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Original Research Article

A prospective randomised comparative study of intrathecal buprenorphine versus intrathecal magnesium sulphate as an adjuvant to 0.5% hyperbaric bupivacaine for lower limb surgeries under subarachnoid block

Gajanan Fultambkar*, Rohith Salla, Vijayanand Budi

Department of Anaesthesiology, Yashoda Hospitals, Shivaji Nagar, Secunderabad, Telangana, India

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***Correspondence:**
Dr. Gajanan Fultambkar,
E-mail: gfultambkar@gmail.com

ABSTRACT

Background: Spinal anaesthesia can be strengthened and improved postoperative analgesia can be achieved by adding an adjuvant to a local anaesthetic. The objective of this study is to assess the onset and duration of sensory and motor block, duration of analgesia and to compare the efficacy of 0.5 percentage of hyperbaric bupivacaine with magnesium sulfate to that of 0.5 percentage of hyperbaric bupivacaine in conjunction with buprenorphine during surgeries of the lower limb.
Methods: A total of 60 ASA 1 and 2 patients undergoing lower limb surgeries under spinal anaesthesia, were randomly divided into two groups (30 each). Group B was administered a 15mg dose of a 0.5% heavy bupivacaine solution, in conjunction with 1 mcg/kg buprenorphine, as an adjuvant. Conversely, Group M received the same dosage but was additionally infused with 0.5 ml (50 mg) of magnesium sulfate (Total 3.5 ml) The subarachnoid block was performed in the interspace between the L3-L4 vertebrae following a confirmed cerebrospinal fluid (CSF) flow in the seated position. The onset of analgesic effect, degree of blockade, sedation score, duration of analgesia, occurrence of adverse effects and hemodynamic parameters were all meticulously monitored.
Results: The findings of this study revealed no significant disparities in age, sex, weight or the mean duration of surgery across the two groups. Furthermore, there was no significant difference in the time required for the onset of motor block between the study groups ($p>0.05$). Mean duration of sensory block (141.83 vs 90.0 mins; $p<0.01$) and motor block (267.8 vs 218.1; $p<0.01$) was significantly more in cases of magnesium sulphate group as compared to buprenorphine group. Mean duration of analgesia (294.83 vs 245.5; $p<0.01$) was significantly more in cases of magnesium sulphate group as compared to buprenorphine group.
Conclusions: A good analgesia is achieved by magnesium sulphate as compared to buprenorphine when added to 0.5% hyperbaric bupivacaine for lower limb surgeries. Depth of sensory block was greater with magnesium sulphate.

Keywords: Bupivacaine, Buprenorphine, Magnesium sulphate, Spinal anaesthesia

INTRODUCTION

Spinal anaesthesia is a technique used in neuraxial regional anaesthesia, which involves injecting a local anaesthetic or an opioid into the subarachnoid space. It boosts several notable benefits, including a rapid onset of action, its cost-effectiveness, ease of administration and a relatively low incidence of adverse effects, along with shorter periods spent in the post-anaesthesia care unit. However, these advantages may be counteracted by the technique's limited duration of action and an increased risk of delayed recovery of motor function, which delays in ambulation and extended hospital stays.[1] Adjuvants are frequently employed with intrathecal local anaesthetics in order to

enhance the quality of the spinal anaesthesia block, increase its duration of action, and lessen the dose of local anaesthetics used, thereby diminishing the occurrence of adverse effects associated with high-dose local anaesthetics, including delayed and severe bradycardia, hypotension, nausea and vomiting.[2] Research has revealed that a variety of medications, including opioids like fentanyl, morphine and sufentanil, α2-adrenergic agonists (clonidine and dexmedetomidine (Dex)), neostigmine, magnesium sulfate, midazolam and ketamine could be served as adjuvants to enhance the efficacy of spinal anaesthesia.[3]

