



Comparing the effects of Bupivacaine and Ropivacaine Instillation for Postoperative Analgesia in Patients Undergoing Lumbar Spine Surgery: A Prospective Randomised Double Blind Study

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Abstract

Introduction: Laminectomy is associated with considerable postoperative pain. Providing analgesia locally in the area of surgical trauma, with minimal systemic side effects has become an integral part of multimodal analgesia. The objective of this study is to compare the effects of bupivacaine and ropivacaine instillation for postoperative analgesia in patients undergoing lumbar spine surgery.

Methods: The study was conducted in a double blind manner. 40 ASA I & II patients scheduled for lumbar laminectomy were randomly divided into two groups to receive either 20 ml (0.25%) of bupivacaine (group B) or ropivacaine (0.25%) instillation into the wound after securing hemostasis. After a dwell time of 60 sec the wound was closed in layers without mopping or suctioning. After extubation, the pain scores were evaluated by Numerical rating scale at 0 hours i.e., immediately after extubation and then at every 1 hour up to first 8 hours and then at every 6 hours till 24 hours and also the time for first demand of analgesia, number of analgesic demands and the total amount of analgesia consumed were noted by an independent observer.

Results: The area under curve for mean pain score over 24 hrs time period on the basis of NRS scale was 46.8 ± 5.84 in ropivacaine group (R) and 44.78 ± 5.36 in bupivacaine group (B) with $p = 0.26$. The duration of analgesia and number of demands and the amount of analgesia consumed was also found statistically not significant.

Conclusion: Surgical wound instillation with bupivacaine and ropivacaine provided better analgesic effect and safe postoperative analgesia in patients undergoing laminectomy surgeries.

Introduction

Lumbar spine surgery is a commonly performed procedure in neurosurgical and orthopaedic practice. Commonly performed spinal surgeries

include laminectomies, discectomies, spinal fusions, instrumentations, scoliosis corrections, and spinal tumor excision. Patients usually suffer significant pain after surgery.¹ Postoperative pain

relief helps in early mobilization, initiation of physiotherapy, provides satisfaction to the patients, preventing the development of chronic pain and plays an important role in reducing the morbidity and mortality.²⁻³ Currently several postoperative analgesic options are available. Intravenous opioids, NSAIDs, intrathecal administration of opioids and local anaesthetics have been evaluated. Most of these techniques may be limited by potentially high failure rates, high cost, technically challenging, and labor intensive, adverse /toxic effects, and procedure-related complications. Instillation of local anaesthetic drug into the wound was found to provide postoperative analgesia in certain surgical procedures like hernia repair and laparoscopic cholecystectomy.⁴ Simple technique of instillation of wound with bupivacaine or ropivacaine and leaving a contact time of 60 seconds may alleviate postoperative pain following lumbar laminectomy. The probable mechanism of pain relief could be due to the anaesthetic effect of bupivacaine acting on the pain receptors distributed in the soft tissues and the nerve endings exposed in the wound right from the skin to the dura meninge (skin, paraspinal muscle, posterior longitudinal ligament, dorsal annulus, facet joint capsule, nerve root which was under compression and the spinal meninges the dura supplied by recurrent nerve of Von Luschka).⁵ Recently, Rushdi et al. reported that the wound was infused with a solution of ropivacaine 0.4 %, suggesting the potential for the use of this method in major spinal surgery⁶. The present study was designed to evaluate and compare the effectiveness of wound instillation technique for postoperative analgesia after lumbar spine discectomy and laminectomy by using 20 ml bupivacaine (0.25%) or 20 ml ropivacaine (0.25%).

