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Original research article

A Comparative Study Evaluating the Efficacy of Bilateral Ultrasound Guided Erector SPINAE Plane Block for Postoperative Analgesia in Lumbar Spine Surgery under General Anaesthesia: A Prospective Randomised Double Blinded Controlled Study

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Abstract

Introduction: Ultrasound (US)-guided Erector spinae plane block has recently become popular in anaesthesia practice, they have great potential to support effective postoperative pain management and it has become common analgesic method after surgery involving the lumbar spine.

Aim:

1. To assess the efficacy of 0.25% Bupivacaine and 0.5% Ropivacaine in pain relief after Lumbar spine surgeries using Ultrasound guided Erector spinae plane block.
2. Requirement of first rescue dose.
3. To assess complications related to the technique and drug related adverse effects.

Materials and Methods: A comparative, randomized, double blinded study was carried out on 60 ASA physical status grade I and II patients of either sex between 18-60 years of age, scheduled for elective lumbar spine surgeries. 60 patients were divided equally by using computer generated random numbers into two groups. Group 1 received 15 ml of 0.25% Bupivacaine on each side. Group 2 received 15 ml of 0.5% Ropivacaine on each side. The Erector spinae plane block was performed at the beginning of the surgery before induction using the ultrasound machine.

Results: Mean duration of analgesia was 373.75 minutes with SD of 66.1512 in Bupivacaine group and 687 minutes with SD of 119.433 in Ropivacaine group. The difference was highly significant in Group 2 compared to Group 1 ($p<0.0001$).

Conclusion: Thus, we conclude that 0.5% Ropivacaine provided longer duration of analgesia than 0.25% Bupivacaine when used in Erector spinae plane block for providing post-operative analgesia after Lumbar spine surgeries.

Keywords: Bupivacaine, ropivacaine, erector spinae, lumbar spine

Introduction

Postoperative pain is often severe in patients undergoing lumbar surgery. Due to post-operative pain, patients are unwilling to get out of bed at an early stage, which affects their recovery [1, 2]. Patient-controlled analgesia or epidural injection analgesia is usually used in the post-operative period. However, patient-controlled analgesia is prone to opioid-related side effects. Epidural injection is associated with infections, hematomas and other adverse events [3, 4]. Furthermore, the analgesic effect of conventional postoperative analgesia is limited. If the postoperative pain of the lumbar spine could not be effectively relieved, it may develop into chronic pain, affecting the quality of life of the patients [5]. Erector spinae plane block as a new fascial block technique was proposed in 2016 [6].

Erector spinae plane block has aroused the interest of many nerve block experts. Some believe that Erector spinae plane block can block the posterior root of the spinal nerve and produce part of the paraspinal block effect with the diffusion of the drug solution [7, 8]. Many scholars have applied Erector spinae plane block to postoperative analgesia in chest and abdomen. Furthermore, they found that Erector spinae plane block may reduce perioperative muscle relaxation and analgesic drug use. Similarly, a report showed that Erector spinae plane block relieved postoperative pain in patients with lumbosacral spine surgery, reducing the use of analgesic drugs [9]. Reducing the use of analgesic drugs in the

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perioperative period is beneficial to accelerate the recovery of patients and reduce the cost of hospitalization.

Methodology

A Prospective randomized double blinded controlled study was carried out on 60, ASA physical status grade I and II patients of either sex, between 18-60 years of age, scheduled for elective Lumbar spine surgery under General anaesthesia. The study was conducted in the Department of Anaesthesiology, at tertiary health hospital and the study period was for one year from January 2022 to December 2022. After the approval by the Institutional Ethical Committee (numbered 2020-2021/98), written informed consent was obtained from all the patients before being included in the study. Sampling was done by Simple Random Sampling using computer generated table. Sample size was calculated using Open-epi software (AG Dean, KM Sullivan, MM Soe-3.03/September 22, 2014) considering 95% confidence interval, 80% power of study and assumed standard deviation of 4.5 with 10% drop rate.

Sample size calculation formula

$$n == \frac{2(Z\alpha+Z\beta)^2 \times p \times q}{d^2}$$

$$\text{where } p = \frac{p1+p2}{2}, \qquad q = 1-p, \qquad Z\alpha = 1.96 \text{ at } 5\% \ \alpha\text{- error}$$

$$Z\beta = 0.842 \text{ at } 80\% \text{ power}$$

- d = difference between two proportions or effect size.
- σ-Pooled standard deviation.
- d-Difference between two group means.
- Z1-β-Z value for corresponding power.

