DOI: 10.7860/JCDR/2025/80337.21444

Original Article

Anaesthesia Section

Effects of Intravenous Magnesium Sulphate Administration on Postoperative Analgesia in Infraumbilical Surgeries under Spinal Anaesthesia: A Double Blinded Randomised Clinical Study

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ABSTRACT

Introduction: Inadequate management of postoperative pain can lead to complications like prolonged recovery time, ileus, nausea, urinary retention, and infection. Although spinal anaesthesia is highly effective in intraoperative pain relief, its effects wear off after surgery, with a tendency to produce opioid dependence. Magnesium sulphate, an NMDA receptor blocker, has the potential to augment spinal anaesthesia effects and postoperative analgesia.

Aim: To determine whether intravenous magnesium sulphate infusion could improve postoperative pain management in patients who had undergone spinal anaesthesia for infraumbilical surgery.

Materials and Methods: The present double-blind, randomised clinical trial including 60 American Society of Anaesthesiologists (ASA) I-II patients who had infraumbilical spinal anaesthesia was conducted at Dr. D. Y. Patil Medical College in Pune, Maharashtra, India. Patients were given 15 mg of 0.5% hyperbaric bupivacaine intrathecally, along with a random assignment to receive either intravenous magnesium sulphate (Group M) or normal saline (Group C). Statistical Package for Social Sciences (SPSS) v27 was used to assess and analyse postoperative pain {Visual Analogue Scale (VAS)}, haemodynamics, block characteristics, time to first analgesia, and side-effects. The data was collected, compiled and tabulated. Data entry was done in Microsoft Excel and tables and apt charts was formed. Quantitative data was analysed using unpaired student t-test and qualitative data was analysed using Chi-square test analysed by SPSS software 27.

Results: Demographic characteristics and haemodynamic data were similar across groups. The mean age of the patients was 41.93±11.64 in Group M and 36±13.5 in Group C. VAS scores in Group M were lower from 45 minutes through to 16 hours postoperative compared with Group C. Analgesic duration was longer, and the time to the first rescue analgesia in Group M was longer than in Group C. The time to onset for sensory and motor block was identical, but blocks lasted significantly longer in Group M.

Conclusion: Intravenous magnesium sulphate as an adjuvant to spinal anaesthesia safely extends postoperative analgesia, decreases pain severity, and postpones the need for rescue analgesia without inducing significant haemodynamic instability or side-effects. Therefore, magnesium sulphate is an effective and safe adjuvant for enhancing postoperative pain relief in infraumbilical operations.

Keywords: Pain Measurement, Postoperative pain, Rescue analgesia, Treatment outcome

INTRODUCTION

Postoperative pain is one of the most critical issues in patient care after surgery. If not controlled, it will initiate a cascade of undesirable physiological and psychological responses that reach far beyond pain. Poorly controlled postoperative pain is well-established to elevate sympathetic activity, slow recovery, impede mobility, interfere with wound healing, and extend hospital stay [1]. Uncontrolled pain has been associated with increased rates of postoperative complications, including ileus, nausea, vomiting, urinary retention, and infections, all leading to poor clinical outcomes. Considering these consequences, adequate control of postoperative pain is essential to enhance recovery, improve patient satisfaction, and lower healthcare expenditure [2]. In the past, regional anaesthesia, most commonly spinal anaesthesia, has served as the bedrock for intraoperative pain control in infraumbilical procedures. By injecting local anaesthetics into the subarachnoid space, spinal anaesthesia inhibits sensory, motor, and sympathetic fibres, providing instant onset and dependable intraoperative analgesia with few systemic implications. Since the effects of spinal anaesthesia wear off after surgery, patients tend to develop a return of pain, sometimes severe. The main challenge in spinal anaesthesia is to prolong the analgesic duration into the postoperative period, maintaining patient comfort while reducing dependence on opioids, which are linked with many side-effects [3,4].

Magnesium sulphate, as a non-competitive NMDA receptor antagonist, diminishes central sensitisation and excitability of the neurons, hence elevating the pain threshold. Intravenous (i.v.) magnesium sulphate reinforces and prolongs spinal anaesthetic analgesia by enhancing the effect and action of local anaesthetics, reducing the requirement for opioids, and minimising the side-effects associated with opioids [5]. Magnesium sulphate enhances recovery from the operation by enabling early mobilisation and lowering the incidence of complications due to inadequate control of pain. Therefore, i.v. magnesium sulphate is a valuable adjuvant that augments and extends the effects of spinal anaesthesia [6]. These results are similar to the studies done by Kumar A et al., (2013) and Shah PN et al., (2016) [7,8]. Kumar A et al., (2013) concluded that intravenous magnesium sulphate lengthened the time of analgesia and delayed the requirement of rescue analgesia in comparison to the control group. Postoperative pain free time was more in patients given magnesium sulphate and had less opioid intake within 24 hours. The results identify the contribution of magnesium