Opioids are frequently used intrathecal adjuvants, that could augment the sensory blockade provided by local anaesthetics without impacting sympathetic activity.[4] Yaksh and Rudy, in 1976, were the first investigators to demonstrate direct opioid analgesia at the spinal cord level.[5] Morphine was the first opioid administered intrathecally to augment neuraxial blocks.[6] Many adjuvants like fentanyl, buprenorphine have been tried and are effective to prolong the anaesthetic effects.[7] Buprenorphine is a prolonged-acting, highly lipophilic opioid that has demonstrated efficacy as an analgesic when administered via the intrathecal route, exhibits approximately 25 times enhanced potency compared to that of morphine.[8] It is a μ receptor partial agonist with low intrinsic activity can be safely used in subarachnoid block. It prolongs the duration of sensory block and thus decreases the need for postoperative analgesia.[9] Common adverse drug reactions associated with the use of buprenorphine include: nausea, vomiting, drowsiness, respiratory depression, pruritis, dry mouth, orthostatic hypotension and urinary retention.[10] Magnesium sulfate functions as an N-methyl-D-aspartate (NMDA) receptor antagonist, thereby obstructing voltage-gated calcium channels. It has undergone thorough investigation for its analgesic effects in diverse clinical environments and administration strategies.[11] Research has demonstrated that magnesium sulfate can decrease the need for postoperative pain relief in a range of cases. Furthermore, the administration of magnesium sulfate intrathecally has been found to diminish nociceptive signals in neuropathic pain and enhances the analgesic effects of opioids in animal experiments.[12] In humans too, intrathecal magnesium has shown promising results by prolonging the duration of analgesia in various surgical procedures like lower limb surgeries.[13] Despite the availability of so many adjuvants, the debate is still on regarding the best adjuvant in spinal anaesthesia. Also, there is a paucity of data regarding comparison of magnesium sulphate and buprenorphine for their efficacy as adjuvants to subarachnoid block. To our knowledge, a single study has been conducted till date that has directly compared the outcomes of intrathecal magnesium sulfate with those of buprenorphine as adjuvants to bupivacaine. The authors observed that duration of spinal anaesthesia did not increase with the addition of magnesium but did so with buprenorphine. However, it significantly prolonged the time for first analgesic request though to a lesser extent than buprenorphine.[14]

To address the lacunae within the existing literature, we have undertaken this study to determine the efficacy of various drugs as adjuvants to hyperbaric bupivacaine in spinal anaesthesia during lower limb surgeries.

METHODS

Study design

A prospective, double blind randomized control study.

Study site

The current study is a single-centre, hospital-based investigation conducted for 9 months in the department of anaesthesia, Yashoda hospital, Secunderabad, which is accredited by the NABH and NABL.

Study sample

A total of 60 ASA I and II patients undergoing lower limb surgeries under spinal anaesthesia, were randomly divided into two groups (30 each) using computer generated random numbers. Group B received 15 mg of 0.5% heavy bupivacaine with 1 mcg/kg buprenorphine as adjuvant whereas group M received 15 mg of 0.5% heavy bupivacaine with 0.5 ml (50 mg) of magnesium sulphate to a total volume of 3.5 ml.

Inclusion criteria

The study includes patients scheduled for elective lower limb surgery under spinal anaesthesia between 18 years to 65 years of age and American society of anaesthesiologists (ASA) grade I and II patients with BMI ranging from 18-28 kg/m^2.

Exclusion criteria

Participants in this study with co-morbid conditions such as uncontrolled diabetes mellitus, asthma, hypertension, cardiac disease, haematological diseases, and others were excluded. Additionally, individuals allergic to local anaesthetics, those in ASA classes III, IV, V and those with a body mass index (BMI) exceeding 28 kg/m^2 were also exempted. Patients scheduled for emergency surgeries and those with absolute contraindications to spinal anaesthesia, including raised intracranial pressure, severe hypovolemia, bleeding diathesis and local infections, were also not considered for inclusion. Furthermore, participants who denied to participate in the study were exempted from the study.

Data was gathered from a cohort of 60 patients who met the specified criteria. A preoperative assessment was conducted for each participant, followed by the acquisition of written informed consent. The patients were maintained

on NIL per OS (nothing by mouth) for solid foods for 6 hours and clear fluids for 2 hours prior to surgery. A total of 37 patients received premedication on the night preceding the surgical procedure, administered via oral tablets: Ranitidine 150 mg and alprazolam 0.5 mg. An intravenous line was successfully established employing a 18G/20G cannula, which was subsequently preloaded with a solution of Ringer's lactate at a concentration of 10 mL/kg body weight. Each patient was positioned in a seated position under aseptic conditions and a subarachnoid block was performed at the L3-L4 inter-space via a mid-line approach, utilizing a 25G Quincke's spinal needle. Following the confirmation of a clear and the unobstructed CSF flow, the study drug was administered into the subarachnoid space. The patients were then transitioned to a supine posture, ensuring the table was kept flat and supplemental oxygen was administered.

