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ORIGINAL ARTICLE

Efficacy of bupivacaine and ropivacaine for postoperative analgesia in continuous epidural infusion in lower limb surgeries under combined spinal-epidural analgesia

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ABSTRACT

Background: Bupivacaine has been traditionally used as a local anesthetic of choice for regional anesthesia and analgesia. Ropivacaine has been marketed in our country with a claim of better motor profile, better safety profile and an equivalent analgesic profile when used in epidurals for postoperative pain. This study aims to compare both drugs as an epidural infusion in terms of safety, analgesic efficacy by NRS score and patient satisfaction score and motor blockade by modified bromage score in postoperative period.

Methodology: 70 patients of ASA grade I or II, of either sex between the age of 20-65 years, posted for orthopedic lower limb surgery under combined spinal epidural anesthesia were enrolled in this prospective randomised double blind study. The patients were randomly allocated to one of the two groups; Group 1 patients received 0.125% bupivacaine with 2 µg/ml fentanyl, while Group 2 patients received 0.2% ropivacaine, with 2 µg/ml fentanyl as an adjunct in epidural infusion postoperatively. Epidural infusion was started at the rate of 8 ml/hour after either four hours of administration of spinal anesthesia or at an NRS score of three, whichever was earlier. We evaluated the NRS scores, patient satisfaction scores and the need of rescue analgesic. Vital parameters and modified bromage score were also registered.

Results: The pain score was similar in both groups at different time intervals, except at 15 and 30 min after starting epidural infusion, where the pain score was significantly lower in Group 2 when compared to Group 1 (p-value 0.007, 0.006 respectively). Patient satisfaction score was significantly more in Group 2 patients. There was no significant difference in requirement of rescue analgesia in two groups. Modified bromage grade was statistically more in Group 1.

Conclusion: We conclude that ropivacaine can be used as an alternative to bupivacaine for postoperative analgesia by epidural infusion, as it provides effective pain control with the added advantage of lower incidence of motor blockade.

Key words: Postoperative, Analgesia; Analgesia; Epidural; Bupivacaine; Ropivacaine; Fentanyl

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INTRODUCTION

Achievement of adequate postoperative analgesia is still under investigation despite having so many management protocols. The latest emerging concepts are pre-emptive analgesia and multimodal approach.[1] It is beneficial for the patients to remain pain free postoperatively for early ambulation and recovery, and to avoid adverse effects of pain ranging from uneasiness to serious cardiovascular and respiratory complications resulting in increased morbidity and longer hospital stay.[2-3] Contemporary use of systemic analgesia is now supplemented with other modalities like peripheral nerve blocks and neuraxial blockade. Bupivacaine, a commonly used local anesthetic for epidural analgesia, produces a longer duration of motor blockade which may not be desirable. A newly emerged homolog drug is ropivacaine, that has less cardiotoxic and motor blockade properties.[4-6] In a previous similar study, 0.2 % of ropivacaine and 0.125 % of bupivacaine have been compared assuming them to be equipotent. This assumption was based on the fact that ropivacaine is about 40% less potent than bupivacaine.[7]

This prospective randomized double blind study was conducted to compare the efficacy of bupivacaine 0.125% and ropivacaine 0.2% with fentanyl 2 μg/ml as epidural infusion for postoperative pain relief by numeric rating scale (NRS) and patient satisfaction score in orthopedic lower limb surgeries.

METHODOLOGY

After obtaining Institutional Ethics Committee approval and written informed consent from the subjects, the study was conducted in two years. Seventy ASA grade I-II patients, aged 20-65 years, of either sex, undergoing elective orthopedic lower limb surgery of less than three hours duration, were included in the study. The exclusion criteria were hypovolemia, sepsis, coagulopathy or known allergy to local anesthetic agents. Patients who required intraoperative epidural top up dose were also excluded from the study. The patients were randomly allocated to one of the two groups by computer generated randomised number method. The number generated was placed in a sealed envelope. The primary investigator and the patient were blinded to the group allocated and the study drug received. Each group had 35 subjects. Combined spinal epidural anesthesia technique was employed. Group 1 patients received 0.125% bupivacaine and 2 μg/ml fentanyl epidural infusion postoperatively while Group 2 patients received 0.2% ropivacaine and 2 μg/ml fentanyl as epidural infusion.