sulphate towards improved postoperative analgesia and decreased requirements of analgesic without impacting the onset and recovery of spinal anaesthesia [7]. Shah PN and Dhengle Y (2016) showed that intravenous magnesium sulphate prolonged both the sensory and motor blockade significantly and postponed the need for rescue analgesia in comparison with the control group. Few patients in the magnesium group needed further analgesia, and it was required a lot later compared to the control group. The haemodynamic stability was ensured for both groups with no significant untoward effects. The research concluded that intravenous magnesium sulphate significantly improves postoperative analgesia and minimises the demand for rescue analgesics after spinal anaesthesia [8].

Despite spinal anaesthesia being widely used for infraumbilical surgeries due to its rapid onset and reliable intraoperative analgesia, its limited postoperative duration often necessitates the use of opioids, which are associated with significant side-effects such as respiratory depression, nausea, and pruritus. Several adjuvants have been explored to prolong postoperative analgesia, but many pose risks of sedation or haemodynamic instability. Magnesium sulphate, an NMDA receptor antagonist, has shown promise in enhancing postoperative analgesia by reducing central sensitisation [9]. While most published studies have assessed neuraxial or perioperative magnesium in general anaesthetic settings [10,11], only a limited number have evaluated intravenous magnesium sulphate as an adjunct specifically with spinal anaesthesia in infraumbilical surgical patients [12]. A handful of randomised controlled trials- including arthroscopic knee surgeries, hip replacement, and infraumbilical procedures- report that i.v. magnesium prolongs sensory and motor block, delays the need for rescue analgesia, and reduces postoperative opioid consumption, without significant side-effects [12-14]. Accordingly, the present study seeks to systematically assess the efficacy and safety of i.v. magnesium in infraumbilical spinal anaesthesia to identify opioid-sparing alternatives.

The primary aim in the study was to evaluate the analgesic effect and duration of sensory and motor blockade. The secondary aim included assessment of haemodynamic effects of intravenous magnesium sulphate and rescue analgesia requirement.

MATERIALS AND METHODS

The present randomised, double-blinded clinical trial was conducted at Dr DY Patil Medical College and Research Centre, Pimpri, Pune, Maharashtra, India. The study was performed between October 2024 and April 2025, after obtaining Ethics Committee Approval (Protocol No: IESC/PGS/2023/155) and registration with the Clinical Trials Registry of India (CTRI/2024/09/073996).

Sample size calculation: The study included 60 patients who were scheduled for elective infraumbilical surgical procedures under spinal anaesthesia recruited over 1.5 years based on a sample size calculated using WINPEPI 11.38 (5% significance level, 85% power 95% confidence interval), followed by six months of data analysis and reporting after written informed consent was obtained.

Inclusion criteria: Patients aged 18-65 years undergoing infraumbilical surgeries under spinal anaesthesia, BMI between 20-35 kg/m^2, ASA Grade I and II, Mallampati Score Class I and II, patients providing written informed consent, haemodynamically stable patients, duration of surgery less than four hours.

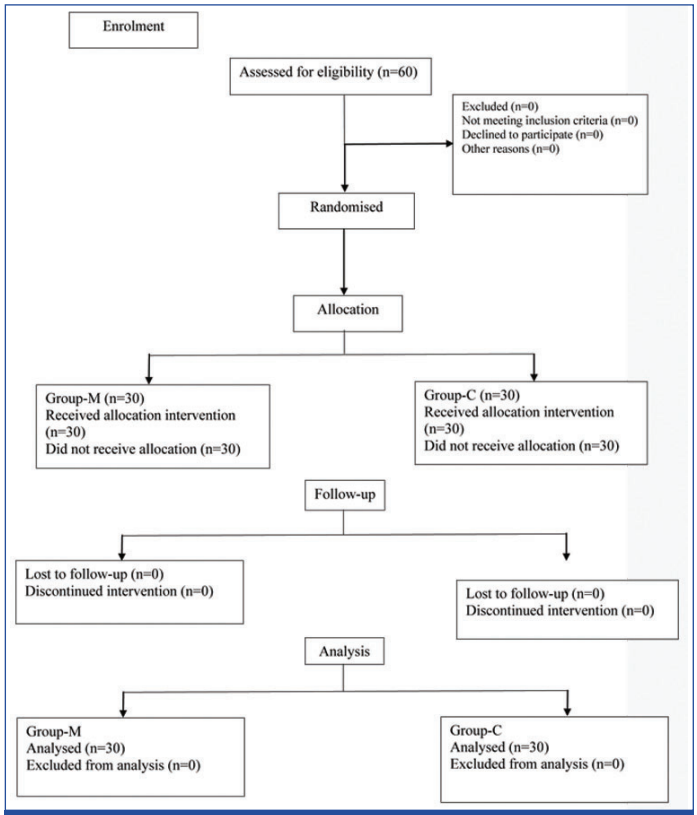
Exclusion criteria: Patients unwilling to give consent to the study, ASA Grade III and i.v. patients, presence of haemodynamic instability such as hypotension and bradycardia, Severe or poorly controlled diabetes or hypertension, cardiovascular diseases such as coronary artery disease, heart failure, cardiomyopathies and valvular heart diseases, hepatic and renal impairment, known coagulopathies, abnormal haemoglobin, or anaemia, spinal deformities, especially kyphoscoliosis.