The sample size obtained was 30 in each group. 60 patients were divided equally by using computer generated random numbers into two groups containing 30 each. Group 1 (n = 30) received 15 ml of 0.25% Bupivacaine on each side. Group 2 (n = 30) received 15 ml of 0.5% Ropivacaine on each side. Patients with age group of 18-60 years of either sex, ASA grade I or II and patients who gave informed and written consent were included in the study. Patients not willing to participate in the study, ASA III and IV, history of bleeding diathesis, patients on systemic anticoagulation therapy, infection at the site of injection, patients with chronic pain syndromes, history of allergy to local anesthetics, Body Mass Index (BMI) < 18 or > 35 Kg/m^2 were excluded from the study. Statistical Analysis was done using Statistical package for social sciences (SPSS) software version 20. Results of categorical variables was presented using proportions and analyzed using Chi square test or Fisher's exact test as appropriate. Results of continuous variables was presented as means and analyzed using t-test or Mann Whitney test.

Pre anaesthetic evaluation was done a day prior to surgery for all patients and routine investigations like hemoglobin estimation, coagulation profile, blood sugars, blood urea, serum creatinine, electrolytes, urine examination and chest X-ray were done. The procedure of general anaesthesia and ultrasound guided block was explained to the patient and written informed consent was taken. Preparation included an overnight fast of 8 hours before the surgery. Anaesthetic machine and all equipments were checked and kept ready along with the crash cart. After securing 18G (IV) cannula, the patient was randomized to undergo Ultrasound guided erector spinae plane block with either 30 ml of 0.25% Bupivacaine (Neon, India) i.e. 15 ml each side, which was classified as Group 1 versus 30 ml of 0.5% Ropivacaine (Neon, India) i.e. 15 ml each side which was classified Group 2. Patient was shifted on to OT table, connected to multiparameter monitor with heart rate (HR), noninvasive measurements of systolic blood pressure (SBP), diastolic blood pressure (DBP), mean arterial pressure(MAP), temperature probe and continuous ECG monitoring, oxygen saturation. Baseline heart rate (HR), systolic blood pressure (SBP), diastolic blood pressure (DBP), mean arterial blood pressure (MAP), oxygen saturation (Spo2), was recorded after 5 minutes by an anaesthesiologist who was blinded for the study.

Erector spinae plane block was given at the beginning of surgery before induction.

Technique of ultrasound guided Erector Spinae Plane block: Patients were placed in the prone position and the spine palpated downwards from C7-L5; the position of L3-L4 was marked on the skin. After ensuring skin asepsis in a standard manner, a high frequency linear probe (Model: LOGIQ V2) in a sterile sheath was placed longitudinally 2-3cm lateral to L4 spinous process. The trapezius and erector spinae muscles were identified from outwards to inwards. The skin was infiltrated with local anaesthetic, and an 18 G Tuohy needle was inserted using an in plane superior to inferior approach, so that the tip

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was placed into the fascial plane on the deep aspect of the erector spinae muscle. The correct location of the needle tip was confirmed by visible fluid spread below the erector spinae muscle off the bony shadow of the transverse process. A total volume of 15ml of study drug was injected through the needle. The procedure was then repeated on the opposite side.

Fig 1: Showing the position of USG probe and in plane technique of needle placement.

