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COMPARISON OF DEXAMETHASONE AND DEXMEDETOMIDINE AS AN ADJUVANT TO ROPIVACAINE IN USG-GUIDED ERECTOR SPINAE PLANE BLOCK FOR POST OPERATIVE PAIN RELIEF IN LUMBAR SPINE SURGERIES

Anaesthesiology

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ABSTRACT

Background: Postoperative pain following lumbar spine surgery is often intense due to paraspinal muscle dissection, bony manipulation, and neural tissue handling. Ultrasound-guided erector spinae plane block provides effective regional analgesia, and the addition of adjuvants to ropivacaine may enhance block duration and reduce opioid requirement.**Objectives:** To compare the efficacy and safety of dexamethasone and dexmedetomidine as adjuvants to 0.375% ropivacaine in ultrasound-guided erector spinae plane block for postoperative analgesia in patients undergoing lumbar spine surgery.**Materials and Methods:** This randomized, single-blind, comparative clinical study included 80 ASA I–II patients aged 18–60 years undergoing elective lumbar spine surgery. Patients were divided into two groups of 40 each. The dexamethasone group received 8 mg dexamethasone with 0.375% ropivacaine, while the dexmedetomidine group received 1 µg/kg dexmedetomidine with 0.375% ropivacaine for bilateral ESP block. VAS scores, rescue analgesia, fentanyl consumption, and adverse effects were recorded.**Results:** VAS scores were significantly lower in the dexmedetomidine group from 1 to 24 hours ($p < 0.001$). Rescue analgesia was delayed, with 52.5% requiring no rescue analgesia. Fentanyl consumption was significantly lower with dexmedetomidine (31.4 ± 33.6 µg vs 183.0 ± 40.9 µg; $p < 0.001$). Hypotension and bradycardia were not significantly different.**Conclusion:** Dexmedetomidine was more effective than dexamethasone as an adjuvant to 0.375% ropivacaine in ultrasound-guided ESP block for lumbar spine surgery, providing lower pain scores, longer analgesic duration, and reduced fentanyl consumption, without a statistically significant increase in haemodynamic adverse events.

KEYWORDS

Dexmedetomidine; Dexamethasone; Ropivacaine; ESP Block; Lumbar Spine Surgery; Postoperative Analgesia.

INTRODUCTION

Postoperative pain after lower-thoracic and lumbar spinal fusion is a major perioperative concern because surgical exposure involves paraspinal muscle dissection, bony manipulation, and neural tissue handling, resulting in substantial nociceptive stimulation and delayed functional recovery. Evidence from a prospective randomized trial in neurosurgical lower-thoracic and lumbar fusion supports the perioperative role of ultrasound-guided erector spinae plane block as an analgesic component in spine surgery.[1] Although ropivacaine-based wound infiltration has been evaluated in lumbar spinal fusion, the addition of dexamethasone or dexmedetomidine did not consistently prolong analgesia, indicating uncertainty regarding the optimal adjuvant strategy.[2]

In posterior lumbar spine surgery, combining dexmedetomidine with ropivacaine for erector spinae plane block has been shown to reduce postoperative pain and opioid consumption, highlighting its potential clinical value in this patient group.[3] Systematic review evidence also supports the analgesic efficacy of erector spinae plane block in lumbar spine surgery, with reductions in postoperative pain scores and perioperative analgesic requirements.[4] Dexmedetomidine has demonstrated analgesic-prolonging and opioid-sparing effects when added to ropivacaine for ultrasound-guided erector spinae plane block in major thoracic surgery, although haemodynamic monitoring remains clinically relevant.[5]

Across spinal surgical procedures, pooled evidence indicates that erector spinae plane block reduces postoperative opioid use and improves pain outcomes.[6] In lumbar spine surgery specifically, direct comparison of dexamethasone and dexmedetomidine as adjuvants to 0.375% ropivacaine in ESP block provides a clinically relevant basis for evaluating adjuvant efficacy and safety.[7] Existing lumbar-spine-focused reviews further describe ESP block as an emerging regional analgesic technique, while emphasizing the need for additional high-quality comparative studies.[8]

Adjuvant selection remains important because dexamethasone and dexmedetomidine may differ in analgesic duration, opioid-sparing effect, sedation profile, and haemodynamic response. Comparative regional anaesthesia evidence supports the relevance of both agents as adjuncts to ropivacaine.[9] Bilateral ultrasound-guided ESP block has been shown to improve postoperative analgesia after lumbar spine surgery.[10] Indian spine-surgery evidence using ropivacaine with dexmedetomidine also supports opioid-sparing benefit in a local clinical context.[11] Further comparative ESP block evidence suggests that dexmedetomidine may provide superior analgesic prolongation compared with dexamethasone in some surgical settings.[12] Therefore, this study is required to determine a safe, effective, and context-appropriate ESP block adjuvant regimen for Indian patients undergoing lumbar spine surgery.

