Int J Physiol Pathophysiol Pharmacol 2025;17(5):169-176
www.ijppp.org /ISSN:1944-8171/IJPPP0167700

Original Article

Bupivacaine with methylprednisolone in ESP block reduces postoperative pain and opioid consumption after lumbar spine surgery

Masoud Nashibi[1], Parisa Sezari[1,2], Farhad Safari[1,2], Arash Aziznezhad[3], Ali Kheiandish[4], Saleh Shahsavari[5], Hasanali Ahmadi[6], Atieh Sadat Moosavi Tarshizi[2], Niloofar Deravi[7], Sogol Asgari[6]

[1]Anesthesiology Research Center, Shahid Beheshti University of Medical Sciences, Tehran, Iran; [2]Department of Anesthesiology, School of Medicine, Shahid Beheshti University of Medical Sciences, Tehran, Iran; [3]Universal Scientific Education and Research Network (USERN), Tehran, Iran; [4]Department of Pharmacology, School of Medicine, Iran University of Medical Sciences, Tehran, Iran; [5]Department of Surgery, Shohadaye Tajrish Hospital, Shahid Beheshti University of Medical Sciences, Tehran, Iran; [6]Skull Base Research Center, Loghman Hakim Hospital, Shahid Beheshti University of Medical Sciences, Tehran, Iran; [7]Student Research Committee, School of Medicine, Shahid Beheshti University of Medical Sciences, Tehran, Iran

Received July 25, 2025; Accepted October 23, 2025; Epub October 25, 2025; Published October 30, 2025

Abstract: Background: Postoperative pain management in spine surgery is challenging. While opioids are effective, their significant adverse effects, including respiratory depression, necessitate opioid-sparing strategies. The Erector Spinae Plane (ESP) block has emerged as a promising regional technique. This study investigates whether the addition of methylprednisolone to bupivacaine in an ESP block enhances postoperative analgesia and reduces opioid consumption in patients undergoing lumbar spine surgery. Method: This prospective, randomized clinical trial (Ethical Approval ID: IR.SBMU.RETECH.REC.1403.467) included 64 patients (18-65 years) for two- or three-level lumbar spine surgery. Patients were randomized into two groups: the control group (bupivacaine alone) and the intervention group (bupivacaine combined with methylprednisolone). Data were collected on intraoperative metrics (e.g., fluid therapy, blood loss, operation time), opioid consumption, postoperative pain scores (NRS), incidence of nausea and shivering, blood glucose levels, and need for rescue analgesia up to one month post-surgery. Results: The methylprednisolone group showed significantly lower narcotics consumption (intraoperatively and in the PACU). The pain level (NRS) was also lower in this group for up to four weeks post-operation. There were no significant inter-group differences in surgery duration, anesthetic consumption, bleeding, or the incidence of nausea and chills. Conclusion: The use of methylprednisolone as an adjuvant to bupivacaine in the ESP block improves the quality and duration of analgesia in spine surgery patients. However, the transient elevation in blood glucose levels highlights the need for careful glucose monitoring.

Keywords: Methylprednisolone, postoperative pain, erector spinae plane block, bupivacaine, lumbar vertebrae

Introduction

Numerous procedures are conducted annually in hospitals with varying facilities and technologies. Pain management after spine procedures is widely viewed as a significant difficulty [1]. Effectively managing and alleviating post-surgery pain has several key objectives: minimizing pain intensity, mitigating the physical and psychological complications resulting from pain for the patient, their family, and society, enhancing patient outcomes post-surgery, and reducing the duration and expenses patients incur during their hospital stay, thereby improving their satisfaction with the care provided [2, 3].

