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Vishwanath S Bhaire
Consultant and Head of Neuroanaesthesia, Yashoda Hospital, Secunderabad, Hyderabad, Telangana, India

Saladi Sailaja
Department of Anaesthesia, Yashoda Hospital, Secunderabad, Hyderabad, Telangana, India

Gajanan Fultambkar
Consultant Anaesthesia, Yashoda Hospital, Secunderabad, Hyderabad, Telangana, India

Niharika Mustari
Department of Anaesthesia, ESI Hospital, Sanath Nagar Hyderabad, Telangana, India

Mohammad Ali Abu Taha
Junior Consultant, Neuroanaesthesia Yashoda Hospital, Secunderabad, Hyderabad, Telangana, India

P Rajeshwar
Consultant and Head Anaesthesia, Yashoda Hospital, Secunderabad, Hyderabad, Telangana, India

Corresponding Author:
Niharika Mustari
Department of Anaesthesia, ESI Hospital, Sanath Nagar Hyderabad, Telangana, India

A prospective, randomised controlled study of comparing efficacy of dexmedetomidine versus dexamethasone as adjuvant to 0.2% ropivacaine in erector spinae plane block for lumbar spine surgeries

Vishwanath S Bhaire, Saladi Sailaja, Gajanan Fultambkar, Niharika Mustari, Mohammad Ali Abu Taha and P Rajeshwar

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Abstract
Background: Major lumbar spine surgeries cause severe postoperative pain. The aim of this randomized controlled study is to compare analgesic efficacy of dexmedetomidine to dexamethasone as an adjuvant to ropivacaine in erector spinae plane block for lumbar spine surgeries.
Materials and Methods: A total of 60 patients, categorized into ASA grading I, II and III were randomly allocated into Group A and Group B of 30 each. Group a received 30 ml drug (28 ml of 0.2% Ropivacaine + 1mcg/kg dexmdetomidine diluted to 2 ml). Group B received 30 ml drug (28 ml of 0.2% Ropivacaine + 8mg of dexamethasone 2 ml).
Results: The study revealed intra operative analgesic requirement and mean pain score was significantly less in dexmedetomidine compared to dexamethasone (113.67 vs 131.67 mcg: $p<0.01$). Mean time requirement of first analgesia was significantly longer in dexmedetomidine group (8.27 hrs vs 6.67 hrs; $p<0.01$) and mean time for ambulation was significantly shorter in cases of dexmedetomidine group (1.8 vs 2.94 days; $p<0.01$). No significant difference with regard to age, sex, weight, ASA grade between the two groups. Duration of surgery, mean pulse rate, systolic blood pressure, diastolic blood pressure, mean arterial pressure and SPO2 were comparable between two groups.
Conclusion: Addition of Dexmedetomidine to Ropivacaine in an erector spinae block for lumbar spine surgeries leads to a reduction in total opioid consumption, need for rescue analgesia, a shorter postoperative recovery time and a quicker time for mobilization compared to Dexamethasone.

Keywords: Erector spinae plane block, dexmedetomidine, dexamethasone

Introduction
The management of postoperative pain is crucial for enhancing patient comfort, facilitating early mobilization and accelerating recovery. Specifically, proficient postoperative pain management has been demonstrated to be effective in diminishing perioperative morbidity. Furthermore, it leads to a reduction in perioperative opioid use, associated complications and consequently, a shorter hospital stay [1]. It is well known that patients with lumbar spine surgery often experience excruciating postoperative pain, which hinders their ability to get out of bed early and hinders their recuperation [2].
Although Patient-Controlled Analgesia (PCA) with opioids is prone to opioid-related side effects, it is frequently used in clinical settings. Epidural injection, in particular, is linked to complications such as infections, hematomas and additional adverse events [3]. In cases where the postoperative pain of the lumbar spine remains inadequately managed, it may evolve into chronic pain, adversely impacting the quality of life of patients [4].
Erector Spinae Plane Block (ESPB) has captured the attention of numerous experts in nerve block techniques. It might decrease the use of pain-relieving medications during the recovery period after lower back surgery [5]. Lowering the need for pain medications during the recovery phase is advantageous for quick recovery and cutting down hospital costs [6]. Some studies have shown that ESPB might provide more effective pain relief than epidural injections [7].
Dexmedetomidine is a strong α2 agonist which is recognized as a supportive agent for regional anaesthesia and pain relief. It can prolong the duration of nerve block anaesthesia