Preoperatively patients were assessed and explained about the procedure. A written informed consent was taken from all the patients. All patients were kept fasting for eight hours and premedicated with ondansetron 4 mg and ranitidine 50 mg through 18 G iv cannula half an hour prior to the surgery as per institutional protocol. On arrival in the operation room patients were preloaded with 500 ml of normal saline and standard monitoring was attached which included continuous electrocardiogram, SpO_2 and automated non-invasive blood pressure (NIBP). Baseline values of systolic blood pressure (SBP), diastolic blood pressure (DBP), mean arterial pressure (MAP), heart rate (HR) and SpO_2 were noted. Under all aseptic precautions, 18G epidural catheter was inserted in a cephalad direction using 18 G tuohy's needle with loss of resistance to saline technique in L_2-L_3 interspace in sitting position. Subarachnoid block was given with 25 gauge Quincke-Babcock spinal needle in the L_3-L_4 space using 3 ml of 0.5% hyperbaric bupivacaine and 25 μg of fentanyl administered slowly. After fixing the epidural catheter the patient was immediately made to lie down in supine position and 3 ml of test dose using 2% lignocaine with adrenaline was given via epidural catheter to confirm its placement. The level of sensory blockade was checked with pin prick method at intervals of two minutes. Surgery was commenced after the level of sensory blockade reached to T_8 dermatome. Patient's vital parameters were observed at regular intervals and hemodynamic stability was maintained.

Postoperatively, an anesthesia technician prepared the drug of epidural infusion as per the allocated group revealed by sealed envelope. An epidural infusion was started at the rate of 8 ml/hour after either four hours of administration of spinal anesthesia or an NRS score of three, whichever was earlier. This time of starting epidural infusion was noted as T_0. The NIBP, HR, pain score by NRS, modified bromage score (MBS) were noted at 15 min, 30 min, 45 min, 1 hour, 2 hours, 4 hours and then 4 hourly till 48 hours postoperatively. Epidural infusion rate was titrated according to the patient's NRS and MBS.[8]

The epidural infusion rate was decreased by 2 ml/h to a minimum of 6 ml/h if at any time MBS was 2 or 3.

NRS [9] is a pain scale from 0 to 10 where zero denotes no pain, 1-3 suggest mild pain, 4-6 suggest moderate pain, 7-9 suggest severe pain and 10 stands for the worst possible pain.

As shown in Table I, rescue analgesia was administered in the form of epidural top-up with 4 ml

Table 1: Postoperative NRS and rescue analgesia

NRS	Epidural infusion rate (ml/h)	Rescue analgesic
0-1	8	-
2-3	8	epidural top-up of 4 ml
4-6	10-12	epidural top-up of 4 ml
7 and above	12	epidural top-up of 4 ml + iv tramadol 100 mg slowly

NRS= numeric rating scale 0-10; 0-no pain and 10-worst possible pain

Table 2: NRS at different time intervals in group 1 and group 2

NRS	Group 1		Group 2		p-value
	N	Mean ± SD	N	Mean ± SD	
0 min	34	3.38 ± 1.07	35	3.11 ± 1.02	0.292
15 min	34	3.41 ± 0.82	34	2.85 ± 0.82	0.007
30 min	35	2.54 ± 0.89	31	1.97 ± 0.75	0.006
45 min	31	1.52 ± 0.68	20	1.25 ± 0.55	0.148
1 H	10	1.30 ± 0.68	4	1.00 ± 0.00	0.403
2 h	7	1.00 ± 0.00	2	1.00 ± 0.00	0.896
4 h	7	1.86 ± 1.46	3	2.00 ± 1.73	0.743
8 H	9	2.11 ± 1.69	7	1.86 ± 1.22	0.592
12 h	11	1.64 ± 1.21	6	1.33 ± 0.82	0.342
16 h	11	1.64 ± 1.21	9	2.22 ± 1.48	0.937
20 h	10	2.70 ± 2.26	11	2.64 ± 1.29	0.724
24 h	12	2.83 ± 1.75	12	2.58 ± 1.68	0.686
28 h	15	1.67 ± 1.11	8	1.88 ± 1.25	0.283
32 h	13	1.92 ± 1.61	4	3.00 ± 2.00	0.833
36 h	10	2.20 ± 1.81	5	2.00 ± 1.41	0.632
40 h	12	1.92 ± 1.38	9	2.22 ± 1.48	0.769
44 h	13	1.15 ± 0.38	0	0.00 ± 0.00	—
48 h	12	1.08 ± 0.29	0	0.00 ± 0.00	—