Effective pain management necessitates the collaboration of multidisciplinary teams. Understanding various painkillers and their distinct properties is crucial when selecting the most suitable medication for managing postoperative pain [4]. Studies indicate that many surgeons and doctors on a patient's pain manage-

https://doi.org/10.62347/YWW08879

ment team often do not prescribe adequate doses of opioids due to concerns about respiratory depression and other side effects, despite opioids being crucial for post-surgery pain control. Opioids are essential components of intravenous and general anesthesia [5]. Reducing opioid usage is vital due to its adverse consequences, including delayed recovery from general anesthesia, unwanted drowsiness, nausea, and potentially hazardous respiratory depression [6]. The critical need for reducing opioid use is further underscored by its severe adverse consequences, including delayed recovery from general anesthesia, unwanted drowsiness, nausea, and respiratory depression, which can be hazardous [7, 8]. Specifically in lumbar spine surgery, opioid-induced respiratory depression and the resulting hypercapnia are critical concerns. These complications can significantly increase venous pressure, which leads to augmented epidural venous bleeding. This bleeding obscures the surgical field, potentially prolongs the operation time, and increases blood loss and the need for blood transfusion. Therefore, optimizing regional analgesic techniques, such as the Erector Spinae Plane (ESP) block, to minimize perioperative opioid requirements is vital for enhancing patient safety and improving surgical conditions [8].

Various techniques, such as medications and nerve blocks, have been suggested to decrease narcotic usage during surgery. In 2016, Forero and colleagues introduced the erector spinae nerve block for managing thoracic discomfort [9]. It soon became an alternative method to control and reduce pain caused by various pathologies, including pain after thoracotomy and major abdominal surgeries, and acute or chronic pain in the thoracic, abdominal, and lumbar regions [10].

Anesthetic management during the intraoperative period is a key factor in achieving both rapid recovery from surgery and patient comfort [11]. Furthermore, optimization of anesthetic depth, analgesic protocols, and ventilation strategies have all been linked to decreased intraoperative opioid consumption, faster emergence, and improved hemodynamic stability. It has been demonstrated that multimodal analgesia and regional blocks can reduce extubation time [12]. From the perspective of minimizing postoperative opioid consumption and enhancing postoperative analgesia, the ESP block may serve a valuable function as a supplement to general anesthesia [13].

Since decreasing the use of volatile anesthetics and opioids may reduce complications, facilitate recovery, and enhance outcomes, this study aimed to evaluate the effect of combining methylprednisolone with bupivacaine for the ESP block on postoperative pain, opioid consumption, and recovery in lumbar spine surgery. This randomized clinical trial aimed to determine whether the bupivacaine-methylprednisolone combination provides superior analgesia and decreased opioid consumption during the perioperative period compared to bupivacaine alone. We hypothesized that the addition of methylprednisolone to the bupivacaine-based ESP block would significantly reduce postoperative pain scores and total opioid consumption in patients undergoing lumbar spine surgery, compared to the bupivacaine-only group.

Method

Study design and ethical status

This prospective, randomized, double-blind clinical trial included patients admitted to Loghman Hakim Hospital, Tehran, Iran, for elective two- or three-level lumbar spine surgery, conducted from May 2024 to November 2024. The study was approved by the Research Ethics Committee of Shahid Beheshti University of Medical Sciences (Ethical Approval ID: IR.SBMU.RETECH.REC.1403.467) and adhered to the principles outlined in the Declaration of Helsinki. Written informed consent was obtained from all participants prior to their inclusion.

Participants and groups

A total of 64 patients, aged 18 to 65 years with an American Society of Anesthesiologists (ASA) physical status of I or II, scheduled for elective two- or three-level lumbar spine surgery, were enrolled. Exclusion criteria included patient refusal, allergy to local anesthetics, severe coagulopathy, local infection at the injection site, history of chronic pain or daily analgesic use, severe systemic diseases (e.g., severe renal or liver failure), pregnancy, or the pres-

ence of non-electromagnetic compatible devices (e.g., a pacemaker). Participants were randomly allocated into two parallel groups (n=32 per group) using a computer-generated random number table: the Bupivacaine (B) Group and the Methylprednisolone-Bupivacaine (MB) Group. The allocation sequence was concealed in sealed, opaque envelopes to maintain blinding.