Materials and Method

After obtaining approval of the institutional Ethics Committee and informed consent of the patients, a randomized double-blind study was conducted on

40 patients of either sex and ASA I & II physical status, scheduled to undergo single level lumbar laminectomy under general anaesthesia. Patients with ASA grade III-IV, instrumentation due to spondylolisthesis or spinal stenosis, and planned to have multiple distance or double site laminectomy, patients with prior lumbar disc surgery, prior neurological deficits, preoperative opioid use or any history of substance abuse or on steroids, infection, local anaesthetics allergy, bleeding, cerebrospinal fluid leak, were excluded from the study. Patients were randomly allocated in two groups of twenty each using sealed opaque envelopes. Group R received wound site instillation with 20 ml of 0.25% ropivacaine (n=20). Group B received wound site instillation with 20 ml of 0.25% bupivacaine (n=20). All patients were examined pre-operatively and details regarding clinical history, general physical examination were recorded and all routine investigations were carried out. All patients were assessed the day before surgery and instructed how to rate the intensity of pain using numerical rating scale (NRS), a scale of zero to ten, where 0 = no pain and 10 = worst pain. Upon arrival in the operating room, 18 G intravenous cannula was inserted in a peripheral vein and a Ringer lactate solution was started at 6 ml/kg. Monitoring of non-invasive blood pressure (NIBP), heart rate, electrocardiogram, SpO₂ monitoring and Etco₂ was started and carried out throughout the perioperative period. All patients were pre-medicated with injection Glycopyrrolate (0.2mg), injection fentanyl (2mcg/kg), injection midazolam (0.25mg/kg). After 3 min of preoxygenation, anaesthesia was induced with injection propofol 2 mg/kg i.v ; injection succinylcholine 1.5mg/kg i.v. to facilitate endotracheal intubation. Maintenance of anaesthesia was carried out using 67% N₂O in 33% O₂ and halothane 0.5% using controlled ventilation. Neuromuscular blockade was achieved using vecuronium 0.08-0.12 mg/kg. Intra operative analgesia was provided with Paracetamol 1 gram IV. At the end of surgical procedure and when haemostasis was achieved,

patients in group (R) received instillation of 20 ml ropivacaine (0.25%) and group (B) received 20ml (0.25%) bupivacaine. All the drugs were allowed to remain in the wound for a dwell time of 60 seconds. Postoperative pain was assessed by an independent observer blinded to the study by numeric rating scale (NRS), first at 0 hours i.e., immediately after extubation and then at every 1 hour up to first 8 hours and then at every 6 hours till 24 hours. The duration of analgesia was considered from the time the study drug was instilled to the time for first demand of rescue analgesia When pain score reach ≥ 4 point on numeric rating scale, inj. diclofenac 75 mg deep intramuscular was given as rescue analgesia.

Duration of analgesia, total analgesic requirement and hemodynamic variables viz, heart rate, mean arterial blood pressure in 24 hours were also recorded.

Statistical Analysis

At the end of the study, results were represented as Mean \pm SD and percentage changes. The statistical analysis of quantitative data (Mean \pm SD) between the groups was done by student 't' test. The statistical analysis of qualitative data (N%) between the groups is done by using Fischer exact test. P-value <0.05 was statistically significant. All the analysis was done using SPSS Statistical package version 20.0.

Results

Table 1: Demographic data of the patients in study groups

Parameters	Group R	Group B	p value
	n=20	n=20	R vs B
Age	37.45 \pm 7.53	38.5 \pm 10.06	0.71(NS)
Sex			
Male	13 (65%)	13 (65%)	1.00(NS)
Female	7 (35%)	7 (35%)	
Weight	65.75 \pm 12.37	68.5 \pm 10.29	0.45(NS)
Height	164.4 \pm 9.49	166.7 \pm 9.11	0.44(NS)
1	16 (80%)	16 (80%)	1.00(NS)
2	04 (20%)	04 (20%)	

Table 2: Comparison of patients data among the groups

Parameters	Group R	Group B	P value
	n=20	n=20	R vs B
Duration of surgery (minutes)	105.15 \pm 10.03	107.75 \pm 8.85	0.39(NS)
Duration of analgesia (hours)	12.15 \pm 1.49	12.39 \pm 1.56	0.62 (NS)
Amount of analgesia (mg)	97.5 \pm 35.26	93.75 \pm 33.32	0.73(NS)
Number of demands			
1	14 (70%)	15 (75%)	0.84(NS)
2	6 (30%)	5 (25%)	
3	0 (0%)	0 (0%)	