Sixty patients, (30 in each group) where Group M following spinal anaesthesia, received 0.5 mL (250 mg) of Magnesium Sulphate i.v., followed by a continuous infusion of 500 mg (25 mg/mL) at 20 mL/h for one hour. Group C received 0.5 mL of Normal Saline (NS) i.v. as a bolus, followed by an infusion of NS at 20 mL/hr for one hour [15].

Study Procedure

Every patient underwent a thorough preanaesthesia examination and associated laboratory testing. Prior to recruitment, written informed consent was obtained from each participant. Prior to surgery, all patients were nil per oral for six hours. The i.v. access was set-up in the operating room, and crystalloid liquids were preloaded into the patients. During the perioperative phase, standard ASA monitoring was conducted using non invasive blood pressure monitoring, electrocardiography, and pulse oximetry was normal. Throughout the procedure, haemodynamic data were closely watched which was within normal limits, and if there was any instability in the parameters, appropriate action was taken.

Patients were divided into two groups (Group M and Group C) at random using a computer-generated table [Table/Fig-1].



[Table/Fig-1]: CONSORT flow diagram.

Both the patients and the anaesthesiologists who evaluated them were unaware of their group assignment. To establish spinal anaesthesia in all patients, 15 mg of 0.5% hyperbaric bupivacaine was given intrathecally into the L3-L4 interspace under meticulously aseptic conditions. In addition to a 250 mg intravenous bolus, Group M received a continuous infusion of 500 mg (25 mg/mL) of magnesium sulphate at a rate of 20 mL/hour for one hour. Following a bolus of 0.5 mL of normal saline, Group C received an infusion of normal saline at the same rate and duration.

Postoperatively, the patients were shifted to the post anaesthesia care unit where pain was measured by the VAS every 15 minutes for the first hour, hourly for the next four hours, and then every four hours for 24 hours [16]. Injection tramadol 100 mg i.v. was given if VAS ≥4 and time to first rescue analgesia was noted. Haemodynamic monitoring was also continued after the operation, and patients were monitored for side-effects. Patient satisfaction score was also assessed. At the end of the 24-hour postoperative period, patient satisfaction was assessed using a 3-point Likert scale to evaluate their overall experience regarding postoperative pain management. The levels were defined as follows:

- 1-Not satisfied
- 2-Moderately satisfied
- 3-Highly satisfied

Patients were asked to rate their satisfaction based on pain control, comfort, and overall recovery experience during the 24-hour period following surgery. The data were collected by an independent observer who was unaware of the group allocation. To maintain the double-blind design of the study, both the patients and the observer responsible for postoperative data collection were blinded to group assignments. The satisfaction scores were subsequently recorded and analysed for both groups.

STATISTICAL ANALYSIS

Microsoft Excel was used for data entry, and SPSS version 27 was used for statistical analysis. Categorical data were shown as percentages and quantitative data were shown as means with standard deviations. The Chi-square test was used to analyse qualitative data, while the unpaired student's t-test was used to compare quantitative variables. The mean satisfaction scores were then compared between Group M and Group C using the unpaired student's t-test, with a p-value <0.05 considered statistically significant.

RESULTS

[Table/Fig-2] summarises the demographic characteristics of the groups. The two groups did not differ significantly in terms of gender distribution, ASA physical status, Body Mass Index (BMI), age, height, or weight. ASA classification and gender allocation were also similar between the groups.

Parameters	Group M	Group C	p-value
Age (Years)	41.93±11.64	36±13.5	0.73
Height (cm)	166.93±11.53	168.38±11.66	0.93
Weight (kg)	66.6±13.23	67.81±13.02	0.88
BMI (kg/m²)	23.45±2.32	23.67±2.22	0.55
Gender (M/F)	17/13	17/13	1.00
ASA I/II	18/12	19/11	0.60
Mallampati Score Class I/II	19/11	18/12	0.60

[Table/Fig-2]: Demographic parameters.