Anesthetic and block procedure

Standard monitoring included electrocardiography, non-invasive blood pressure, and pulse oximetry. Anesthesia was induced and maintained using standard protocols (propofol, atracurium, and isoflurane). During the surgery, the end-tidal concentration of isoflurane was maintained at 0.8-1.2 MAC, and Fentanyl was administered as needed to maintain a stable heart rate and mean blood pressure (within 20% of baseline).

Before the surgical incision, a bilateral ultrasound-guided Erector Spinae Plane (ESP) block was performed at the level of the surgical site. The Bupivacaine Group received 20 ml of 0.25% Bupivacaine solution bilaterally. The Methylprednisolone-Bupivacaine Group received 20 ml of 0.25% Bupivacaine combined with 40 mg of Methylprednisolone bilaterally. The block was performed by an anesthesiologist who was blinded to the study groups.

Outcomes measurement and data collection

Both the patient and the postoperative data collector were blinded to the group assignment. Data were collected on demographic characteristics, intraoperative metrics, and postoperative outcomes.

Primary outcome: The primary outcome was postoperative pain intensity, assessed using the Numerical Rating Scale (NRS) at 1, 12, and 24 hours post-operation, and during the follow-up period at 1, 2, 3, and 4 weeks.

Secondary and safety outcomes: The secondary outcomes included: (1) Intraoperative Metrics: Total amounts of Isoflurane and Fentanyl used, duration of surgery (min), fluid therapy (mL), blood loss (mL), need for packed red blood cell transfusion, and extubation duration (min). (2) Postoperative Recovery Parameters: Total opioid consumption (Fentanyl) during the recovery unit stay, the incidence and degree of shivering (assessed by a validated scale), incidence of nausea and vomiting, duration until the first request for a painkiller in the ward, and the need for other rescue analgesics. (3) Safety Outcome: Blood glucose levels were monitored at baseline, upon arrival in the post-anesthesia care unit (PACU), and at 12 hours post-operatively.

Statistical analysis

All quantitative variables were expressed as the mean ± standard deviation (SD), and qualitative variables as number (percentage). The normality of quantitative variables was assessed using the Kolmogorov-Smirnov test. For normally distributed continuous variables, comparisons between groups were performed using the independent Student's t-test; for non-normally distributed variables, the Mann-Whitney U test was applied. Categorical variables were analyzed using Pearson's Chi-square test or Fisher's exact test when expected frequencies were less than 5. Repeated measures of postoperative pain scores (NRS at multiple time points) were analyzed using repeated-measures ANOVA with Bonferroni correction for post-hoc comparisons. All statistical tests were performed in a two-tailed manner using SPSS version 27.0 software (IBM, Armonk, NY, USA). A p-value <0.05 was considered statistically significant.

Results

The baseline characteristics of groups

A total of 61 patients were included in this prospective, randomized clinical trial, with 29 patients assigned to the Bupivacaine (B) Group and 32 patients assigned to the Methylprednisolone-Bupivacaine (M) Group. Overall, 24 patients (39.3%) were men, consisting of 15 (51.7%) in the B group and 9 (28.1%) in the M group. Patients in Group B had an average age of 50.97±11.105 years, while those in Group M had an average age of 48.97±10.857 years. There was no significant difference in age between the two groups (P=0.374). All patients were classified as either ASA class I or II (B group: 18 Class I, 11 Class II; M group: 23 Class I, 9 Class II). No statistically significant differ-

Table 1. The baseline characteristics of patients

		Bupivacaine	Methylprednisolone	*P*-Value
Gender, %	Male	51.7	28.1	0.052
	Female	48.3		
Age, year		50.97±11.105	48.97±10.857	0.374
ASA Class, %	I	62.1	71.9%	0.294
	II	37.9	28.1	
PSF Levels		2.55±0.506	2.31±0.535	0.625

Abbreviations: ASA, American Society of Anesthesiologists; PSF, Posterior Spinal Fusion.

ence was found between the two groups regarding ASA classification (P=0.294) or the number of vertebral column levels that underwent manipulation (P>0.05) (**Table 1**).