Table 3: Comparison of heart rate between study groups

HR	Group R	Group B	p-value
Mean \pm SD	n=20	n=20	R vs B
0 hour	88.35 \pm 7.44	86.35 \pm 5.21	0.33
1 hour	83.85 \pm 9.77	85.15 \pm 8.12	0.65
2 hours	81.65 \pm 8.75	83.4 \pm 8.05	0.51
3 hours	80.9 \pm 8.57	83.25 \pm 7.16	0.35
4 hours	81.4 \pm 9.53	83.45 \pm 8.27	0.47
5 hours	82.25 \pm 9.17	83.75 \pm 7.28	0.57
6 hours	83.2 \pm 10.36	83.45 \pm 8.29	0.93
7 hours	86.15 \pm 9.92	85.8 \pm 7.07	0.90
8 hours	88.7 \pm 10.69	87.95 \pm 8.07	0.80
14 hours	94.05 \pm 7.81	90.6 \pm 4.76	0.10
20 hours	90.65 \pm 10.02	90.55 \pm 8.21	0.97
24 hours	91.2 \pm 10.25	91.7 \pm 7.97	0.86

Fig-1: Line diagram showing heart rate changes among groups

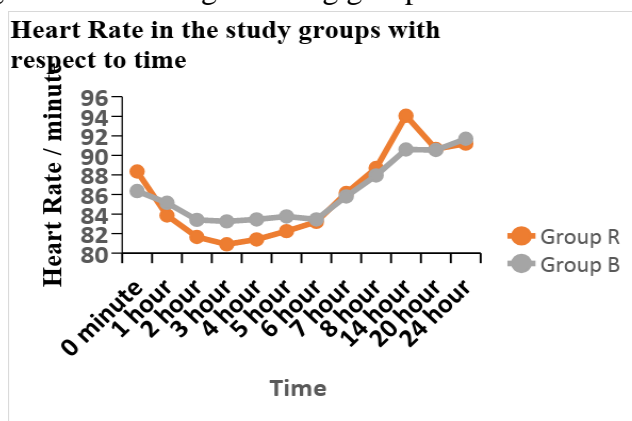


Table 4: Comparison of mean arterial pressure between study groups

MAP	Group R	Group B	p-value
Mean±SD	n=20	n=20	R vs B
0 hour	88.3 ± 4.75	88.7 ± 5.18	0.80
1 hour	85.5 ± 3.89	86.3 ± 4.29	0.54
2 hours	86.0 ± 5.30	86.1 ± 5.28	0.95
3 hours	85.5 ± 5.30	86.25 ± 5.24	0.66
4 hours	86.1 ± 4.67	86.4 ± 5.02	0.85
5 hours	86.6 ± 4.81	87.0 ± 5.35	0.81
6 hours	86.1 ± 4.85	87.1 ± 5.31	0.54
7 hours	86.8 ± 4.38	87.4 ± 4.53	0.67
8 hours	88.1 ± 5.67	88.25 ± 5.55	0.93
14 hours	92.8 ± 5.24	92.85 ± 4.51	0.97
20 hours	90.9 ± 5.28	90.95 ± 4.77	0.97
24 hours	90.7 ± 4.68	90.7 ± 4.31	1.00

Fig- 2: Line diagram showing pattern of MAP in the study groups with respect to time