NRS= numeric rating scale 0-10; 0-no pain and 10-worst possible pain, SD- standard deviation, p-value < 0.05 is significant

of epidural infusion solution according to the group allocated, and/or tramadol 100 mg IV with antiemetic prophylaxis with ondansetron 4 mg.

Any side effects, e.g. hypotension, pruritus or urinary retention, were noted and treated accordingly. Hypotension, defined as SBP ≤ 90 or DBP ≤ 60 mmHg, was treated by 3 mg ephedrine and bolus of 250 ml ringer lactate, also the epidural infusion rate was decreased by 2 ml/h to a minimum of 6 ml/h. The epidural catheter was removed at the end of 48 h and patient's satisfaction score of 1 to 10 was recorded.

Statistical analysis: The sample size for the study was calculated from the formula provided by Training for Clinical Research Program at University of California and San Francisco (UCSF; website: www.sample-size.net). Based on previous similar study[10] done, the expected motor blockade was determined (P_0 and P_1). The sample size was calculated with α-error of 0.05 and power of study 80%.

For qualitative data Chi-square test ($f > 5$) and Fisher's exact test ($f < 5$) were applied. Demographics was compared by mean and percentage. Quantitative data was compared by Student t-test. p-value < 0.05 was considered as significant. Software used to analyze and compute data was SPSS version 17.

RESULTS

Both groups were comparable in age and sex distribution (p-value 0.89 & 0.63 respectively). As shown in Table 2, the NRS score was similar in Group 1 and Group 2 patients at different time intervals, except at 15 min and 30 min where the pain score was significantly lower in Group 2 when compared to Group 1 (p-value 0.007, 0.006 respectively). Clinically and statistically both drugs provided comparable analgesia.

A statistically significant difference in patient satisfaction score was observed in Group 2. Thus, patients receiving ropivacaine infusion postoperatively had a higher satisfaction score (7.94 ± 1.37 vs. 8.66 ± 1.19, p = 0.023)

As shown in Table 3, there was no significant difference in requirement of rescue analgesia in form of epidural top-up in Group 1 and Group 2. There was no incidence of NRS 7 or more in either group, hence no patient was given intravenous analgesia in the form of diclofenac or tramadol.

The incidence of motor blockade was more in Group 1 as compared to Group 2 and the difference was statistically significant. Neither of the groups

demonstrated motor blockade of grade 3 (Table 4).

Patient's baseline parameters were recorded and after starting epidural infusion vitals including HR, SBP, DBP were measured at regular intervals. No significant hemodynamic changes were observed in either group.

Table 3: Requirement of rescue analgesia in group 1 and group 2

Rescue analgesia	Group 1		Group 2		p-value
	Frequency	%	Frequency	%	
0 min	12	34%	12	34%	1.000
15 min	4	11%	0	0%	0.114
30 min	1	3%	1	3%	1.000
45 min	0	0%	0	0%	-
1 h	0	0%	0	0%	-
2 h	0	0%	0	0%	-
4 h	2	6%	1	3%	1.000
8 h	3	9%	3	9%	1.000
12 h	3	6%	1	3%	0.498
16 h	3	9%	5	14%	0.710
20 h	4	11%	8	23%	0.342
24 h	7	20%	7	20%	1.000
28 h	5	14%	3	9%	0.710
32 h	3	9%	4	11%	1.000
36 h	5	14%	2	6%	0.428
40 h	5	14%	5	14%	1.000
44 h	2	6%	0	0%	0.493
48 h	0	0%	0	0%	-

p-value < 0.05 is significant

Table 4: Overall incidence of motor blockade

MBS	Group 1 (n=35)		Group 2 (n=35)		p-value
	Frequency	%	Frequency	%	
1	12	34.3%	5	14.3%	0.001
2	6	17.1%	2	5.7%	0.259