Pulse Rate (PR) was comparable in both group at all preoperative and postoperative periods. No significant difference was found between the groups at any time during the study period. The trends are depicted in [Table/Fig-3].

Time	Group M	Group C	p-value
Preoperative	79.37±12.59	79.26±12.77	0.66
Immediate postoperative	79.23±11.36	79.08±10.81	0.19
Postoperative 15 min	80.5±12.65	80.3±12.29	0.86
Postoperative 30 min	83.3±11.71	83.08±11.22	0.34
Postoperative 45 min	79.07±11.21	80.15±10.89	0.13
Postoperative 1 h	80.33±11.86	81.01±12.06	0.06
Postoperative 2 h	81.21±11.01	82.11±10.92	0.65
Postoperative 3 h	79.99±11.01	81.34±8.22	0.05
Postoperative 4 h	79.93±11.63	79.32±11.54	0.54
Postoperative 8 h	79.57±11.06	80.34±10.94	0.27
Postoperative 12 h	80.83±13.38	79.96±13.09	0.47
Postoperative 16 h	77.93±12.31	77.6±11.67	0.90
Postoperative 20 h	80.13±12.47	80.47±11.76	0.94
Postoperative 24 h	83.1±13.33	83.33±13.1	0.89

[Table/Fig-3]: Comparison of PR.

The mean preoperative Systolic Blood Pressure (SBP) was similar in both groups. Postoperative SBP was identical at all time points, without the groups being statistically different from each other. The findings are depicted in [Table/Fig-4].

Time	Group M	Group C	p-value
Preoperative	104.3±9.17	104.4±8.66	0.71
Immediate postoperative	104.03±9.16	104.07±8.81	0.95
Postoperative 15 min	105.37±9.08	105.01±8.95	0.62
Postoperative 30 min	105±8.89	105.36±8.9	0.22
Postoperative 45 min	105.3±9.99	104.65±9.62	0.86
Postoperative 1 h	104.53±9.37	104.05±9.28	0.94
Postoperative 2 h	102.73±9.12	102.57±9.11	0.87
Postoperative 3 h	101.93±9.3	102.57±9	0.77
Postoperative 4 h	102.93±9.32	103.57±9	0.77
Postoperative 8 h	106±9.21	105.21±9.17	0.95
Postoperative 12 h	103.77±9.22	103.17±9.33	0.34
Postoperative 16 h	107.2±7.85	107.33±7.49	0.14
Postoperative 20 h	102.77±9.77	102.92±9.68	0.80
Postoperative 24 h	105.57±8.99	105.31±8.23	0.61

[Table/Fig-4]: Comparison of SBP.

The comparison of the groups' Diastolic Blood Pressure (DBP) at various time points is shown in [Table/Fig-5]. There were no statistically significant differences between the two groups preoperative and postoperative DBP readings at all time points.

Time	Group M	Group C	p-value
Preoperative	70.57±5.71	70.77±5.78	0.84
Immediate postoperative	71±6.47	70.64±6.14	0.71
Postoperative 15 min	69.9±5.88	70.18±6.00	0.24
Postoperative 30 min	69.7±5.99	70.1±5.76	0.62
Postoperative 45 min	70.33±6.02	70.19±5.95	0.58
Postoperative 1h	69.83±7.01	69.92±7.16	1.00
Postoperative 2h	70.82±6.78	71.1±7.43	0.98
Postoperative 3h	71.23±6.91	69.23±6.45	0.76
Postoperative 4h	69.9±6.28	69.75±6.16	0.47
Postoperative 8h	69.07±6.5	68.75±6.17	0.14
Postoperative 12h	71.93±6.55	72.03±6.43	0.44
Postoperative 16h	70±5.96	70.29±5.83	0.78
Postoperative 20h	69.77±6.12	69.88±6.18	0.65
Postoperative 24h	70.4±6.72	70.87±6.68	0.70

[Table/Fig-5]: Comparison of DBP.

[Table/Fig-6] illustrates the difference in oxygen saturation (SpO_2) between the groups at different time intervals. The SpO_2 at each time point did not differ statistically between the groups, and there were no differences between the two groups.

[Table/Fig-7] compare the VAS ratings of Group M and Group C at various time points. Group M's VAS scores were consistently lower than those of Group C. These results imply that intravenous magnesium sulphate had a noticeable analgesic effect during the first 16 hours after treatment.

The comparison of different parameters between the groups is shown in [Table/Fig-8]. Injection tramadol 100 mg i.v. was given if VAS ≥4, in Group M nine patients was given and in Group C 15 patients was given and time to first rescue analgesia was noted.