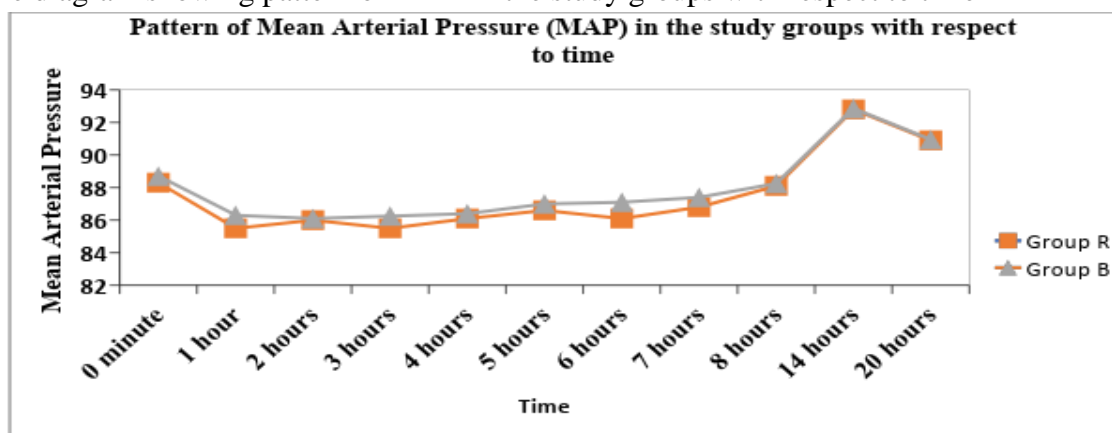


Table 5: Comparison of NRS score between study groups

NRS	Group R	Group B	p-value
Mean±SD	n=20	n=20	R vs B
0 hour	0 ± 0	0 ± 0	-
1 hour	0.1 ± 0.3	0.55 ± 0.5	0.001*
2 hours	0.25 ± 0.4	0.65 ± 0.5	0.008*
3 hours	0.7 ± 0.5	0.85 ± 0.4	0.30
4 hours	0.95 ± 0.4	1.0 ± 0	0.58
5 hours	1.3 ± 0.5	1.2 ± 0.4	0.49
6 hours	1.7 ± 0.5	1.3 ± 0.5	0.01*
7 hours	1.9 ± 0.3	1.8 ± 0.4	0.38
8 hours	2.6 ± 0.5	2.2 ± 0.4	0.008*
14 hours	2.7 ± 0.8	2.5 ± 1.0	0.49
20 hours	2.1 ± 0.7	2.1 ± 0.8	1.00
24 hours	2.2 ± 0.5	2.2 ± 0.6	1.00

Fig-3: Line diagram showing Pattern of NRS in the study groups with respect to time

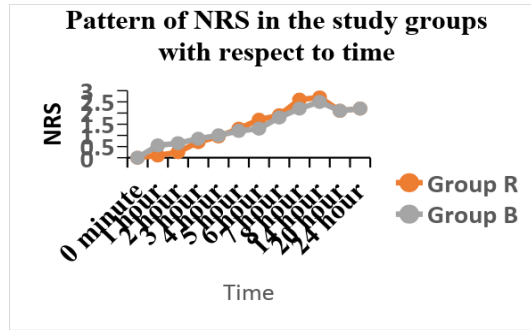


Fig-4: Bar diagram showing pattern of NRS among study groups.

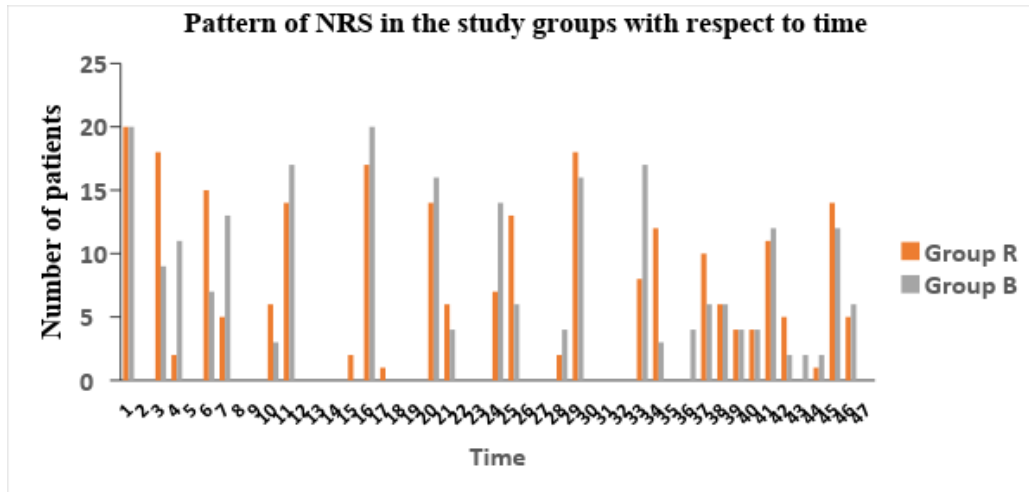
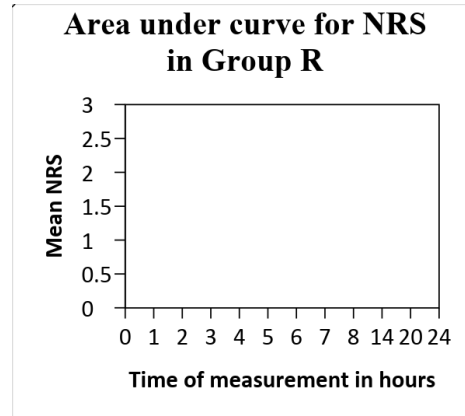
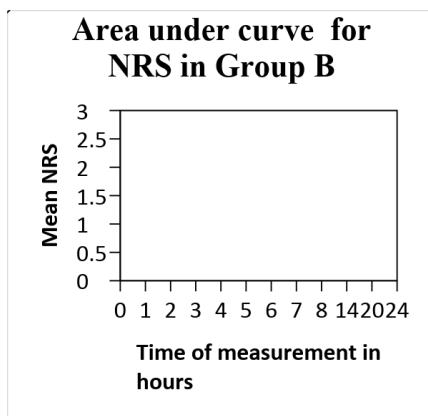