Clinical outcomes

The patient's condition and operative parameters were monitored and recorded.

Intraoperative and recovery metrics: Patients in Group B received an average of 2172.31± 436.624 mL of fluids, while patients in Group M received 2900.00±987.339 mL, which was a significantly lower requirement in the Bupivacaine-only group (P=0.001). The duration of surgery (B: 151.72±38.272 min vs. M: 167.19±73.998 min) and the time required for extubation (B: 8.52±4.413 min vs. M: 10.06±7.215 min) were not significantly different between the groups (P=0.304 and P=0.313, respectively). Similarly, no significant differences were observed in blood loss (B: 418±204.159 mL vs. M: 511.88±394.637 mL, P=0.260), packed red blood cell transfusion (P=0.637), or isoflurane consumption (P=0.221) (**Table 2**).

Opioid consumption and rescue analgesia: The consumption of fentanyl was significantly lower in the Methylprednisolone group (M) both intraoperatively (8.839±1.56 μg) compared to the Bupivacaine group (B) (22.573±15.52 μg, P=0.004), and during recovery (M: 4.419± 0.78 μg vs. B: 10.887±6.03 μg, P=0.020). Regarding rescue analgesia in the recovery unit, three patients (10.3%) from Group B and nine patients (28.1%) from Group M required other non-fentanyl rescue drugs (morphine, pethidine, ketorolac, or Apotel); however, this difference was not statistically significant (P= 0.076). Conversely, the number of patients requesting pain relief in the general ward was significantly higher in the Bupivacaine group (16 patients, 55.2%) compared to the Methylprednisolone group (9 patients, 28.1%, P=0.04). The time until the first request for a painkiller in the ward was 6.673±15.5 hours for Group B and 12 hours for Group M, but the difference was not statistically significant (P=0.053).

Postoperative pain scores (NRS): The postoperative pain level, assessed by the NRS scale, was recorded at multiple time points up to four weeks.

(1) In the early postoperative period, patients in Group M exhibited significantly lower pain levels at 1 hour (3.31±1.615 vs. 2.24±1.746, P=0.016) and 12 hours (3.31±1.655 vs. 4.41±1.615, P=0.011).

(2) In the extended period, patients in the Bupivacaine group (B) reported significantly lower pain scores at the end of the first day (24 hours) and throughout the follow-up weeks (1, 2, 3, and 4 weeks) (P<0.001 for all time points).

Safety outcomes: The incidence and degree of shivering in the recovery unit were evaluated. Patients in Group B had an average shivering score of 0.412±0.21, while no patient in Group M experienced shivering, indicating a significant difference. Five patients from Group B and two from Group M experienced nausea during recovery, but this difference was not statistically significant (P=0.241).

Blood glucose levels, monitored at baseline, in the recovery unit (PACU), and at 12 hours postoperatively, showed that Group B had significantly higher blood glucose levels during recovery (Group B: 100% normal vs. Group M: 81.3% normal, P=0.016). However, no significant difference was observed 12 hours following surgery (P=0.271) (**Table 2**).

Discussion

Erector Spinae Plane Block (ESPB) has emerged as a novel approach for reducing postoperative pain across various surgical procedures, including spine surgery [14]. In this pro-

Table 2. The statistical analysis of clinical outcomes of patients during operation

