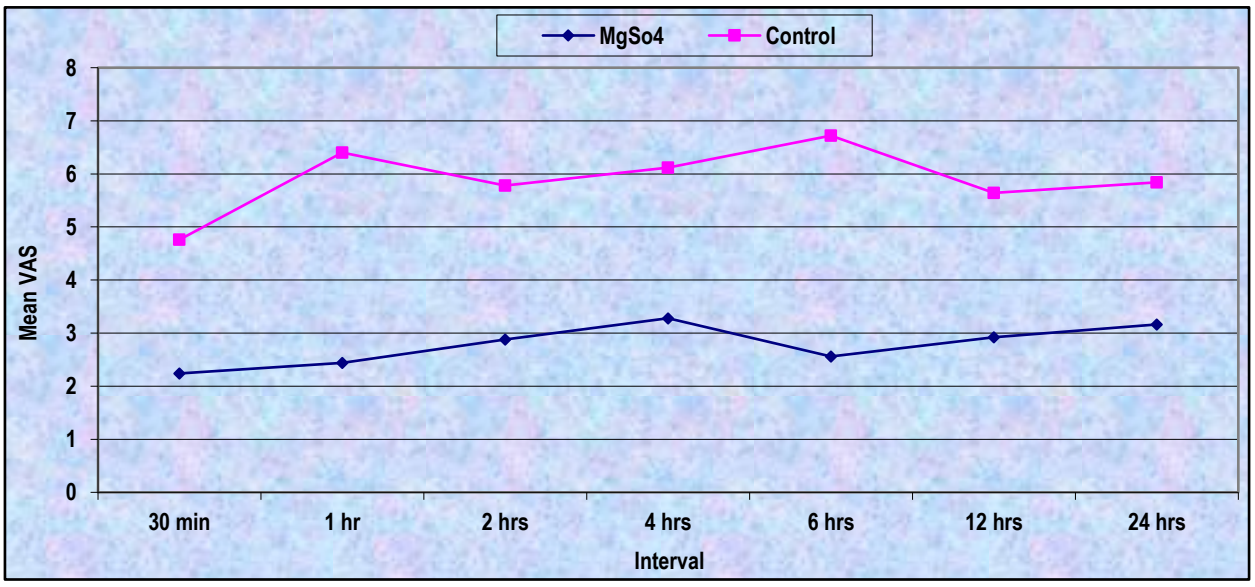
Graph 1: Comparison of Mean ± S.D. of Pulse Rate at various intervals in patients in both the Groups



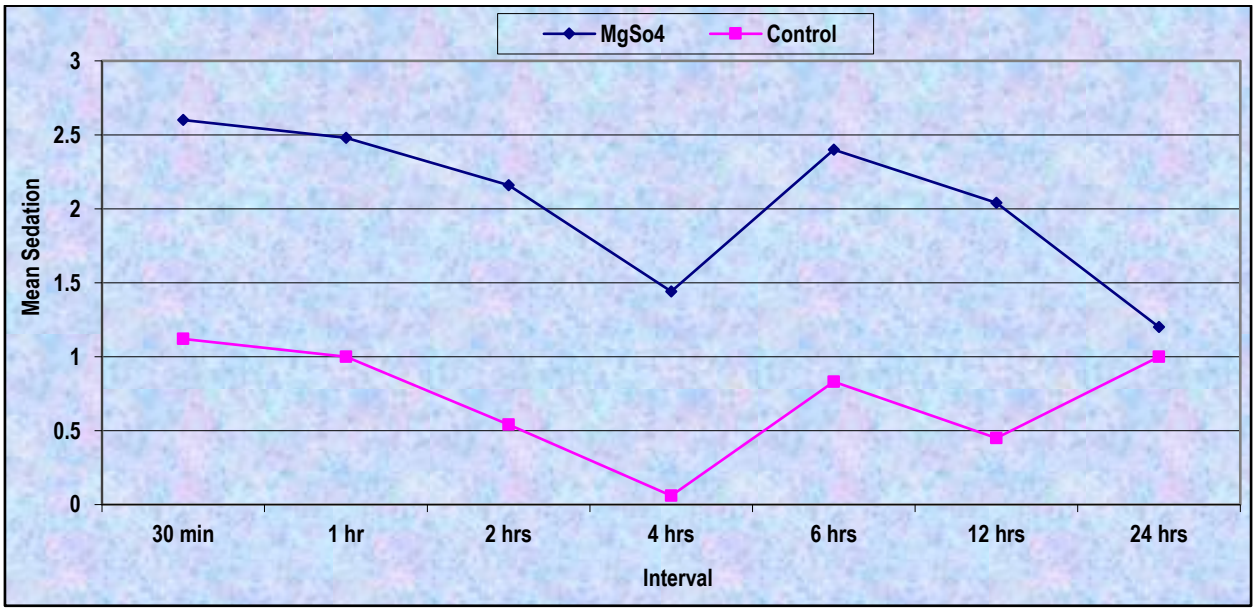
Graph 2: Comparison of Mean ± S.D. of SBP (Systolic Blood Pressure) at various intervals in patients in both the Groups