MATERIAL AND METHODS

Study Design: This was a randomized, single-blind, comparative clinical study conducted to compare dexamethasone and dexmedetomidine as adjuvants to 0.375% ropivacaine in ultrasound-guided erector spinae plane block for postoperative analgesia in lumbar spine surgery.

Study Setting: The study was conducted at BRD Medical College, Gorakhpur, a government tertiary care teaching institution with facilities for neurosurgical and orthopaedic spine procedures and ultrasound-guided regional anaesthesia.

Study Population: Adult patients aged 18–60 years, belonging to ASA physical status I–II, scheduled for elective lumbar spine surgery under general anaesthesia were included after written informed consent.

Sample Size: A total of 80 patients were enrolled and randomly allocated into two equal groups of 40 each. Group I received

dexamethasone 8 mg with 0.375% ropivacaine, while Group II received dexmedetomidine 1 µg/kg with 0.375% ropivacaine. In both groups, 20 mL of the study drug solution was administered on each side for bilateral ESP block.

Inclusion Criteria: Patients aged 18–60 years, scheduled for lumbar spine surgery, and classified as ASA physical status I–II were included.

Exclusion Criteria: Patients refusing consent, those with coagulopathy, infection at the block site, or ASA physical status III–IV were excluded.

Data Collection and Investigations: All patients underwent standard pre-anaesthetic assessment and intraoperative monitoring. VAS pain scores were recorded at 0, 1, 2, 4, 6, 12, 18, and 24 hours postoperatively, along with duration of analgesia, first rescue analgesia time, 24-hour fentanyl requirement, haemodynamic parameters, and adverse events.

Intervention and Postoperative Analgesia: Bilateral ultrasound-guided erector spinae plane block was performed under real-time sonographic visualization at the level of the transverse process. Postoperatively, all patients received intravenous paracetamol 15 mg/kg every 8 hours. Intravenous fentanyl 1 µg/kg was administered as rescue analgesia whenever VAS exceeded 4.

Ethical Consideration: The study was approved by the College Research Council and Institutional Human Ethics Committee of BRD Medical College, Gorakhpur. Written informed consent was obtained from all participants, with confidentiality maintained throughout.

Statistical Analysis: Data were analyzed using SPSS version 24. Continuous variables were compared using independent t-test or Mann–Whitney U test, while categorical variables were analyzed using Chi-square or Fisher's exact test. A p-value <0.05 was considered statistically significant.

RESULTS

Table 1. Distribution of Age Groups Across Study Groups (N = 80).

Age Group (years)	Dexamethasone (n= 40) (%)	Dexmedetomidine (n= 40) (%)	Total (N=80) (%)	p-value
18–30	11 (27.5%)	8 (20.0%)	19 (23.8%)	
31–45	18 (45.0%)	18 (45.0%)	36 (45.0%)	
46–60	11 (27.5%)	14 (35.0%)	25 (31.2%)	
Total	40 (100%)	40 (100%)	80 (100%)	0.659

χ^2 test applied.

Table 1 shows that age distribution was comparable between the two study groups. Most patients belonged to the 31–45 years age group in both groups (45.0% each). The 46–60 years category was slightly higher in the dexmedetomidine group. However, the difference was not statistically significant (p = 0.659).

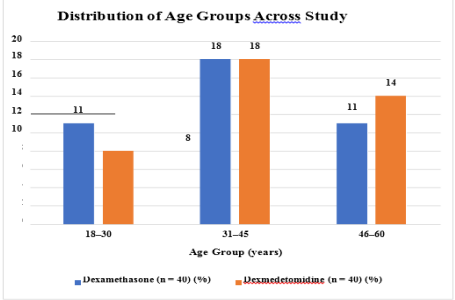

Figure1. Distribution of Age Groups Across Study Groups (N = 80).