The following parameters were recorded: the onset of sensory and motor blockade, duration of sensory and motor blockade, peak level of sensory blockade, time taken to reach peak level, time taken for sensory regression, along with duration of analgesia. Throughout the block and pre operative period, all patients were under continuous monitoring using a multi-channel monitor. This device displayed vital signs including heart rate, systolic and diastolic blood pressure, mean arterial pressure, electrocardiogram (ECG), and arterial oxygen saturation (SpO_2).

Statistical analysis

Qualitative data was depicted through frequency and percentage representations. The association among qualitative variables was evaluated using Chi-square and Fisher's exact tests. Quantitative data was summarized with mean±SD. The analysis of quantitative data between the two groups was conducted via unpaired t-tests when the data met the 'Normality test,' and by Mann Whitney tests when the data did not meet the 'normality test.' A $p<0.05$ was considered statistically significant.

RESULTS

Table 1 revealed that the mean average age among the patients in the study was 58.35±7.25 years, and there was no notable disparity between the two groups (p=0.23). Among the 60 patients, 53.3% were female while 46.7% being male, with no significant difference between the two groups (p=0.08). The data also indicated that 21.7% of the patients were in ASA grade I, while 78.3% were in ASA grade II, with no significant difference between the groups (p=0.41). Furthermore, the patients who experienced no complications were significantly more common in the group treated with bupivacaine + magnesium sulphate (M) (83.3%) compared to those treated with bupivacaine + buprenorphine (B) (56%). The rates of hypotension and bradycardia were notably lower in the group treated with bupivacaine + buprenorphine (b) (3.3%, 0.0%) compared to those treated with bupivacaine + magnesium sulphate (M) (6.7%, 10.0%). It was also observed that the group treated with bupivacaine + buprenorphine (B) group displayed no cases of pruritis (0.0%) or sedation (0.0%), in contrast to the group treated with bupivacaine + magnesium sulphate (M), where it was reported as 6.7% and 10.0%, respectively.

Table 2 explains that, the mean BMI was 27 kg/m^2 with no significant difference between the study groups (p=0.19) and the mean duration of surgery was more (167.50 mins) in buprenorphine (B) group than in magnesium sulphate (M) group (161.17 mins) with no significant difference between the two groups ($p<0.65$). Mean duration of sensory block (141.83 vs 90.0 mins; $p<0.01$) and motor block (267.8 vs 218.1; $p<0.01$) was significantly more in case of magnesium sulphate group (M) as compared to buprenorphine group (B). Mean duration of analgesia (294.83 vs 245.5 mins; $p<0.01$) and time for rescue analgesia (306.77 vs 267.50 mins; $p<0.01$) was significantly more in case of magnesium sulphate group (M) as compared to buprenorphine group (B).

Table 3 revealed that the average heart rate was similar between the groups that received bupivacaine + buprenorphine (B) and those that received bupivacaine + magnesium sulfate (M), with a p=0.81 indicating no significant difference. The group (M) that received 15 mg of 0.5% heavy bupivacaine with 0.5 ml of magnesium experienced a lower average heart rate during the surgical operation than the group B that received 15 mg of 0.5% heavy bupivacaine with 1 mcg/kg buprenorphine as adjuvant; however, the difference was found to be statistically insignificant ($p>0.05$). Results also indicated that, the mean respiratory rate was comparable between bupivacaine + buprenorphine (B) and bupivacaine + magnesium sulphate (M) received groups before and after the surgical procedure ($p>0.05$).

Table 4 explained that, the mean arterial pressure at baseline was similar with no significant difference (p=0.98) among the two groups bupivacaine + buprenorphine (B) and bupivacaine + magnesium sulphate (M). Mean arterial pressure decreased in both the groups during the surgery, but there was a slight drop in the bupivacaine + buprenorphine (B) group compared to the bupivacaine + magnesium sulfate (M) group, though the difference was not statistically significant in most cases ($p>0.05$).

Table 5 depicts that; the pain score was comparable between the two groups at baseline (0.00 vs 0.13; p=0.19). Pain was significantly lower in magnesium sulphate groups as compared to buprenorphine group from 15 mins onwards till the end of 4^{th} hour.

In most of the cases rescue analgesia was given at that time. From then onwards, pain scores were comparable between the two groups.

Table 1: Comparison of study groups based on age, gender, ASA grade and complications.