Graph 3: Comparison of Mean ± S.D. of DBP (Diastolic Blood Pressure) at various intervals in patients in both the Groups



Graph 4: Comparison of mean VAS in Post-operative Period in both the Groups



Graph 5: Comparison of mean Sedation in Post-operative Period in both the Groups

DISCUSSION

Our study has shown that infusion of magnesium sulphate 50 mg/kg given before induction of anaesthesia was associated with less postoperative pain in patients undergoing lower abdominal surgery. Previous studies done by Levaux and others[4] on orthopaedic surgery, Seyhan and others[5] and Ryu and others[6] on gynaecological surgery have also reported that magnesium sulphate boluses were effective for postoperative pain relief. However, they had used continuous infusion or repeat bolus in addition to initial bolus of magnesium sulphate in their studies in contrast we use single bolus preoperatively in the present study.

We administered magnesium sulphate in dosage of 50 mg/kg IV infused over 30 min before induction of anaesthesia without any subsequent infusion. This dosage has been reported to be safe without any adverse effects as reported by several studies. It has been suggested that NMDA (N- Methyl D- Aspartate) blocking drugs should be given before beginning of nociceptive stimulus to inhibit process of central sensitization.

The mechanism of analgesic effect of magnesium sulphate is due to the inhibition of calcium channels and NMDA (N- Methyl D-Aspartate) receptors seem to play an important role. It has been commented by various workers that calcium channel blockers have an antinocieptive action in algesiometric tests in rats under acute conditions. The analgesic action of calcium channel blockers could be mediated by an increase of the nociceptive threshold resulting from interference with calcium influx because the latter is important for the release of neurotransmitters and other substances implicated innociception and inflammation.

Tramer and others[7] observed that pretreatment with IV magnesium sulphate had no impact on postoperative pain and analgesic consumption, but the patients in their study received diclofenac suppository immediate preoperatively. Moreover, in their study all patients undergoing hernia repair had an ilioinguinal and iliohypogastric nerve block done with 20 ml of 0.5% bupivacaine at the end of surgery resulting in consistently decreased pain scores in first 4 hrs.

Similarly, Ko and others[8] have also investigating the efficacy of magnesium sulphate administration on postoperative analgesic requirement, but they had also used epidural analgesia in their study. It is possible that superior analgesic efficacy of nerve block or epidural analgesia in their patients might have masked analgesic efficacy of magnesium sulphate. No nerve block or epidural analgesia was used in any of our patients.

Shashi kiran and others[9] observed that pre operatively single dose of $MgSO_4$ IV decrease post-operative pain and requirement of rescue analgesia after inguinal surgery and patients are more sedated as compared to placebo group.

Also in our study patients receiving magnesium sulphate were found to be more sedated in immediate postoperative period as compared to control group, although they were easily arousable. This is expected as magnesium is regarded as a CNS depressant.

Woolf et al.[3] studied the dependence of the central sensitization on NMDA receptor activation in rats and found that NMDA receptor activation is involved in the induction and maintenance of central sensitization processes that characterize post injury pain states. Therefore, NMDA receptor antagonist may play a role in prevention and treatment of perioperative pain.

It is well known that magnesium sulphate inhibits acetylcholine release at motor nerve terminals, thus potentiating the effect of neuromuscular blocking agents. In some studies, prior administration of magnesium sulphate prolonged clinical duration of intermediate acting non-depolarizing neuromuscular blocking agents.

In our study, we did not monitor neuromuscular block by train of four method; nevertheless no clinical prolongation of neuromuscular block was observed with magnesium sulphate. This reason could be attributed to use of atracurium in our study. Moreover, we used magnesium sulphate only as single bolus dose whereas most of the studies have used magnesium sulphate as subsequent infusion also in addition to initial single bolus.

It has been studied that most of total body magnesium (99%) is intracellular and estimation of plasma magnesium does not represent magnesium content of body tissues. So therefore, there is a lack of correlation between plasma magnesium concentration and total body magnesium content.

However it is well known that magnesium may induce hypotension directly by vasodilatation as well as indirectly by sympathetic blockade and inhibition of catecholamine release. Whereas, we did not observe any hypotensive episode in our patients treated with magnesium sulphate. None of our patients had any significant bradycardia that required treatment.

CONCLUSION

We concluded that administration of intravenous Magnesium sulphate 50 mg/kg preoperatively significantly reduces postoperative pain in patients undergoing lower abdominal surgery. Patients receiving Magnesium sulphate during preoperative period have better pain relief, more sedated and fewer requirements of rescue analgesics in the postoperative period, without any major side effects.

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