		Bupivacaine	Methylprednisolone	*P*-Value
Fluids, mL		2172.31±436.624	2900.00±987.339	0.001
Blood loss, mL		418±204.159	511.88±394.637	0.260
Blood transfusion (received packed red blood cells)		0.28±0.455	0.34±0.653	0.637
Isoflurane, mL		21.03±5.241	23.75±10.701	0.221
Operation time, min		151.72±38.272	167.19±73.998	0.304
Extubating duration, min		8.52±4.413	10.06±7.215	0.313
Incidence of nausea, n		5	2	0.241
fentanyl	Intraoperative	22.573±15.52	8.839±1.56	0.004
	During recovery	10.887±6.03	4.419±0.78	0.020
Pain level of patients based on the NRS scale, mean ± SD	1 hour	2.24±1.746	3.31±1.615	0.016
	12 hours	4.41±1.615	3.31±1.655	0.011
	24 hours	6.69±0.967	1.69±1.091	0.000
	1 week	5.83±0.848	1.13±1.157	0.000
	2 weeks	4.00±0.926	0.38±0.907	0.000
	3 weeks	2.83±1.256	0.16±0.628	0.000
	4 weeks	3.41±0.825	0.16±0.628	0.000
Blood glucose	Base	100% normal	96.9% normal	0.525
	PACU	100% normal	81.3% normal	0.016
	12 hours	100% normal	93.8% normal	0.271

Abbreviations: NRS, Numerical Rating Scale; SD, Standard Deviation, PACU, Post-Anesthesia Care Unit.

spective randomized clinical trial, we investigated the effects of the ESPB using bupivacaine, both alone and in combination with methylprednisolone, aiming to enhance analgesia, optimize painkiller use, and reduce perioperative complications in patients undergoing Posterior Spinal Fusion (PSF) surgery. Consistent with this goal, a network meta-analysis by Hong et al. in 2023 supported the use of ESPB and other regional analgesic techniques, such as the thoracolumbar interfascial plane (TLIP) block and wound infiltration (WI), for lumbar spinal surgery due to their significant opioid consumption reduction [15].

Regarding pain scores, our results showed that methylprednisolone decreased pain levels at 1 and 12 hours after surgery. Conversely, the bupivacaine-only group reported significantly lower pain levels at the end of the first day (24 hours) and throughout the follow-up weeks (1, 2, 3, and 4 weeks). This finding suggests that while the steroid provides a potent early analgesic boost, bupivacaine alone may offer a better pain profile in the prolonged postoperative period. Overall, bupivacaine alone appears to be associated with better pain control during the extended postoperative follow-up. This aligns partly with the findings of Jowkar et al., who investigated the effect of continuous bupivacaine injection via an intra-incisional catheter compared to morphine for lumbar spine stabilization surgeries. Their intervention group, receiving bupivacaine via catheter plus postoperative morphine, showed that continuous bupivacaine infusion more efficiently reduced postoperative pain, particularly in the early hours, consequently reducing morphine consumption postoperatively [16].

Yawata et al. compared intraoperative remifentanil and postoperative fentanyl consumption, VAS scores, and side effects (including nausea) between an ESPB group and an opioid-based analgesia group in lumbar spine surgery candidates. Although they found the VAS score in the short postoperative period in the ESPB group was approximately half that of the control group, the difference was not statistically significant [17]. Furthermore, case reports by Peksoz and colleagues demonstrated that ESPB combined with methylprednisolone and bupivacaine effectively reduced pain in patients with lumbar disc herniation (LDH) and post-herpetic neuralgia (PHN) [18, 19].

Consistent with the opioid-sparing goal, our study found that the use of fentanyl as an analgesic agent was significantly lower in the methylprednisolone group compared to the bupivacaine-only group. While Jowkar et al. showed that bupivacaine decreased morphine consumption, having a third group using morphine would have indeed allowed for a more comprehensive comparison [16]. Additionally, Ersyli et al. evaluated the efficacy of local tissue infiltration protocols using bupivacaine or bupivacaine-methylprednisolone for pain relief after lumbar discectomy. They reported significantly better results across various protocols compared to the control group, noting that the bupivacaine-methylprednisolone infiltration groups had lower parenteral opioid requirements after surgery and shorter hospital stay [20]. The study by Yawata et al. similarly showed that ESPB significantly reduced remifentanil consumption intraoperatively in lumbar spine surgery patients, although the total postoperative fentanyl consumption difference was not statistically significant [17].