Table 2. Distribution of Planned Surgical Procedures Across Study Groups (N = 80).

Procedure Category	Dexamethasone (n = 40) (%)	Dexmedetomidine (n = 40) (%)	Total (N= 80) (%)	p-value
Microdiscectomy / Discectomy	18 (45.0%)	18 (45.0%)	36 (45.0%)	
Laminectomy / Decompression	13 (32.5%)	13 (32.5%)	26 (32.5%)	
Fusion Procedures	9 (22.5%)	9 (22.5%)	18 (22.5%)	
Total	40 (100%)	40 (100%)	80 (100%)	1.00

χ^2 test applied.

Table 2 shows that the distribution of planned surgical procedures was identical in both groups. Microdiscectomy/discectomy was the most common procedure (45.0%), followed by laminectomy/ decompression (32.5%) and fusion procedures (22.5%). The difference was not statistically significant (p = 1.00), confirming comparable surgical distribution between groups.

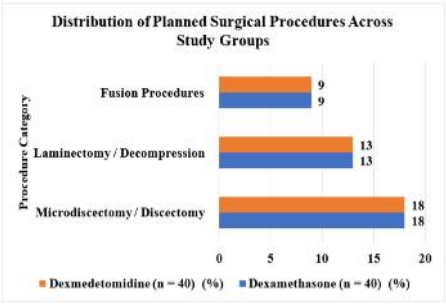

Figure 2. Distribution of Planned Surgical Procedures Across Study Groups (N = 80).

Table 3. Comparison of Postoperative VAS Scores at Different Time Intervals Between Study Groups Using Welch's ANOVA (N = 80).

Time Interval	Dexamethasone (n = 40) Mean ± SD	Dexmedetomidine (n = 40) Mean ± SD	p-value
VAS 0h	0.20 ± 0.41	0.10 ± 0.30	0.216
VAS 1h	1.73 ± 0.45	1.03 ± 0.16	<0.001*
VAS 2h	2.40 ± 0.50	1.50 ± 0.51	<0.001*
VAS 4h	3.18 ± 0.39	2.20 ± 0.41	<0.001*
VAS 6h	3.73 ± 0.45	2.50 ± 0.51	<0.001*
VAS 12h	4.73 ± 0.45	3.30 ± 0.46	<0.001*
VAS 18h	5.55 ± 0.50	3.83 ± 0.39	<0.001*
VAS 24h	5.73 ± 0.45	4.45 ± 0.55	<0.001*

Table 3 shows that postoperative VAS scores were comparable at 0 hour between the two groups (p = 0.216). From 1 hour onward, VAS scores were significantly lower in the dexmedetomidine group at all intervals (p < 0.001), indicating superior and sustained postoperative analgesia compared with dexamethasone.

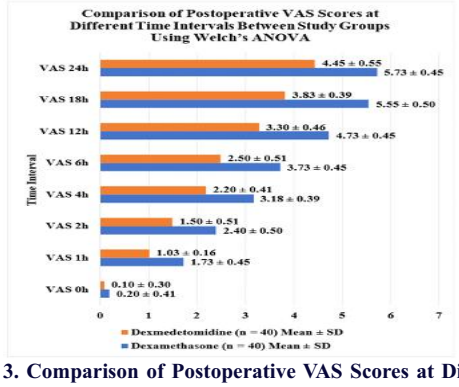

Figure 3. Comparison of Postoperative VAS Scores at Different Time Intervals Between Study Groups Using Welch's ANOVA (N = 80).

Table 4. Comparison of Time to First Rescue Analgesia Between Study Groups (N = 80)

Time to First Rescue Analgesia (hours)	Dexamethasone Group (n = 40) n (%)	Dexmedetomidine Group (n = 40) n (%)	p-value
No rescue required	0 (0.0%)	21 (52.5%)	<0.001*

24 hours	0 (0.0%)	19 (47.5%)	
18 hours	11 (27.5)	0 (0.0%)	
12 hours	29 (72.5)	0 (0.0%)	
Total	40 (100%)	40 (100%)	

Table 4 shows a significantly prolonged time to first rescue analgesia in the dexmedetomidine group. More than half of these patients required no rescue analgesia, while the remaining required it only at 24 hours. In contrast, all dexamethasone patients required rescue analgesia by 12–18 hours ($p < 0.001$).