Characteristics	Group, N (%)		Total	P value
	Bupivacaine + buprenorphine (B)	Bupivacaine + magnesium sulphate (M)		
Age (Mean±SD) (in years)	30 (59.73±6.26)	30 (56.97±9.76)	60	0.23
Gender				
Female	14 (46.7)	21 (70.0)	35 (53.3)	0.08
Male	16 (53.3)	9 (30.0)	25 (46.7)	
Total	30 (100)	30 (100)	60 (100)	
ASA grade				
Grade 1	8 (26.7)	5 (16.7)	13 (21.7)	0.41
Grade 2	22 (73.3)	25 (83.3)	47 (78.3)	
Total	30 (100)	30 (100)	60 (100)	
Adverse effects				
None	17 (56)	25 (83.3)	42 (70)	<0.0.1
Bradycardia	0 (0.0)	2 (6.7)	2 (3.3)	0.48
Hypotension	1 (3.3)	3 (10.0)	4 (6.7)	0.61
Pruritis	2 (6.7)	0 (0.0)	2 (3.3)	0.48
Sedation	13 (43.3)	0 (0.0)	13 (21.7)	<0.0.1

Table 2: Mean comparison of BMI, duration of surgery, sensory block and motor block characteristics among study groups.

Parameters	Group	N	Mean±SD	P value
BMI (kg/m^2)	Bupivacaine + buprenorphine (B)	30	27.21±02.31	<0.19
	Bupivacaine + magnesium sulphate (M)	30	3.63±0.56	
Duration of surgery	Bupivacaine + buprenorphine (B)	30	167.50±33.26	<0.65
	Bupivacaine + magnesium sulphate (M)	30	161.17±23.62	
Duration of sensory block (min)	Bupivacaine + buprenorphine (B)	30	90.00±23.53	<0.01
	Bupivacaine + magnesium sulphate (M)	30	141.83±23.76	
Duration of motor block (min)	Bupivacaine + buprenorphine (B)	30	218.17±24.65	<0.01
	Bupivacaine + magnesium sulphate (M)	30	267.83±32.26	
Duration of analgesia (min)	Bupivacaine + buprenorphine (B)	30	245.50±25.88	<0.01
	Bupivacaine + magnesium sulphate (M)	30	294.83±27.99	
Time for rescue analgesia (min)	Bupivacaine + buprenorphine (B)	30	267.50±23.14	<0.01
	Bupivacaine + magnesium sulphate (M)	30	306.77±24.70	

Table 3: Comparison of changes in heart rate and respiratory rate among the study groups.

Time	Heart rate, mean±SD		P value	Respiratory rate		P value
	Bupivacaine + buprenorphine (B),	Bupivacaine + magnesium sulphate (M),		Bupivacaine + buprenorphine (B),	Bupivacaine + magnesium sulphate (M),	
Base line	81.37±12.25	87.10±9.46	0.131	17.37±2.68	16.33±1.95	0.11
5 mins	79.97±10.80	83.87± 9.93	0.317	17.10±18.47	15.07±1.78	0.187
10 mins	77.93± 11.32	80.50±10.77	0.592	16.40±2.65	15.10±2.01	0.067
15 mins	75.30±10.29	77.67±11.24	0.612	15.70±2.32	15.27±2.16	0.524
20 mins	73.47±9.39	74.83±10.82	0.674	15.07±2.60	15.13±1.94	0.469
25 mins	71.33±9.82	73.70±10.19	0.566	14.73±2.63	15.17±2.10	0.224
30 mins	68.97±9.47	73.00±10.65	0.272	14.40±3.10	14.83±2.32	0.233
45 mins	69.30±8.84	71.07±10.62	0.678	14.07±2.79	15.03±2.14	0.072
60 mins	68.67±9.07	71.60±11.79	0.2	13.87±2.58	14.93±2.50	0.053
75 mins	70.13±10.06	71.27±11.91	0.416	14.17±2.77	15.23±2.31	0.143
90 mins	69.13±8.92	70.03±11.64	0.933	14.33±2.38	15.13±2.57	0.15
120 mins	70.50±9.67	72.43±12.08	0.744	14.27±2.56	15.20±2.46	0.242
150 mins	70.46±9.01	73.70±11.98	0.472	14.69±2.28	15.03±1.69	0.735
180 mins	69.17±4.49	74.46±10.41	0.105	14.33±2.74	15.00±1.77	0.486

Continued.