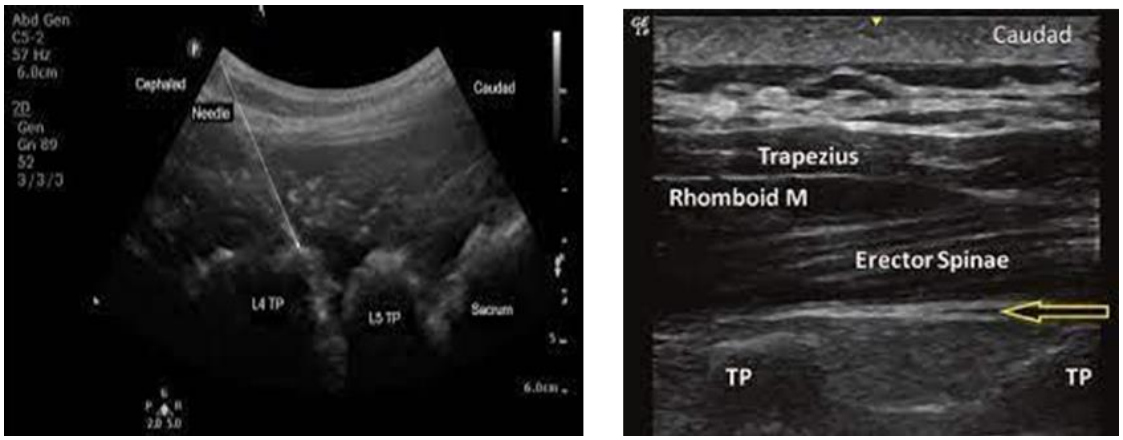

Fig 2: USG imaging showing the needle direction and erector spinae muscle

All the patients were then premedicated with Inj. Fentanyl 2mcg/kg IV; Inj. Ondensetron 0.08mg/kg IV; Inj. Pantoprazole 40mg IV; Inj. Glycopyrolate 0.005 mg/kg IV and preoxygenated with 100% oxygen for 3 minutes before induction. After premedication patients were induced with Inj. Propofol 2mg/kg iv and the dose sufficient to abolish eyelash reflex, followed by Inj. Succinyl choline 2mg/kg IV was administered to facilitate intubation and produce muscle relaxation (after attaining Gudel's stage 3). Intubation was carried out with an appropriate sized disposable, high volume low pressure cuffed endotracheal tube. After confirmation of the tracheal intubation with auscultation of the chest for bilateral air entry and using ETCO2, the tube was secured and connected to close circuit and anaesthesia was maintained with 66% nitrous oxide, 34% oxygen and Isoflurane 0.6%, maintenance dose of vecuronium with a tidal volume of 8-10 ml/kg and respiratory rate of 10-12 breaths per minute. At the end of procedure, the patients were reversed with Inj. Neostigmine 0.05 mg/kg and Inj. Glycopyrrolate 0.01 mg/kg IV. The patients were extubated after attainment of extubation criteria and shifted to the recovery. Mean duration of surgery lasted for 2 to 2.5 hours.

Patients were observed for 24 hours after the surgery in post-anaesthesia care unit by an anaesthesiologist

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who was not aware of the patient's group assignment. The pain score was evaluated using 11-point Numerical Rating Scale (0=pain, 10=worst pain) on arrival in the post anaesthesia care unit and then at 2, 4, 6, 8, 12 and 24 hours postoperatively. The number of patients requiring rescue analgesia during the first 24 hours after the surgery was recorded.

Complications

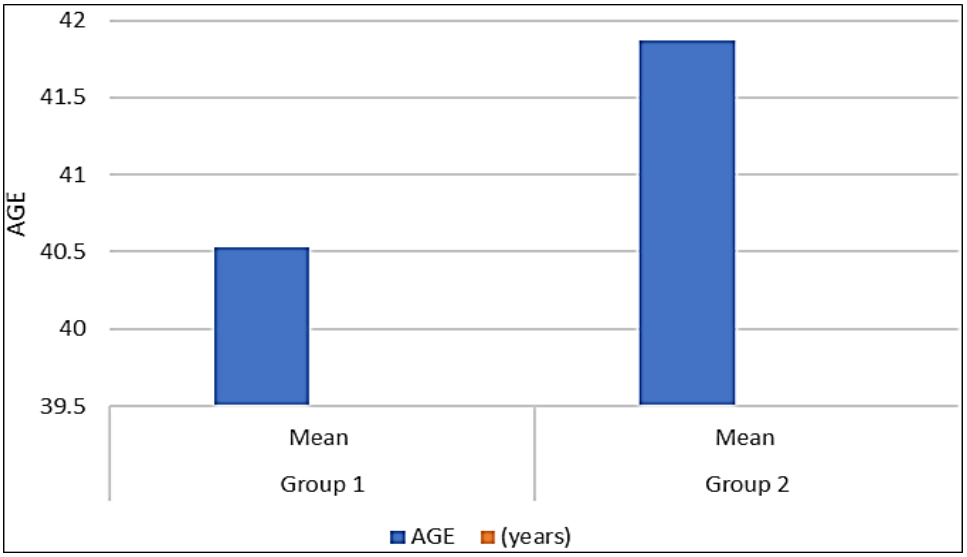
Any block related complications like hypotension, vascular puncture and local anaesthetic toxicity was recorded intraoperatively and also in the postoperative period.