MBS= modified bromage score; p-value < 0.05 is significant

DISCUSSION

"It is easier to find men who will volunteer to die, than to find those who are willing to endure pain with patience" - Julius Caesar. Postoperative pain management is essential for early ambulation and recovery of the patient. Inadequate postoperative pain management can lead to multiple complications such as pulmonary, circulatory or urinary dysfunction as well as deranged psychological and emotional behavior. Epidural analgesia with local anesthetics is one of the most effective techniques used for postoperative pain relief and may improve patient outcome.[11] Ropivacaine is a long acting local anesthetic, used in clinical practice since 1996. By virtue of its pure S enantiomer form, it is less cardiotoxic than bupivacaine. Also, it is less potent,[12,13] and hence, the motor blocking feature of ropivacaine is less intense and of lesser duration.[11] Finding the balance between motor block and analgesia is the major challenge in epidural analgesia.

In this study, the quality of postoperative analgesia in both groups was good. A similar degree of pain relief was observed in both groups except at 15 and 30 min after starting epidural infusion, where the NRS was lower in Group 2 than Group 1 and the difference was statistically significant. After 30 min the NRS was similar in both groups. None of the patients reported NRS of seven or more and, therefore, intravenous analgesia was not prescribed to any patient. The need for rescue analgesia in the form of epidural top up was similar in both groups. Sara Korula et al,[7] compared ropivacaine 0.2% and bupivacaine 0.125% for epidural analgesia following bilateral inguinal mesh hernioplasty and concluded that sensory profile was similar in both groups. Muldoon et al,[14] in their study concluded that VAS score was more in ropivacaine group when compared to bupivacaine. Our study results were in accordance to the study conducted by Sara Korula et al.[7] This could be due to the comparison of same concentration of the two drugs. Contradictory results to our study was found in study conducted by Surabathuni S et al[15]. They concluded that visual analogue scale showed significant difference in patients receiving ropivacaine, having higher VAS score at 1 h (p = 0.0126), 12 h (p = 0.0311) and 24 h (p = 0.042) after

the commencement of epidural infusion as compared to bupivacaine.

The patient satisfaction score was more in Group 2 when compared to Group 1 in our study (p-value 0.023). Our study results showed similar rate of epidural infusion in both the groups and the difference being statistically non-significant. Rescue analgesia in form of IV analgesics was not required in either group. This was in accordance with the study conducted by Korula et al.[7]

The present study results showed higher incidence of motor blockade in Group 1 when compared to Group 2. None of the patients reported MBS more than two in any group. Twelve patients in Group 1 reported a motor blockade of MBS 1 while the incidence was limited to five patients in Group 2. Brodner et al.[16] deduced in their study that MBS more than zero was found only in bupivacaine group. In addition to it, postoperative mobilization was restored earlier in the patients receiving epidural ropivacaine. Finegold et al.[10] in their study compared ropivacaine 0.1% with fentanyl and bupivacaine 0.125% with fentanyl infusion for epidural labor analgesia and concluded that ropivacaine was associated with less motor blockade. The outcome of both of the studies were in accordance with our study results.

The baseline vital parameters were comparable in both groups. After the epidural infusion was started the drop in heart rate was comparable in both groups but the drop in blood pressure was more in Group 1. The maximum drop in the blood pressure was in the first hour of starting of epidural infusion following which the vital parameters were maintained near constant.

Since varying results are observed for efficacy of two drugs, when compared with other previous studies, a larger sample size would be required for validation of the results. Small sample size probably is the limitation of our study.

CONCLUSION

From our study we conclude that ropivacaine provides comparable postoperative pain control by epidural infusion as bupivacaine, with the added advantage of lower incidence of motor blockade and enhanced patient satisfaction score.

Conflict of interest: None declared by the authors

Authors' Contribution:
MS, MS: manuscript editing
GA: conduct of study
PK, KB: literature search

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