Regarding side effects, the study by Ersyli et al. reported lower incidences of nausea in the groups receiving local tissue infiltration with bupivacaine or bupivacaine-methylprednisolone [20]. Our results, however, showed only two patients in the methylprednisolone group experienced nausea compared to five in the bupivacaine group, but this difference was not statistically significant. Gao et al. demonstrated that using dexmedetomidine as an adjuvant to ropivacaine in ESPB prolonged sensory block duration, provided effective acute pain control, and required less rescue analgesia after video-assisted thoracoscopic lobectomy surgery (VATLS) [21]. Similarly, Siddique et al. showed that co-administering dexamethasone with bupivacaine in ESPB provided better and prolonged analgesia after thoracotomy [22]. Focusing on safety, the study by Tanabe et al. reported that the addition of dexamethasone increased blood glucose levels in non-diabetic patients within the first 24 hours after nerve blockade [23]. Our study also demonstrated that the addition of methylprednisolone to bupivacaine for the ESP block increased the blood glucose levels of patients during recovery. However, no significant difference in blood glucose levels was seen between the two groups 12 hours post-surgery.

Our findings demonstrated that the addition of methylprednisolone to bupivacaine in ESPB significantly reduced opioid consumption and improved analgesia in the early postoperative phase of lumbar spine surgery. To evaluate the effectiveness of the anesthetic intervention on the overall success of lumbar spine surgery, our study monitored several key metrics. The observed reductions in intraoperative opioid use and the associated improvements in perioperative variables - such as decreased blood loss, potentially shorter operation times (due to a less congested surgical field), and longer duration of effective analgesia (NRS up to 4 weeks) - serve as important indirect indicators of improved surgical success and better conditions for functional recovery. Although these results suggest a potential role for steroid adjuvants in multimodal analgesic blocks, caution is warranted due to the single tertiary center study design, limited number of cases, and relatively short follow-up period. Admittedly, these findings cannot be generalized to all surgical patient populations, and the overall benefits of ESPB with steroid adjuvants in perioperative pain control remain controversial. Nevertheless, they provide a clinical rationale for incorporating ESPB with steroid adjuvants into the perioperative pain management plan, which may lead to enhanced quality of recovery and a lower incidence of opioid-related adverse events. Additional multicenter randomized studies are needed to confirm these data.

Conclusion

In conclusion, the ESPB, utilizing both bupivacaine alone and in combination with methylprednisolone, effectively reduces postoperative pain in patients undergoing posterior spinal fusion surgery. The combination with methylprednisolone demonstrated significant analgesic superiority and a greater reduction in opioid consumption during the early recovery phase. Both treatment protocols successfully minimized overall opioid consumption, thereby reinforcing the established benefits of regional analgesia techniques in perioperative care. Given the sustained difference in pain scores over the long term and the transient elevation

in blood glucose associated with the steroid adjuvant, further comparative and dose-optimization studies are warranted to establish the optimal pain management strategy in this specific surgical population.

Disclosure of conflict of interest

None.

Address correspondence to: Dr. Sogol Asgari, Department of Anesthesiology, Skull Base Research Center, Loghman Hakim Hospital, Shahid Beheshti University of Medical Sciences, Kamali Street, Kargar Ave, Tehran 1333635445, Iran. Tel: +98-9127421711; E-mail: drasgari98429@gmail.com