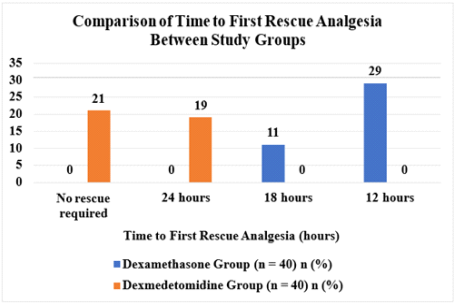

Figure 4. Comparison of Time to First Rescue Analgesia Between Study Groups (N = 80)

Table 5. Comparison of Total Fentanyl Consumption in 24 Hours Between Study Groups (N = 80)

Variable	Dexamethasone Group (n = 40) Mean ± SD	Dexmedetomidine Group (n = 40) Mean ± SD	t-value	df	p-value
Total fentanyl consumption in 24 h (µg)	183.0 ± 40.9	31.4 ± 33.6	18.1	78	<0.001 *

Table 5 demonstrates that total fentanyl consumption in the first 24 hours was significantly lower in the dexmedetomidine group compared with the dexamethasone group. The mean requirement was 31.4 ± 33.6 µg versus 183.0 ± 40.9 µg, respectively, showing a marked opioid-sparing effect with dexmedetomidine ($p < 0.001$).

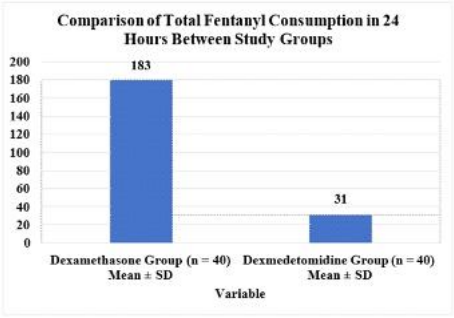

Figure 5. Comparison of Total Fentanyl Consumption in 24 Hours Between Study Groups (N = 80)

Table 6. Comparison of Hypotension and Bradycardia Between Study Groups (N = 80).

Variable	Outcome	Dexamethasone (n = 40) n (%)	Dexmedetomidine (n = 40) n (%)	Total (n = 80) n (%)	χ^2 Value	Df	p-value
Hypotension	Yes	5 (12.5%)	10 (25.0%)	15 (18.8%)	2.0 5	1	0.1 52
	No	35 (87.5%)	30 (75.0%)	65 (81.2%)			
Bradycardia	Yes	4 (10.0%)	8 (20.0%)	12 (15.0%)	1.5 7	1	0.2 10
	No	36 (90.0%)	32 (80.0%)	68 (85.0%)			

Table 6 shows that hypotension and bradycardia were more frequent in the dexmedetomidine group than in the dexamethasone group. However, the differences were not statistically significant for hypotension (25.0% vs 12.5%, p = 0.152) or bradycardia (20.0% vs 10.0%, p = 0.210), indicating a comparable safety profile.

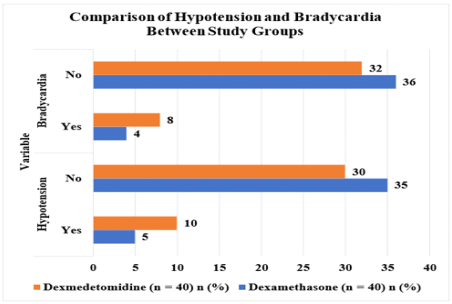

Figure 6. Comparison of Hypotension and Bradycardia Between Study Groups (N = 80).

DISCUSSION

Age distribution was comparable between the dexamethasone and dexmedetomidine groups, with 11 patients (27.5%) versus 8 patients (20.0%) in the 18–30-year category, 18 patients (45.0%) in each group in the 31–45-year category, and 11 patients (27.5%) versus 14 patients (35.0%) in the 46–60-year category, showing no significant difference (p = 0.659). Similar demographic balance was reported by Gupta et al. (2021)[7] in 60 lumbar spine surgery patients and Yi-Han et al. (2022)[3] in 120 posterior lumbar spine surgery patients. Bellantonio et al. (2023)[1] and Gao et al. (2019)[12] also maintained comparable adult randomized groups. Mohta et al. (2019)[11] differed by including patients aged 15 years or older.