Time	Heart rate, mean±SD		P value	Respiratory rate, mean±SD		P value
	Bupivacaine + buprenorphine (B),	Bupivacaine + magnesium sulphate (M),		Bupivacaine + buprenorphine (B),	Bupivacaine + magnesium sulphate (M),	
210 mins	73.00±6.65	75.00±9.64	0.812	15.60±2.88	14.70±1.34	0.622
240 mins	69.00±7.55	-	0.138	15.33±2.52	-	0.624

Table 4: Comparison of changes in arterial pressure and oxygen saturation among study groups

Time	Arterial pressure (AP), mean±SD		P value	Oxygen saturation (SpO_2), mean±SD		P value
	Bupivacaine + buprenorphine (B),	Bupivacaine + magnesium sulphate (M),		Bupivacaine + buprenorphine (B),	Bupivacaine + magnesium sulphate (M),	
Base line	104.90±5.54	105.33±4.66	0.98	98.43±0.77	98.83±0.53	0.075
5 mins	92.37±10.88	96.37±8.14	0.08	98.37±0.93	98.81±0.99	0.304
10 mins	89.57±12.48	93.03±13.98	0.311	98.30±1.34	99.00±0.69	0.05
15 mins	86.87±12.19	89.83±10.14	0.23	97.77±1.55	98.93±1.78	0.09
20 mins	81.03±11.11	83.27±10.59	0.19	97.371.87	98.87±1.82	0.07
25 mins	78.80±10.47	83.83±10.01	0.12	97.17±2.02	98.83±1.05	0.09
30 mins	79.63±10.21	82.87±15.01	0.21	97.40±1.75	98.50±1.11	0.06
45 mins	75.50±11.54	83.27±11.29	0.16	98.00±1.31	98.63±0.81	0.103
60 mins	77.77±10.35	83.57±9.52	<0.05	98.43±0.86	98.80±0.76	0.26
75 mins	79.17±9.65	84.47±8.73	0.06	98.77±0.50	99.00±0.69	0.297
90 mins	79.80±10.89	85.87±10.33	<0.05	98.70±0.60	99.03±0.67	0.12
120 mins	76.17±9.49	85.13±10.34	<0.05	99.03±0.67	99.00±0.64	0.188
150 mins	77.47±8.92	84.08±9.53	<0.05	98.65±0.49	99.07±0.58	0.017
180 mins	78.10±9.68	84.28±10.09	0.163	98.50±0.51	99.14±0.56	0.07
210 mins	78.46±9.23	84.30±9.40	0.411	98.50±0.53	98.70±0.48	0.07
240 mins	82.90±7.51	83.67	0.787	98.33±0.58	-	0.667

Table 5: Mean comparison of study groups as per VAS score.

VAS	Group	N	Mean±SD	P value
Baseline	B	30	0.13±0.57	0.19
	M	30	0.00±0.00	
15 mins	B	30	0.90±0.84	<0.01
	M	30	0.10±0.31	
30 mins	B	30	1.37±0.76	<0.01
	M	30	0.63±0.49	
45 mins	B	30	1.77±0.90	<0.01
	M	30	1.17±0.38	
60 mins	B	30	1.97±1.16	<0.01
	M	30	1.23±0.52	
2 hrs	B	30	3.30±1.24	<0.01
	M	30	2.57±0.68	
3 hrs	B	30	2.97±1.03	<0.01
	B	30	1.87±1.40	
4 hrs	B	30	0.43±0.82	0.98
	M	30	0.43±0.57	
5 hrs	B	30	0.30±0.47	0.91
	M	30	0.33±0.48	
6 hrs	B	30	0.43±0.50	0.57
	M	30	0.37±0.49	
7 hrs	B	30	0.43±0.50	0.58
	M	30	0.40±0.50	
8 hrs	B	30	0.50±0.51	0.59
	M	30	0.53±0.51	

Continued.

VAS	Group	N	Mean±SD	P value
12 hrs	B	30	0.30±0.47	0.46
	M	30	0.43±0.50	
24 hrs	B	30	0.30±0.47	0.55
	M	30	0.43±0.50	

DISCUSSION

Spinal anaesthesia represents a secure and dependable approach to anaesthesia for surgeries involving the abdomen and lower limbs. To augment the effectiveness of the blockage and prolong the period of analgesia, appropriate adjuvants are often utilized in conjunction with intrathecal local anaesthetics.[15] Despite the plethora of adjuvants available, the discussion surrounding the optimal adjuvant for spinal anaesthesia continues. Furthermore, there exists a scarcity of data concerning the comparative efficacy of magnesium sulfate and buprenorphine as adjuvants for subarachnoid block.