when combined with a local anaesthetic and its side effects are minimal [8]. It is believed to function by decreasing the production of inflammatory substances and by inhibiting potassium channel mediated discharge of C fibres [9]. Studies on humans have shown that those treated with dexamethasone experienced a longer period of sensory and motor blockage compared to those in the control group [10].
Current study aims to compare analgesic efficacy of dexmedetomidine versus dexamethasone as perineural adjuvant to 0.2% ropivacaine in erector spinae plane block for lumbar spine surgeries.

Materials and Methods

Study design: A prospective, randomized and double blinded controlled study.

Study sample: This study included ASA Grade I, II, and III inpatients between 21 to 75 years of age posted for elective lower lumbar spine surgery.

Study site: The current study is a single-centre, hospital-based investigation conducted from December 2020 to August 2021 in the Department of Anaesthesiology, Yashoda Hospital, Secunderabad, Telangana, India.

Inclusion criteria: Participants scheduled for elective lumbar spine surgeries between 21 to 75 years of age with physical condition of ASA I, II, or III, and Body Mass Index (BMI) between 18 and 35 kg/m^2 were included.

Exclusion criteria: Participants who were unable to provide informed consent, allergies to local anaesthetics or medications, peripheral neuropathy, BMI over 35 kg/m^2, schizophrenia, bipolar disorder, drug or alcohol abuse, under tricyclic antidepressants, serotonin-norepinephrine, tramadol, morphine uptake on a daily basis were excluded from the study.
All 60 cases were randomly segregated into Group A and Group B of each comprising 30 cases. Group A (Ropivacaine + dexmedetomidine) received 28 ml of 0.2% Ropivacaine plus 1mcg/kg dexmedetomidine diluted to 2 ml with NS (15 ml on each side) while Group B (Ropivacaine + dexamethasone) received 28 ml of 0.2% Ropivacaine along with 8mg of dexamethasone 2 ml (15 ml on each side). A comprehensive pre-anaesthetic assessment was conducted 24 hours prior to the scheduled procedure. Patients were premedicated with Pantoprazole 40 mg orally and Alprazolam 0.5 mg orally. On the morning of the study, all patients underwent preparation for intravenous access. After the connection of multi-parameter monitors, including Electrocardiogram (ECG), pulse oximeter, and Non-Invasive Blood Pressure (NIBP) monitors, baseline parameters were recorded. General anaesthesia was administered through a blend of glycopyrrolate at a dosage of 0.01 mg/kg, ondansetron at a concentration of 0.1 mg/kg, fentanyl at a rate of 1 mcg/kg, Propofol administered was between 1.5 -2.5 mg/kg and Atracurium of 0.5 mg/kg, serve as a muscle relaxant. The endotracheal tube was inserted and mechanical ventilator was fixed. The patient's heart rate and blood pressure were continuously monitored. Time of recovery was noted from time of administering reversal drugs. Patients were extubated and then shifted to post anaesthesia unit and monitored.

Erector spinae plane block technique: The ESP block was performed after induction of general anaesthesia with patients in prone position. A low-frequency probe was placed in a longitudinal orientation along the midline. Subsequently, the probe was scanned laterally, to visualize the para-spinous muscles and the transverse process simultaneously. A needle was advanced in cephalad to caudad direction, in plane under real time ultra sound guidance, until reaching transverse process.

Statistical analysis: SPSS Version 21.0 was used for data analysis and Microsoft Excel 2010 for graphical representation. Qualitative data was depicted through frequency and percentages and association among qualitative variables was evaluated using Chi-Square and Fisher's exact tests. When the quantitative data between the two groups satisfied the Normality test it was analysed using unpaired t-tests when it did not Mann Whitney tests were used and was summarized with Mean ± Standard Deviation. A $p< 0.05$ was considered statistically significant.