The distribution of planned surgical procedures was identical between groups, with microdiscectomy/discectomy in 18 patients (45.0%) each, laminectomy/decompression in 13 patients (32.5%) each, and fusion procedures in 9 patients (22.5%) each, producing complete comparability (p = 1.00). This procedural balance reduces confounding from variation in surgical trauma and postoperative pain intensity. Comparable lumbar surgical designs were used by Gupta et al. (2021)[7], Yi-Han et al. (2022)[3], and Singh et al. (2020)[10], all assessing ESP block-based analgesia in lumbar spine surgery. Bellantonio et al. (2023)[1] and Li et al. (2023)[2] focused more heavily on fusion procedures, differing from this dataset where fusion formed only 22.5% of cases.

Postoperative VAS scores were similar at 0 hour in the dexamethasone and dexmedetomidine groups (0.20 ± 0.41 vs 0.10 ± 0.30; p = 0.216). From 1 hour onward, scores were significantly lower with dexmedetomidine, including 1 hour (1.03 ± 0.16 vs 1.73 ± 0.45), 12 hours (3.30 ± 0.46 vs 4.73 ± 0.45), and 24 hours (4.45 ± 0.55 vs 5.73 ± 0.45), all $p < 0.001$. Similar analgesic superiority was noted by Yi-Han et al. (2022)[3], Gupta et al. (2021)[7], Gao et al. (2019)[12], and Singh et al. (2020)[10]. In contrast, Li et al. (2023)[2] found no clinically meaningful benefit of either adjuvant during wound infiltration.

Time to first rescue analgesia was significantly prolonged in the dexmedetomidine group, where 21 patients (52.5%) required no rescue analgesia and 19 patients (47.5%) required rescue only at 24 hours, while all patients in the dexamethasone group required rescue analgesia at either 12 hours (29 patients, 72.5%) or 18 hours (11 patients, 27.5%), with a significant difference ($p < 0.001$). Similar prolongation of analgesia with dexmedetomidine was reported by Yi-Han et al. (2022)[3], Gupta et al. (2021)[7], Wang et al. (2022)[5], and Gao et al. (2019)[12]. Singh et al. (2020)[10] and Liang et al. (2021)[6] also observed delayed rescue analgesic requirement with ESP block. In contrast, Li et al. (2023)[2] reported no significant prolongation of analgesia with either dexamethasone or dexmedetomidine in wound infiltration.

Total fentanyl consumption over 24 hours was markedly lower in the dexmedetomidine group compared with the dexamethasone group, with mean consumption of 31.4 ± 33.6 µg versus 183.0 ± 40.9 µg, respectively, and the difference was statistically significant (t = 18.1, df = 78, $p < 0.001$). This opioid-sparing effect is similar to findings by Yi-Han et al. (2022)[3], where dexmedetomidine with ropivacaine reduced postoperative opioid and flurbiprofen-axetil consumption, and Gupta et al. (2021)[7], where dexmedetomidine reduced tramadol use compared with dexamethasone. Bellantonio et al. (2023)[1], Oh et al. (2022)[4], and Singh et al. (2020)[10] also reported reduced opioid requirement with ESP block. In contrast, Li et al. (2023)[2] found no significant reduction in hydromorphone use with dexamethasone or

dexmedetomidine wound infiltration. Hypotension occurred in 10 patients (25.0%) in the dexmedetomidine group and 5 patients (12.5%) in the dexamethasone group, while bradycardia occurred in 8 patients (20.0%) and 4 patients (10.0%), respectively. Although these events were numerically higher with dexmedetomidine, the differences were not statistically significant for hypotension ($\chi^2 = 2.05$, df = 1, p = 0.152) or bradycardia ($\chi^2 = 1.57$, df = 1, p = 0.210), indicating comparable clinical safety. Similar manageable haemodynamic profiles were described by Yi-Han et al. (2022)[3], Gupta et al. (2021)[7], Wang et al. (2022)[5], and Gao et al. (2019)[12]. Singh et al. (2020)[9] also noted that dexmedetomidine and dexamethasone were clinically acceptable as ropivacaine adjuvants. The unique observation here is that dexmedetomidine had greater analgesic benefit despite numerically higher, statistically insignificant haemodynamic events.