Group M had a significantly higher level of patient satisfaction. These results overall show that Group M yielded improved patient satisfaction relative to Group C, as seen in [Table/Fig-9].

This result Suggested a minimal occurrence of side-effects in both groups, with a notably higher incidence of no side-effects in Group C as seen in [Table/Fig-10].

Time	Group M	Group C	p-value
Preoperative	97.7±1.82	97.81±1.68	0.12
Immediate postoperative	97.77±1.61	97.88±1.52	0.59
Postoperative 15 min	97.2±1.54	97.19±1.59	0.22
Postoperative 30 min	97.53±2.00	97.77±1.91	0.67
Postoperative 45 min	97.17±1.60	96.93±1.44	0.49
Postoperative 1 h	97.13±1.55	97.18±1.49	0.81
Postoperative 2 h	97.41±2.11	97.8±1.62	0.84
Postoperative 3 h	97.91±2.33	97.24±1.98	0.73
Postoperative 4 h	97.83±1.68	97.78±1.73	0.88
Postoperative 8 h	97.5±1.57	97.45±1.55	0.49
Postoperative 12 h	97.87±1.87	97.89±1.89	0.73
Postoperative 16 h	97.2±1.69	97.26±1.65	0.26
Postoperative 20 h	97.37±1.77	97.44±1.73	0.30
Postoperative 24 h	96.77±1.30	96.71±1.30	0.06

[Table/Fig-6]: Comparison of SpO_2.

Time	Group M	Group C	p-value
Immediate postoperative	0.5±0.63	0.53±0.51	0.84
15 min	0.83±0.65	0.77±0.43	0.67
30 min	1±0.53	1.03±0.18	0.77
45 min	1.17±0.65	1.53±0.51	0.02
1 h	1.33±0.48	2.1±0.31	<0.0001
2 h	1.46±0.51	2.56±0.71	<0.0001
3 h	1.72±0.54	2.62±0.81	<0.0001
4 h	1.83±0.59	2.75±0.61	<0.0001
8 h	1.83±0.79	3.2±0.92	<0.0001
12 h	2.73±0.94	3.4±0.45	<0.0001
16 h	2.8±1.17	3.7±0.86	0.0005
20 h	3±2.3	3.8±1.9	0.05
24 h	3.5±1.97	4.5±1.4	0.86

[Table/Fig-7]: Comparison of VAS.

Parameters	Group M	Group C	p-value
Duration of analgesia (min)	450±43.02	320±29.93	<0.001
Time to first rescue analgesia	510±48.58	380±32.5	<0.001
Onset of sensory block (min)	4.67±1.35	4.78±1.03	0.78
Onset of motor block (min)	6.78±0.57	6.89±0.53	0.82
Duration of sensory block (min)	169.73±2.96	154.4±2.94	<0.0001
Duration of motor block (min)	193.84±4.76	180.9±4.12	<0.0001

[Table/Fig-8]: Comparison of parameters.

Parameter	Group M	Group C	p-value
Level of satisfaction	2.67±0.48	1.67±0.66	<0.0001

[Table/Fig-9]: Comparison of level of satisfaction.

Side-effects	Group M (n=30)	Group C (n=30)
Burning at injection site	3	0
No side-effects	27	30

[Table/Fig-10]: Side-effects.

DISCUSSION

Intravenous magnesium sulphate is increasingly being used in perioperative care because of its analgesic, anti-inflammatory, and muscle relaxant effects [17]. Through its action mainly as an NMDA receptor antagonist and a blocker of calcium channels, magnesium sulphate reduces central sensitisation to pain and decreases requirements for anaesthetics and opioids. It has been used extensively to increase perioperative analgesia, optimise the quality of regional anaesthesia, and stabilise haemodynamic reactions to surgery. Magnesium sulphate has proven helpful in controlling postoperative pain, preventing the occurrence of chronic postsurgical pain, and exerting a neuroprotective effect in various clinical conditions [13]. The demographic profile between the groups was similar, with no statistically significant differences in age, height, weight, BMI, ASA classification, or gender distribution, thus making the groups homogeneous and reducing confounding variables. These results were in agreement with the findings of Dhananjeyulu P and Pradeep R, Prasad D et al., and Messeha MM et al., [18-20].

Baseline haemodynamic indices like PR, SBP, DBP, and SpO_2 were identical in both groups and remained stable intraoperatively and postoperatively without statistically significant variation. This indicates that the use of intravenous magnesium sulphate did not alter the haemodynamic parameters. The same results were reported in studies by Hwang JY et al., Farouk S, and Benevides ML et al., [13,21,22]. Farouk S (2008) concluded that haemodynamic and respiratory parameters, as well as the incidence of side-effects such as sedation, pruritus, nausea, and vomiting, were similar between all groups [21]. Hwang JY et al., (2010) concluded that haemodynamic stability and the occurrence of adverse events were similar in the two groups [13]. The study by Benevides ML et al., (2021) found that both the study groups had no statistical significance in haemodynamic parameters measured across the study interval [22].