Results

Table 1 reveal that the average age of the study cohort was 49.68 years, with no significant disparity observed between the two groups (p = 0.26). Out of 60 cases, present study encompassed 63.3% females and 36.7% males. Furthermore, the analysis indicated that 28.3% of the cases were classified in ASA grade I, 55% in grade II and 16.7% in grade III, with no discernible difference between the groups (p = 0.43). The mean weight of the participants was found comparable across the two groups, with a difference of 0.8 Kg (60.5 vs 64.3 Kg; p = 0.07).

Table 1: Age, Gender, and ASA grade, and weight comparison among study groups

Characteristics	Group		Total	*P*
	Ropivacaine + Dexmedetomidine (A)	Ropivacaine + Dexamethasone (B)		
Age (Mean±SD) (Years)	30 (48.13±15.51)	30 (51.23±11.36)	60	0.26
Female	21(70.0%)	17(56.7%)	38(63.3%)	0.422
Male	9(30.0%)	13(43.3%)	22(36.7%)	
Total	30(100%)	30(100%)	60(100%)	
ASA grade				
Grade 1	10(33.3%)	7(23.3%)	17(28.3%)	0.43
Grade 2	14(46.7%)	19(63.3%)	55(10%)	
Grade 3	6 (20.0%)	4 (13.3%)	10(16.7%)	
Total	30(100%)	30(100%)	60(100%)	
Weight (Kg)	30(60.50±6.09)	30(64.30±9.40)	60(100%)	0.07

Table 2 revealed that the average duration of surgery remained same across both study groups, with no significant difference (p = 0.12). Furthermore, the need for analgesia during the intraoperative period was significantly higher (p=0.02) in cases where dexamethasone was utilized, (131.67 mcg) compared to dexmedetomidine (113.67 mcg). Additionally, the time required for the analgesia was notably longer in cases treated with dexmedetomidine as opposed to dexamethasone (8.27 hrs. vs 6.67 hrs; p<0.01). The total consumption of tramadol in the post-operative period was also significantly higher in cases treated with dexamethasone compared to dexmedetomidine (67.18 vs 39.17 mcg; p<0.01). Only five cases of which 4 in the dexamethasone group and 1 dexmedetomidine group required additional analgesia within the first 48 hours with a p-value of 0.35 suggesting no significant difference. The mean time for ambulation was found to be significantly shorter in cases treated with dexmedetomidine compared to the dexamethasone group (1.8 vs 2.94 days; p<0.01).

Table 3 represented that the average pulse rate at the onset and throughout the procedure was comparable across the study groups (p> 0.05). Similarly, the mean arterial pressure at the beginning and during the procedure was also comparable between the groups (p > 0.05).

Table 2: Comparison among study groups as per different parameters

Variables	Group	Total number (N)	Mean ±SD	*P*
Duration of surgery(min)	Dexmedetomidine(A)	30	109.53±13.09	0.12
	Dexamethasone (B)	30	115.13±14.11	
Intraop Analgesia				
Total Fentanyl Requirement (mcg)	Dexmedetomidine(A)	30	116.67±23.97	0.02
	Dexamethasone (B)	30	131.67±24.51	
Time for rescue Analgesia (hrs)	Dexmedetomidine(A)	30	8.27±2.20	<0.01
	Dexamethasone (B)	30	6.67±1.99	
Postop Analgesia				
Total Tramadol consumption (mcg)	Dexmedetomidine(A)	30	39.17±45.61	<0.01
	Dexamethasone (B)	30	67.18±53.08	
Time for mobilization (Days)	Dexmedetomidine(A)	30	1.80±0.81	<0.01
	Dexamethasone (B)	30	2.94±0.90	
Additional Rescue Analgesia				
No	Bupivacaine (B)	30	29(96.7%)	<0.01
	Ropivacaine (R)	30	26(86.7%)	
Yes	Bupivacaine (B)	30	1(3.3%)	0.11
	Ropivacaine (R)	30	4(13.3%)	
Total	Bupivacaine (B)	30	100.0%	0.35
	Ropivacaine (R)	30	100.0%	

Table 3: Comparison among study groups as per pulse rate and mean arterial pressure