Results

Table 1 shows the mean age were comparable in both the groups. The mean age in Group 1 was 40.53 years and in Group 2 was 41.87 years.

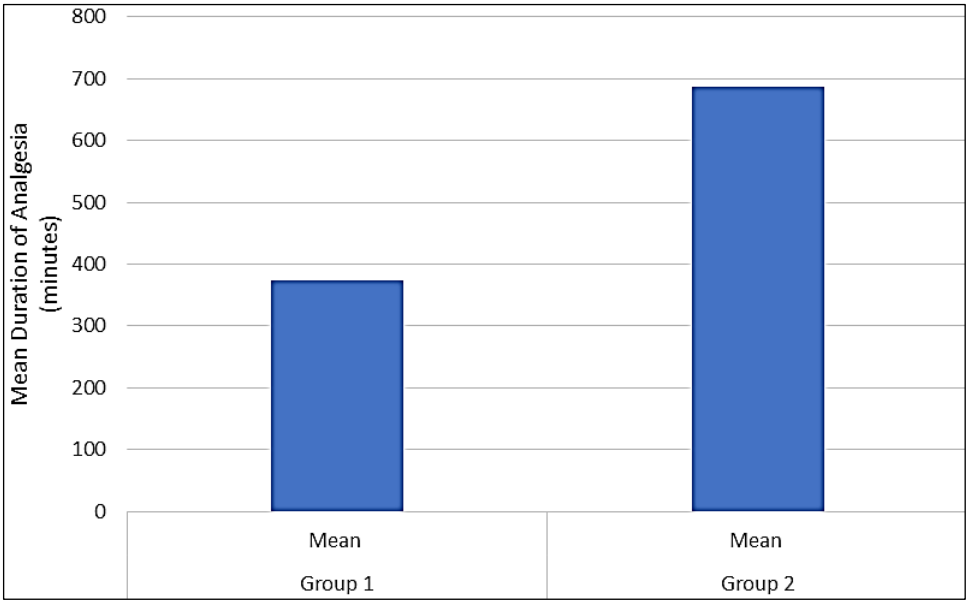
Table 1: Distribution of Age

Parameters	Group 1		Group 2		Mean Difference	p value
	Mean	SD	Mean	SD		
Age (years)	40.53	0.856	41.87	1.064	1	0.05



Graph 1: Graphical representation of Distribution of Age (years)

Graph 2 shows mean duration of analgesia was 373.75 minutes with SD of 66.15 in Bupivacaine group and 687 minutes with SD of 119.43 in Ropivacaine group with a mean difference of 313.25. The difference was highly significant in Group 2 compared to Group 1 ($p < 0.0001$).



Graph 2: Graphical representation of Distribution of Analgesia

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Table 2 shows in group 1, first rescue analgesia was required in 26 patients between 6-8 hours. Remaining 4 patients required between 8-10 hours. In group 2, 24 patients required the first rescue after 10 hours, 4 patients required between 6-8 hours and remaining 2 patients required between 8-10 hours.

Table 2: Rescue doses

First Rescue Dose	Group 1	Group 2
Between 6 and 8 hours	26	4
Between 8 and 10 hours	4	2
After 10 hours	0	24
Total	30	30

There were no complications associated with Erector spinae plane block and drug related adverse effects in either group.

Discussion

There is an increase in the number of patients with lumbar diseases and a large number of them need lumbar spine surgery [10]. As there is obvious pain after lumbar spine surgery, postoperative analgesia is often needed. However, patient-controlled intravenous analgesia and epidural analgesia, which are commonly used postoperatively and have their limitations. Side effects such as nausea and vomiting caused by postoperative opiod use result in poor postoperative experience, reduce patient satisfaction and are not conducive to rapid recovery [11]. In fact, neuraxial techniques may be complicated with headache, backache, unintended dural punctures and puncture site hemorrhage. Neuraxial ultrasound may help improve the safety. Epidural hematoma, epidural abscess and intracord injections are rare but serious complications that need more attention [12]. In addition, neuraxial techniques have disadvantages such as hypotension, urinary retention and being limited to the patient who has spine fracture or spine surgery. Paraneuraxial nerve blocks such as Erector spinae plane block may have an advantage in success rate and analgesic efficacy.