CONCLUSION

Overall, the findings support the study hypothesis that dexmedetomidine is a more effective adjuvant than dexamethasone when combined with 0.375% ropivacaine for ultrasound-guided erector spinae plane block in lumbar spine surgery. Both groups were well matched for age and surgical procedure distribution, reducing baseline and operative confounding. The dexmedetomidine group demonstrated significantly lower postoperative VAS scores from 1 to 24 hours, prolonged time to first rescue analgesia, and markedly reduced 24-hour fentanyl consumption, indicating stronger and more sustained analgesic efficacy. Although hypotension and bradycardia were numerically higher with dexmedetomidine, the differences were not statistically significant, suggesting an acceptable safety profile under standard perioperative monitoring. These outcomes are clinically relevant because they indicate improved opioid-sparing analgesia without a significant increase in adverse haemodynamic events, supporting dexmedetomidine as a preferable adjuvant in this protocol.

REFERENCES

1. Bellantonio D, Bolondi G, Cultrera F, Lofrese G, Mongardi L, Gobbi L, Sica A, Bergamini C, Viola L, Tognù A, Tosatto L. Erector spinae plane block for perioperative pain management in neurosurgical lower-thoracic and lumbar spinal fusion: a single-centre prospective randomised controlled trial. BMC anesthesiology. 2023 May 30;23(1):187.
2. Li W, Ali KA, Deng X, Li Y, Fang Z. Dexamethasone and dexmedetomidine as adjuvants to ropivacaine do not prolong analgesia in wound infiltration for lumbar spinal fusion: a prospective randomized controlled study. Journal of orthopaedic surgery and research. 2023 Sep 4;18(1):654.
3. Yi-Han W, Rong T, Jun L, Min W, Yan Z, Yi L, Jie-Ting L, Sheng-Hui H. Dexmedetomidine combined with ropivacaine for erector spinae plane block after posterior lumbar spine surgery: a randomized controlled trial. BMC Musculoskeletal Disorders. 2022 Mar 11;23(1):235.
4. Oh SK, Lim BG, Won YJ, Lee DK, Kim SS. Analgesic efficacy of erector spinae plane block in lumbar spine surgery: a systematic review and meta-analysis. Journal of clinical anesthesia. 2022 Jun 1;78:110647.
5. Wang Q, Li H, Wei S, Zhang G, Ni C, Sun L, Zheng H. Dexmedetomidine added to ropivacaine for ultrasound-guided erector spinae plane block prolongs analgesia duration and reduces perioperative opioid consumption after thoracotomy: a randomized, controlled clinical study. The Clinical Journal of Pain. 2022 Jan 1;38(1):8-14.
6. Liang X, Zhou W, Fan Y. Erector spinae plane block for spinal surgery: a systematic review and meta-analysis. The Korean Journal of Pain. 2021 Oct 1;34(4):487-500.
7. Gupta R, Nasar N. Comparison of dexamethasone and dexmedetomidine as adjuvant to 0.375% ropivacaine in erector spinae plane block for lumbar spine surgery: A randomized, double blind, placebo control trial. Int J Med Anesthesiol. 2021 Oct 1;4:30-.
8. Qiu Y, Zhang TJ, Hua Z. Erector spinae plane block for lumbar spinal surgery: a systematic review. Journal of pain research. 2020 Jul 1:1611-9.
9. Singh N, Gupta S, Kathuria S. Dexmedetomidine vs dexamethasone as an adjuvant to 0.5% ropivacaine in ultrasound-guided supraclavicular brachial plexus block. Journal of Anaesthesiology Clinical Pharmacology. 2020 Apr 1;36(2):238-43.
10. Singh S, Choudhary NK, Lalin D, Verma VK. Bilateral ultrasound-guided erector spinae plane block for postoperative analgesia in lumbar spine surgery: a randomized control trial. Journal of neurosurgical anesthesiology. 2020 Oct 1;32(4):330-4.
11. Mohta M, Rani A, Sethi AK, Jain AK. Efficacy of local wound infiltration analgesia with ropivacaine and dexmedetomidine in tubercular spine surgery–A pilot randomised double-blind controlled trial. Indian journal of anaesthesia. 2019 Mar 1;63(3):182-7.
12. Gao Z, Xiao Y, Wang Q, Li Y. Comparison of dexmedetomidine and dexamethasone as adjuvant for ropivacaine in ultrasound-guided erector spinae plane block for video-assisted thoracoscopic lobectomy surgery: a randomized, double-blind, placebo-controlled trial. Annals of translational medicine. 2019 Nov;7(22):668.