Group M experienced a faster onset of sensory block than Group C, suggesting that magnesium sulphate facilitated the accelerated establishment of sensory anaesthesia. Although the difference was not as significant, Group M also experienced a faster onset of motor block. In Group M, the duration of both sensory and motor blockade was noticeably longer. This suggests that magnesium sulphate not only shortens the onset of the blockade but also increases the anaesthetic effect, allowing for a longer duration of analgesia. However, the lengthened motor blockade duration should be given careful consideration in patients for whom earlier mobilisation is an essential priority. These observations have been consistent with earlier research conducted by Kumar A et al., Shah PN et al., Hwang JY et al., Gupta R et al., Farouk S, Solanki NM et al., and Apan A et al., [7,8,13,23,22,24,25]. Kumar A et al., (2013)'s study indicated that, in comparison with both groups (intrathecal control), intravenous $MgSO_4$ gave the most prolonged pain-free interval, lower pain scores, extended sensory and motor blockade, and reduced need for rescue analgesia [7]. In the study conducted by Shah PN et al., (2016) the duration of sensory blockade as well as motor blockade in the magnesium group was significantly more than the control group. However, Apan A et al., (2004), in their studies carried out did not show any significant difference among the two groups [25]. Solanki NM et al., (2023) concluded that adding 50 mg magnesium sulphate to intrathecal bupivacaine prolongs both sensory and motor block durations, along with increasing postoperative analgesia in lower limb orthopaedic surgeries [24].

VAS scores between groups were similar at the beginning but were found to be much lower in Group M from 45 minutes postoperatively and continued to be so up to 12 hours. This indicates a better and longer-lasting analgesic effect with magnesium sulphate, corroborating findings in studies by Kumar A et al., Shah PN et al., Hwang JY et al., Farouk S, Apan A et al., Shin HJ et al., and Verma N et al., [7,8,13,22,25-27]. Group M experienced analgesia for a noticeably more extended period than Group C. Likewise, Group M experienced a longer delay to initial rescue analgesia. These findings were comparable to those of the research conducted by Kumar A et al., Shah PN et al., and Farouk S [7,8,22].

The study by Kumar A et al., (2013) evaluated block characteristics, VAS pain scores at discrete intervals of up to 24 hours, and total rescue analgesic consumption. Results indicated that, in comparison with both groups (intrathecal control), intravenous $MgSO_4$ gave the most prolonged pain-free interval, lower pain scores, extended sensory and motor blockade, and reduced need for rescue analgesia, all

of which were significant at the p<0.05 level [7]. Shah PN et al., (2016) in the study demonstrated significantly less VAS score in patients treated with magnesium [8]. Shin HJ et al., (2016) showed that magnesium sulphate decreased postoperative VAS scores significantly more than the control group following both the first and second TKA, with prolonged analgesic effects at 24 and 48 hours. The pain was greater during the second TKA in the control group, while in the magnesium group, there was no difference. Magnesium also decreased rescue analgesic and fentanyl use, which indicates its effectiveness in managing postoperative pain [26]. Verma N et al.'s (2023) study showed that 50 mg/kg magnesium sulphate significantly prolonged the analgesia duration, reduced VAS pain scores, and diminished postoperative analgesic requirements compared to the 30 mg/kg dose [27]. Patient satisfaction scores were significantly greater in Group M, reflecting improved postoperative comfort and pain control. These results were supported by Kumar A et al., Shin HJ et al., and Shah PN et al., [7,8,26].

Kumar A et al., (2013) concluded that intravenous magnesium sulphate lengthened the time of analgesia and delayed the requirement of rescue analgesia in comparison to the control group. Postoperative pain-free time was more in patients given magnesium sulphate and had less opioid intake within 24 hours. The results identify the contribution of magnesium sulphate towards improved postoperative analgesia and decreased requirements of analgesic without impacting the onset and recovery of spinal anaesthesia [7]. Shin HJ et al., (2016) discovered that intravenous magnesium sulphate lowered postoperative pain scores in patients who underwent staged bilateral total knee arthroplasty more than the control group. The analgesic effect was similar for both the first and second surgeries, while the control group had higher pain during the second surgery. The magnesium group patients also needed lower doses of fentanyl and rescue analgesics in the first 48 hours. The research concluded that magnesium sulphate significantly improves postoperative analgesia and reduces pain progression between serial surgeries [26].