A study by Luis -Navarro JC *et al*., concluded that Erector spinae plane block was initially described for postoperative pain control or analgesic rescue when other techniques failed. In our experience, however, intra-operative use reduces the need for intravenous analgesics during surgery. Our experience with unilateral Erector blockade during laparoscopic nephrectomy shows a high rate of success and no complications related to either catheter placement or continuous administration of local anaesthetic [13, 14, 15]. This discovery encourages us to continue to use it as the first-line analgesia as part of multimodal analgesia, replacing the use of the epidural catheter. The experience with bilateral blockades in abdominal surgery has also been positive. It is a useful alternative to the epidural catheter or intradural anaesthesia, especially when there are contraindications to these techniques or their performance is difficult or unsuccessful. In another study by Ezzzt M. Siam *et al*., concluded that Erector spinae plane block can be considered safe and effective perioperative analgesic modality for lumbar spine simple decompression surgery. It helps in controlled hypotensive anaesthetic technique and decreases inhalational anaesthetics and intraoperative opioid requirements.

Renee J.C. van den Broek *et al*., concluded that implementing the Erector spinae plane block for Posterior lumbar interbody fusion surgery as standard care in our center has caused a significant reduction in postoperative pain and length of hospital stay, most likely by allowing earlier mobilization. Amit Goyal *et al*., concluded that Erector spinae plane block is feasible and effective for Perioperative analgesia in cervical and thoracic spine surgeries without adverse effects [16, 17]. The benefits included intraoperative hemodynamic stability, good perioperative analgesia, avoidance of opioids, and early ambulation in the postoperative period.

Another study by Oezel L *et al*., concluded that ultrasound guided Erector spinae plane block for lumbar spine Surgery was associated with zero complications, no interference with intraoperative neuromonitoring or the early postoperative neurological examination, and low incidence of poorly controlled pain in the post anaesthesia care unit [18, 19, 20]. These results help to establish procedure specific risks and benefits of Erector spinae plane block for spine surgery.

Rishi M. Kanna *et al*., concluded that in patients undergoing Posterior cervical spine surgery, Erector spinae plane block is a safe and effective technique with better outcomes than standard multimodal analgesia alone, in terms of reduced intraoperative opioid requirements and blood loss, better postoperative analgesia and early mobilization.

Seok Kyeong Oh *et al*., concluded that Erector spinae plane block provided effective postoperative analgesia resulting in better patient satisfaction and recovery with decreased postoperative nausea and vomiting in patients undergoing lumbar surgery compared to control.

In our study duration of post-operative analgesia was 373.75 minutes with SD of 66.1512 in Bupivacaine group and 687 minutes with SD of 119.433 in Ropivacaine group. The difference was statistically highly significant ($p < 0.0001$). Concerning hemodynamics, in our study there were no statistically significant

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changes in pulse rate and systolic blood pressure between two groups in first 24 hours (p>0.05). However, at 6, 12 and 18 hours, there were significantly lower pulse rates and systolic blood pressure in Group 2 compared to Group 1 (p<0.05). There were no statistically significant changes in diastolic blood pressure between two groups in first 24 hours (p>0.05). The first rescue dose was needed between 6-8 hours post-operatively in as many as 26 patients in group 1 unlike just 4 patients in group 2. On the other hand, 24 patients in group 2 needed the first rescue dose after 10 hours postoperative hours.
In our study, we have not come across any local or systemic complications with either group. However, resuscitation measures in case of toxicity or drug reaction were kept ready, including Steroids, Intralipid 20% and Defibrillator.

Conclusion

Thus, we conclude that 0.5% Ropivacaine provided longer duration of analgesia than 0.25% Bupivacaine when used in ultrasound guided Erector spinae plane block for providing post-operative analgesia after Lumbar spine surgeries. Also, the requirement of first rescue analgesia was at a later time in Ropivacaine group compared to Bupivacaine. So, looking to safety profile, longer duration of post-operative analgesia and patient satisfaction, 0.5% Ropivacaine can be used for ultrasound guided Erector spinae plane block. Overall, the findings were suggestive that ultrasound guided Erector spinae plane block may be an effective component of a multimodal approach to pain management in the post-operative period in patient with lumbar spine surgeries.

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