Table 6: Area under curve for NRS among study groups

Parameters	Group R	Group B	p-value
	n=20	n=20	R vs B
Area under curve (NRS)	46.8±5.84	44.78±5.36	0.26



Discussion:

In our study the demographic data with respect to age, sex, ASA grade and duration of surgery were comparable among all the groups (table 1). In the current study, the study drug was instilled and allowed a dwell time of 60 seconds. The subjects were observed for varying parameters to assess

the effects on, duration of analgesia, number of demands, amount of rescue analgesic requirement, hemodynamic changes and NRS pain score over a period of 24 hours (table2,3,4,5). The pain scores were low at all points of time in the study groups. We have taken area under curve for mean pain score over 24 hrs time period on the basis of NRS

scale and it was 46.8 ± 5.84 in ropivacaine group (R) and 44.78 ± 5.36 in bupivacaine group (B) (table 6). However, when we compared group R with group B statistically no significant difference was found ($p=0.26$). Mean duration of analgesia in group R and group B were 12.15 ± 1.49 hours and 12.39 ± 1.56 hours. There was statistically no significant difference found when ropivacaine (R) group was compared with bupivacaine (B) group ($p=0.62$). The demands of rescue analgesia in ropivacaine group (group R) was one time in 14 (70%) patients and two times in 6 (30%) patients. In bupivacaine (group B) it was one time in 15 (75%) patients and two times in 5 (25%) patients. Number of demands were statistically not significant when group R was compared with group B ($p=0.84$). In ropivacaine group (R) mean amount of rescue analgesia was 97.5 ± 35.26 mg and in bupivacaine group (B) was 93.75 ± 33.32 mg respectively. There was statistically no significant difference when group R was compared with group B ($p=0.73$). The results of our study showed that pain score was less in ropivacaine group (R) and bupivacaine group (B) but found to be statistically not significant ($p=0.26$). The findings in our study correlates to the study done by *Hernández-Palazón J et al*⁷ in 2001 who found that infiltration of the surgical wound with 0.25% bupivacaine or 0.25% ropivacaine was similarly effective for treatment of pain after lumbar disk laminectomy. In their results the mean time until the first request for analgesia was significantly longer in bupivacaine group than in ropivacaine or control group (164 ± 53 min versus 68 ± 31 and 38 ± 14 min, respectively). The difference could be due to paracetamol 1gram i.v. given during intraoperative period. In another similar study done by *Kucuk C et al*⁸ in 2007 found intraperitoneal instillation of 100 mg bupivacaine, 100 mg ropivacaine, or 150 mg ropivacaine at the end of a laparoscopic cholecystectomy significantly reduced the morphine consumption during the first 24 hour. However, for preventing postoperative pain 150 mg ropivacaine proved to