On analysis of our findings, we observed no difference between the study groups in terms of time required for onset of motor block. Overall T4 was the maximum level of sensory block reached by 90% cases of magnesium sulphate group patients as compared to 60% cases of buprenorphine group. Mean duration of sensory and motor block was significantly more in cases of magnesium sulphate groups as compared to buprenorphine group.

Not many studies have compared the effects of intrathecal magnesium sulphate with buprenorphine as adjuvants to bupivacaine. The only similar study reported so far has observed that mean time of onset of analgesia to T10 was higher in the magnesium group when compared to the buprenorphine group.[16] Also, the mean time of onset of complete motor block was more in magnesium group relative to the buprenorphine group. With respect to highest level of sensory block achieved, the median was T7 in buprenorphine group and T8 in magnesium group. Mean duration of regression of analgesia to S1 as well as the mean duration of motor block was relatively low in the magnesium group. In present study, mean duration of analgesia and time for rescue analgesia were significantly more in cases of magnesium sulphate groups as compared to buprenorphine group. Pain score was comparable between the two groups at baseline. Pain was significantly lower in magnesium sulphate group as compared to buprenorphine group from 15 mins onwards till the end of 4th hour.

Various studies have shown the efficacy of buprenorphine and magnesium sulphate as an adjuvant in spinal anaesthesia. Braga et al in their study compared intrathecal 0.03 mg buprenorphine with bupivacaine 30 mg for post-operative analgesia in the elderly patient. They showed prolonged analgesia with minimal disturbance of consciousness and comfortable breathing.[17] Green et al in a randomized double-blind trail comparing buprenorphine with morphine, concluded that buprenorphine is a satisfactory analgesic for 66 major surgeries with no difference in incidence of unwanted effects.[18] Sunil dixit studied to compare intrathecal bupivacaine (0.5%) and buprenorphine (60 µg with bupivacaine (0.5%) for postoperative analgesia in C-section, where the onset of analgesia was very early in control group in relation to the study group. The total duration of analgesia was prolonged from control group to study group.[19]

Kroin et al demonstrated in his study that magnesium sulphate potentiates morphine analgesia when administered intrathecally and suggested that intrathecal magnesium sulphate may be a useful adjuvant to spinal morphine analgesia.[20] Buvendran et al undertook a research endeavour to assess the potential of intrathecal magnesium in augmenting the efficacy of intrathecal opioid analgesia in patients necessitating labour analgesia. The duration of spinal analgesia was prolonged in group F+M (75 mins) compared with group F (60 mins).[21] Kawakami et al in their study concluded that the addition of intrathecal magnesium sulphate to bupivacaine spinal anaesthesia significantly prolonged the duration of spinal anaesthesia and also reduced the postoperative analgesic requirement without additional side effects.[22] In addition, Sanand et al.in their study compared the effects of intrathecal magnesium sulphate with buprenorphine as adjuvants to bupivacaine.[23] Mean duration of effective analgesia was less in the magnesium group that that in the buprenorphine group. Our results are contrary to the findings observed in this study. We observed that duration of analgesia was significantly more in cases of magnesium sulphate group. This warrants conduction of more such randomized double-blind trials to throw light on the best adjuvants to bupivacaine for spinal surgeries among these two drugs.

In the current study, a notable distinction was noted between the two groups in terms of hemodynamic parameters, including heart rate, blood pressure and respiratory rate at both the baseline and any subsequent time points during the procedure. The research conducted by Usha and Ponnusamy, revealed that there were minimal variations in heart rate, arterial blood pressure, and respiratory rate across both groups, with these differences not reaching statistical significance.[24] This indicates that both medications were found to be hemodynamically stable.

CONCLUSION

Efficacy of analgesia is significantly enhanced by the addition of magnesium sulphate to 0.5% hyperbaric bupivacaine, in contrast to the use of buprenorphine for the

same purpose in lower limb surgical procedures. The depth of sensory block achieved with magnesium sulphate was notably greater. Furthermore, the duration of both sensory and motor block was extended when magnesium sulphate was employed, in comparison to buprenorphine. It is important to note that buprenorphine is associated with sedation as a potential adverse effect. Consequently, we endorse the use of magnesium sulphate as the preferred additive to 0.5% hyperbaric bupivacaine for spinal anaesthesia in lower limb surgeries.

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