Shah PN et al., (2016) showed that intravenous magnesium sulphate prolonged both the sensory and motor blockade significantly and postponed the need for rescue analgesia in comparison with the control group. Few patients in the magnesium group needed further analgesia, and it was required a lot later compared to the control group. The haemodynamic stability was ensured for both groups with no significant untoward effects. The research concluded that intravenous magnesium sulphate significantly improves postoperative analgesia and minimises the demand for rescue analgesics after spinal anaesthesia [8].

In terms of side-effects, very few Group M participants experienced a mild burning sensation at the site of injection. In contrast, no side-effects were reported in Group C. Generally, the rate of adverse events was low and self-limiting, as previously documented by Hwang JY et al., Farouk S and Verma N et al., [13,22,27].

Limitation(s)

The comparatively small number of patients limits the applicability of the results to a broader population. As this was a single-centre study, institutional habits and patient populations could have played a part in influencing the results, potentially causing bias. The brief follow-up period limited the evaluation of long-term postoperative analgesic impacts and patient outcomes. The application of subjective pain questionnaires, such as the VAS, brought about variability in patients' pain perception reporting. The baseline values of serum magnesium were not tested and might have impacted the degree of response towards intravenous magnesium sulphate and its effectiveness in pain.

CONCLUSION(S)

Results demonstrate that intravenous magnesium sulphate considerably speeds up the onset and lengthens the duration of both sensory and motor blockage when used as an adjuvant to spinal anaesthesia during infraumbilical procedures. Additionally, it improves patient satisfaction, provides better and longer-lasting postoperative analgesia, and delays the need for rescue analgesics without causing significant haemodynamic or respiratory instability. Because side-effects were uncommon and self-limiting, magnesium sulphate's safety in this situation was confirmed. Magnesium sulphate is an efficient and well-tolerated adjuvant that improves the quality of spinal anaesthesia and speeds up recovery after surgery.

REFERENCES

[1] Kuusniemi K, Pöyhiä R. Present-day challenges and future solutions in postoperative pain management: Results from Pain Forum 2014. J Pain Res. 2016;2016(9):25-36.
[2] Paul A, Borkar A, Bhalerao N, Wanjari D. A comparative evaluation of intra-articular bupivacaine vs bupivacaine and dexmedetomidine for postoperative analgesia in arthroscopic knee surgeries. Cureus. 2023;15(8):e43956.
[3] Attri JP, Kaur G, Kaur S, Kaur R, Mohan B, Kashyap K. Comparison of levobupivacaine and levobupivacaine with fentanyl in infraumbilical surgeries under spinal anaesthesia. Anesth Essays Res. 2015;9(2):178-84.
[4] Benyamin R, Trescot AM, Datta S, Buenaventura R, Adlaka R, Sehgal N, et al. Opioid complications and side-effects. Pain Physician. 2008;11(2):S105-S120.
[5] Asadollah S, Vahdat M, Yazdkhasti P, Nikravan N. The effect of magnesium sulphate on postoperative analgesia requirements in gynecological surgeries. J Turk Soc Obstet Gynecol. 2015;12(1):34-37.
[6] Bhatia A, Kashyap L, Pawar DK, Trikha A. Effect of intraoperative magnesium infusion on perioperative analgesia in open cholecystectomy. J Clin Anesth. 2004;16(4):262-65.
[7] Kumar A, Chaudhary UK, Kansal D, Rana S, Sharma V, Kumar P. Comparison of intravenous Magnesium Sulphate with intrathecal Magnesium Sulphate for post- operative analgesia in orthopaedic patients undergoing extracapsular hip fracture surgery. Int J Basic Clin Pharmacol. 2016;6(1):159-66.
[8] Shah PN, Dhengle Y. Magnesium sulfate for postoperative analgesia after surgery under spinal anesthesia. Acta Anaesthesiol Taiwan. 2016;54(2):62-64.
[9] Na HS, Ryu JH, Do SH. The role of magnesium in pain. In: Vink R, Nechifor M, editors. Magnesium in the Central Nervous System [Internet]. Adelaide (AU): University of Adelaide Press; 2011. [cited 2025 Aug 21].
[10] Koinig H, Wallner T, Marhofer P, Andel H, Hörauf K, Mayer N. Magnesium sulfate reduces intra- and postoperative analgesic requirements. Anesth Analg. 1998;87(1):206-10.
[11] Ko SH, Lim HR, Kim DC, Han YJ, Choe H, Song HS. Magnesium sulfate does not reduce postoperative pain in patients undergoing total abdominal hysterectomy. Br J Anaesth. 2001;87(5):710-14.
[12] Kumar M, Dayal N, Rautela RS, Sethi AK. Effect of intravenous magnesium sulphate on postoperative pain following spinal anaesthesia. Middle East J Anaesthesiol. 2013;22(3):251-58.
[13] Hwang JY, Na HS, Jeon YT, Ro YJ, Kim CS, Do SH. IV infusion of magnesium sulphate during spinal anaesthesia improves postoperative analgesia. Br J Anaesth. 2010;104(1):89-93.
[14] Revi N, Mithun Raju P, Mohsin MA. Effect of intravenous infusion of magnesium sulphate on postoperative analgesia in patients undergoing arthroscopic knee surgeries under spinal anaesthesia. Int J Basic Clin Pharmacol. 2017;6(2):291-97.
[15] Lahkar B, Shah PN, Dhengle Y. Effect of intravenous magnesium sulphate on patients undergoing spinal anesthesia: randomized controlled study of 60 patients (Group M received 250 mg bolus followed by 500 mg infusion at 20 mL/h for 1 h versus saline control). J Clin Diagn Res. 2023;17(5):UC13-UC17.
[16] Klimek L, Bergmann KC, Biedermann T, Bousquet J, Hellings P, Jung K, et al. Visual analogue scales (VAS): Measuring instruments for the documentation of symptoms and therapy monitoring in cases of allergic rhinitis in everyday health care. Allergo J Int. 2017;26(1):16-24.
[17] Dahake JS, Verma N, Bawiskar D. Magnesium sulfate and its versatility in anesthesia: A comprehensive review. Cureus. 2024;16(3):e56348.
[18] Benevides ML, Fialho DC, Linck D, Oliveira AL, Ramalho DHV, Benevides MM. Intravenous magnesium sulfate for postoperative analgesia after abdominal hysterectomy under spinal anesthesia: A randomized, double-blind trial. Braz J Anesthesiol Engl Ed. 2021;71(5):498-504.
[19] Dhananjeyulu P, Pradeep R. Intravenous magnesium sulphate (MgSO4) for postoperative analgesia in patients undergoing hip surgeries under spinal anaesthesia. Indian J Anesth Analg. 2019;6(3):911-14.
[20] Prasad D, Ali MI, Chaudhary P. A comparative study on effect of intravenous MGSO4 on spinal anaesthesia with bupivacaine and buprenorphine. Eur J Mol Clin Med. 2022;9(1):1366-74.
[21] Messeha MM, Boshra V. Comparison of the antinociceptive effect of systemic versus intrathecal magnesium sulphate on spinal morphine analgesia. Magnes Res. 2016;29(1):22-33.
[22] Farouk S. Pre-incisional epidural magnesium provides pre-emptive and preventive analgesia in patients undergoing abdominal hysterectomy. Br J Anaesth. 2008;101(5):694-99.
[23] Gupta R, Verma R, Bogra J, Kohli M, Raman R, Kushwaha JK. A comparative study of intrathecal magnesium sulphate and clonidine as adjuvants to bupivacaine. J Anaesthesiol Clin Pharmacol. 2011;27(4):495-99.