be significantly more effective than either 100 mg bupivacaine or 100 mg ropivacaine. *Cherian and co authors*⁹ in their study evaluating the efficacy of wound infiltration with bupivacaine after lumbar laminectomy found significant analgesia compared to placebo group. the mean time before administration of the first dose of analgesic postoperatively in the bupivacaine and placebo recipients was 807.7 (567.6) minutes and 181.4 (110.1) minutes. In our study mean duration of analgesia in ropivacaine group (R) 12.15 ± 1.49 hours and in bupivacaine group (B) was 12.39 ± 1.56 hours respectively. But there was no significant difference when ropivacaine (R) group was compared with bupivacaine (B) group ($p=0.62$). In another study by *milligan et al*¹⁰ where patients received injection of 10 ml of 0.5% bupivacaine into the wound found less pain scores and longer duration of analgesia following lumbar discectomy. *Padmaja Durga et al*¹¹ in 2015 studied role of wound instillation with bupivacaine through surgical drains for postoperative analgesia in modified radical mastectomy and their results also showed that statistically significant less pain in bupivacaine group. The mean duration of analgesia in the bupivacaine group was 14.6 h, 10.3 in the saline group and 4.3 h in the control group. The rescue analgesic requirement was higher in control group (C) than bupivacaine (B) group with mean \pm SD 146.2 ± 101 mg and 36 ± 43 mg respectively ($p < 0.0001$). This study is in close agreement to our study. The pain scores were low at all points of time in the study group and the mean time before administration of the first dose of analgesic postoperatively lower in study groups however longer in bupivacaine group compared to ropivacaine group but difference is statistically not significant. The amount of rescue analgesia requirement is less in bupivacaine group than ropivacaine group but is statistically not significant.

*Margherita Bianconi et al*¹² in 2004 conducted a study to assess the pharmacokinetics and efficacy of ropivacaine continuous wound instillation after

spine fusion surgery and found less pain score in ropivacaine group. In another similar study done by *Nevan M et al*⁹⁶ in 2011 on sixty patients scheduled for cervical laminectomy with fixation surgery and found pain score during the first 60 h postoperatively on visual analog scale was lower in bupivacaine group when compared to control group and results were found statistically significant ($p < 0.05$). *Neha T das et al*¹³ in 2017 assess the effects of intraperitoneal bupivacaine and ropivacaine versus placebo on postoperative pain after laparoscopic cholecystectomy. They concluded that ropivacaine (0.375%) was longer acting than bupivacaine (0.25%). However, in our study longer duration of analgesia observed in bupivacaine group compared to ropivacaine group but difference is not significant. This may be due to higher concentration (0.375%) being used in the study. *Andrei Goldstein, Patrick Grimault et al*¹⁴ conducted a study to test the hypothesis that local anaesthetics instilled at the end of laparoscopic gynaecologic procedures are able to prevent postoperative pain at wake-up and during the first 24 h. They found that the rescue analgesia (morphine) consumption at wake-up and over the first 24 h was significantly lower ($P, 0.05$) in bupivacaine group (mean, 0.92 mg at wake-up; 3.08 mg over 24 h) and in ropivacaine group (mean, 0.25 mg at wake-up; 0.69 mg over 24 h), than in normal saline group (mean, 4.18mg at wake-up; 12.93mg over 24 h). In our study the mean arterial pressure, heart rate were measured over 24 hrs time periods. The variation in heart rate and mean arterial pressure between the groups does not show statistically significant difference ($p > 0.05$). The results correlate to the study done by *Agrawal S et al*¹⁵ who evaluated postoperative pain relief with intra-peritoneal bupivacaine instillation in laparoscopic cholecystectomy. The observed mean heart rate, systolic blood pressure, diastolic blood pressure between both groups was statistically not significant. In another similar study done by *B l Yolanda-prieto et al*¹⁶ to compare the effectiveness of 7.5% ropivacaine instillation versus infiltration after radical

mastectomy on 20 female patients divided into two groups. They found statistically no significant difference in systolic and diastolic blood pressure between study groups.

The rationale for choosing the instillation route is to block the afferent signalling and potentially modifying nociception and provides analgesia. The local anaesthetic inhibits nociception by affecting nerve membrane associated proteins and by inhibiting the release and action of prostaglandins and other agents that sensitize or stimulate the nocicepters and contribute to inflammation.¹⁵ However, absorption from dura meninge surface may also occur, which may be a further mechanism of analgesia.

Conclusion

The patients who received either ropivacaine or bupivacaine wound instillation had better pain control at all time interval, longer duration of analgesia, less amount of rescue analgesia required. The wound instillation technique is simple, safe and effective in management of acute pain after lumbar laminectomy and can be used as one among the multimodal armamentarium in pain management.

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