	Pulse Rate		P	Mean Arterial pressure		P
	Dexmedetomidie (A) Mean± SD	Dexamethasone (B) Mean± SD		Dexmedetomidine (A) Mean± SD	Dexamethasone (B) Mean± SD	
Base line	82.13±11.24	83.03±16.20	0.804	94.33±8.13	95.20±6.98	0.66
At Intubation	80.67±12.02	85.80± 14.84	0.146	85.70±14.76	88.97±15.85	0.41
Post-block	81.56± 11.09	83.03±16.20	0.332	92.77±6.69	95.20±6.98	0.53
5 mins	68.87±8.15	74.27±13.16	0.061	98.77±15.54	105.37±19.31	0.09
10 mins	69.43±8.32	73.73±13.31	0.119	103.13±16.23	109.83±17.14	0.06
15 mins	67.40±7.98	72.80±13.07	0.058	99.67±12.76	104.60±18.00	0.23
30 mins	68.33±7.46	71.47±13.33	0.219	95.33±11.53	100.63±13.87	0.11
45 mins	66.13±7.35	69.97±13.07	0.130	92.13±11.67	93.70±13.76	0.64
60 mins	65.86±7.19	69.53±12.64	0.070	93.29±7.90	96.73±11.36	0.10
75 mins	66.15±7.27	69.77±12.63	0.120	89.11±8.06	93.83±10.67	0.07
90 mins	67.08±7.26	71.32±13.91	0.130	90.63±7.44	92.24±12.63	0.59
At Extubation	92.37±11.64	91.30±14.51	0.755	105.00±6.90	106.27±10.50	0.58

Table 4 depicts that the mean systolic blood pressure at the baseline and throughout the procedure between the study groups was comparable (p>0.05). Similarly, the mean diastolic blood pressure at the baseline and throughout the procedure between the study groups is also comparable (p>0.05). Results also shows that the average oxygen saturation levels at the onset and throughout the procedure were equivalent across the study groups (p>0.05). Furthermore, the average pain score was notably reduced in patients administered dexmedetomidine as compared to those receiving dexamethasone, from the two-hour post-operative period till 48 hours (p<0.05) (Table 5).

Table 4: Comparison among study groups as per systolic blood pressure and diastolic blood pressure

	Systolic blood pressure		P	Diastolic blood pressure		P
	Dexmedetomidie (A) Mean± SD	Dexamethasone (B) Mean± SD		Dexmedetomidine (A) Mean± SD	Dexamethasone (B) Mean± SD	
Base line	129.47±12.74	129.20 ±11.77	0.93	77.67±7.07	77.03±8.17	0.75
At Intubation	116.13±15.40	119.13±17.29	0.48	70.30±14.44	73.07±14.98	0.47
Post-block	126.00±11.39	129.20±11.77	0.39	76.63±5.89	77.03±8.17	0.62
5 mins	129.30±19.39	138.67±22.44	0.09	79.10±15.79	87.00±16.72	0.07
10 mins	137.63±19.33	145.03±23.02	0.18	83.43±15.97	90.00±15.20	0.11
15 mins	132.73±15.62	138.10±23.65	0.30	83.77±13.16	85.97±14.20	0.058
30 mins	127.63±15.84	131.40±17.84	0.39	79.53±11.43	83.90±12.30	0.16
45 mins	123.17±13.75	124.50±18.29	0.75	77.13±12.51	78.23±11.94	0.73
60 mins	124.25±10.48	128.43±14.10	0.33	74.61±9.59	79.57±10.26	0.06
75 mins	124.41±10.62	127.17±12.39	0.32	73.30±9.53	77.27±8.87	0.11
90 mins	123.63±9.96	126.96±16.66	0.40	74.88±8.48	75.16±10.59	0.92
At Extubation	146.33±8.61	147.33±15.68	0.76	76.33±80.90	80.90±10.26	0.17

Table 5: Comparison among study groups as per oxygen saturation levels and NRS score