[24] Solanki NM, Bhimani MP, Mistry NS, Rajan D. Evaluation of adding magnesium sulphate to intrathecal bupivacaine in lower limb orthopedic surgery. Ain-Shams J Anesthesiol. 2023;15(1):91.
[25] Apan A, Buyukkocak U, Ozcan S, Sari E, Basar H. Postoperative magnesium sulphate infusion reduces analgesic requirements in spinal anaesthesia. Eur J Anaesthesiology. 2004;21(10):766-69.
[26] Shin HJ, Kim EY, Na HS, Kim TK, Kim MH, Do SH. Magnesium sulphate attenuates acute postoperative pain and increased pain intensity after surgical injury in staged bilateral total knee arthroplasty: A randomized, double-blinded, placebo-controlled trial. Br J Anaesth. 2016;117(4):497-503.
[27] Verma N, Nagwanshi J, Patel AK, Tripathi S. Effect of intravenous magnesium sulphate for prevention of postoperative pain in infraumbilical surgeries under subarachnoid block. Int J Toxicol Pharmacol Res. 2024;13(10):01-06.

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PLAGIARISM CHECKING METHODS: [Jain H et al.]
- Plagiarism X-checker: May 16, 2025
- Manual Googling: Jun 28, 2025
- iThenticate Software: Jun 30, 2025 (10%)

ETYMOLOGY: Author Origin

EMENDATIONS: 7

AUTHOR DECLARATION:
- Financial or Other Competing Interests: None
- Was Ethics Committee Approval obtained for this study? Yes
- Was informed consent obtained from the subjects involved in the study? Yes
- For any images presented appropriate consent has been obtained from the subjects. NA

Date of Submission: **May 02, 2025**
Date of Peer Review: **Jun 03, 2025**
Date of Acceptance: **Jul 02, 2025**
Date of Publishing: **Sep 01, 2025**