	Oxygen Saturation levels		P		NRS score		P
	Dexmedetomidie(A) Mean± SD	Dexamethasone(B) Mean± SD		NRS	Dexmedetomidine (A) Mean± SD	Dexamethasone (B) Mean± SD	
Base line	99.40±0.67	99.37±0.93	0.87	2 hrs	0.93±0.74	1.90±1.13	<0.01
At Intubation	99.93±0.25	99.87±0.35	0.40	4 hrs	2.70±0.95	3.63±1.54	<0.01
Post-block	99.98±0.12	99.37±0.93	0.57	8 hrs	3.20±1.21	3.83±1.39	0.04
5 mins	99.80±0.31	99.63±0.49	0.27	12 hrs	2.20 ±1.10	2.97±1.27	0.02
10 mins	99.80±0.31	99.50±0.51	0.19	24 hrs	1.60±0.67	2.50±0.86	<0.01
15 mins	99.90±0.31	99.53±0.51	0.13	48 hrs	1.03±0.85	1.90±1.13	<0.01
30 mins	99.93±0.25	99.50±0.51	0.12	-	-	-	-
45 mins	99.90±0.31	99.60±0.50	0.14	-	-	-	-
60 mins	99.76±0.36	99.43±0.63	0.09	-	-	-	-
75 mins	99.65±0.36	99.47±0.63	0.33	-	-	-	-
90 mins	99.72±0.46	99.44±0.51	0.12	-	-	-	-
At Extubation	99.70±0.47	99.47±0.51	0.12	-	-	-	-

Discussion

Major spine surgeries often result in moderate to severe pain, particularly in the lower back. Despite employing various pain relief strategies, patients frequently require high doses of opioids, which lead to adverse effects and hinder patients mobility, prolong their hospital stay. Erector Spinae Plane Block (ESPB) is a simple, safe and highly effective Ultrasound (US)-guided interfascial plane block which minimizes the need for pain medication, thereby accelerating recovery and reducing hospital expenses [11].

In the current study, no difference was observed between the study groups with regards to demographic, ASA grading and duration of surgery. We also observed no difference between the two groups with regards to hemodynamic variables i.e., mean pulse rate, blood pressure and oxygen saturation. In our study, the dexmedetomidine group experienced significantly lower postoperative mean pain scores than the dexamethasone group. Additionally, the dexmedetomidine group demonstrated superior outcomes during the intraoperative and postoperative periods. Post-operative analgesia is a perceived key benefit of the ESP block which would block not only spinal nerve roots but also rami communicate transmitting sympathetic fibres, thus leading to relief from visceral pain [12]. In the current study, we observed that mean time for requirement of first analgesia was significantly longer in dexmedetomidine group as compared to dexamethasone group. Song *et al*. showed a reduction in the postoperative pain in the cases administered with ropivacaine in combination with dexmedetomidine (RM) at awakening and at subsequent postoperative intervals compared to those administered ropivacaine with dexamethasone (RS) [13]. Furthermore, the total use of Patient-Controlled Analgesia (PCA), length of hospital stay, rate of rescue analgesia was all significantly lower in the RM group compared to the RS group. These findings are in line with the current results [14].

In our study, we found that the total consumption of opioids, specifically tramadol, was significantly reduced in patients managed with dexmedetomidine post-operatively, compared to those managed with dexamethasone. Zhang P *et al*. in their research noted that the duration of analgesia was longer, and the total consumption of postoperative opioids was lower in the dexmedetomidine group [15].

In the current research, it was noted that the average duration of ambulation was notably reduced in participants assigned to the dexmedetomidine group, in contrast to those allocated to the dexamethasone group. Gao Z *et al*. conducted a comparable study and reached the conclusion that dexmedetomidine is efficacious in managing acute pain, facilitating an earlier onset of ambulation [16]. Concurrently, similar findings were observed in the study conducted by Gupta R *et al*. [17].

Conclusion

Dexmedetomidine, used as an adjuvant to 0.2% ropivacaine in erector spinae plane block for lumbar spine surgeries, provide effective intraoperative analgesia, postoperative analgesia, and reduced the time of first analgesia compared to dexamethasone. It also shortened postoperative recovery time and time for mobilisation of patients and thus can be recommended as an adjuvant to ropivacaine for erector spinae block in lumbar spinal surgeries.

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Declarations

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- **Conflict of interest:** None declared
- **Ethical approval:** Not required

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