References

[1] Dihle A, Bjølseth G and Helseth S. The gap between saying and doing in postoperative pain management. J Clin Nurs 2006; 15: 469-479.
[2] Imani F. Postoperative pain management. Anesth Pain Med 2011; 1: 6-7.
[3] Small C and Laycock H. Acute postoperative pain management. Br J Surg 2020; 107: e70-e80.
[4] Vadivelu N, Mitra S and Narayan D. Recent advances in postoperative pain management. Yale J Biol Med 2010; 83: 11-25.
[5] Lee J and Kim S. The effects of ultrasound-guided serratus plane block, in combination with general anesthesia, on intraoperative opioid consumption, emergence time, and hemodynamic stability during video-assisted thoracoscopic lobectomy: a randomized prospective study. Medicine (Baltimore) 2019; 98: e15385.
[6] Bohringer C, Astorga C and Liu H. The benefits of opioid free anesthesia and the precautions necessary when employing it. Transl Perioper Pain Med 2020; 7: 152-157.
[7] Hah JM, Bateman BT, Ratliff J, Curtin C and Sun E. Chronic opioid use after surgery: implications for perioperative management in the face of the opioid epidemic. Anesth Analg 2017; 125: 1733-1740.
[8] Fan YZ, Duan YL, Chen CT, Wang Y and Zhu AP. Advances in attenuating opioid-induced respiratory depression: a narrative review. Medicine (Baltimore) 2024; 103: e38837.
[9] Forero M, Adhikary SD, Lopez H, Tsui C and Chin KJ. The erector spinae plane block: a novel analgesic technique in thoracic neuropathic pain. Reg Anesth Pain Med 2016; 41: 621-627.
[10] Melvin JP, Schrot RJ, Chu GM and Chin KJ. Low thoracic erector spinae plane block for perioperative analgesia in lumbosacral spine surgery: a case series. Can J Anaesth 2018; 65: 1057-1065.
[11] Fu G, Xu L, Chen H and Lin J. State-of-the-art anesthesia practices: a comprehensive review on optimizing patient safety and recovery. BMC Surg 2025; 25: 32.
[12] Rauseo M, Mirabella L, Carrideo AA, Padovano FP, Cantatore LP, Vetuschi P, Da Lima S, Paternoster G and Cinnella G. Opioid-sparing anesthesia in cardiac surgery: a meta-analysis. J Cardiothorac Vasc Anesth 2025; 39: 3140-3153.
[13] Sun Q, Zhang C, Liu S, Lv H, Liu W, Pan Z and Song Z. Efficacy of erector spinae plane block for postoperative analgesia lumbar surgery: a systematic review and meta-analysis. BMC Anesthesiol 2023; 23: 54.
[14] Deng K, Huang K and Wu GF. Ultrasound-guided erector spinae plane block in posterior lumbar surgery (Review). Biomed Rep 2024; 20: 95.
[15] Hong B, Baek S, Kang H, Oh C, Jo Y, Lee S and Park S. Regional analgesia techniques for lumbar spine surgery: a frequentist network meta-analysis. Int J Surg 2023; 109: 1728-1741.
[16] Jowkar S, Farbood A, Amini A, Asadi S, Tahvildari BP, Eghbal K, Asmarian N, Parvin V and Zare A. Effect of continuous intra-incisional bupivacaine on postoperative pain in non-traumatic spinal fixation surgeries: a randomized controlled trial. Braz J Anesthesiol 2022; 72: 599-604.
[17] Yawata S, Imamachi N, Hirabayashi M, Yokoi N, Sakura S and Saito Y. Analgesic effect of erector spinae plane block in spine surgery: a randomized controlled trial. Shimane Journal of Medical Science 2023; 40: 23-29.
[18] Peksöz U, Öner Ü and Çelik M. The effectiveness of the erector spinae plane block using methylprednisolone and bupivacaine in postherpetic neuralgia: case series. Agri 2023; 35: 273-277.
[19] PEKSÖZ U and ÇELİK M. Effectiveness of lumbar erector spinae plane block with methylprednisolone and bupivacaine in low back and leg pain due to lumbar disc herniation: case series. Turkiye Klinikleri Journal of Anesthesiology Reanimation 2021; 19.
[20] Ersayli DT, Gurbet A, Bekar A, Uckunkaya N and Bilgin H. Effects of perioperatively administered bupivacaine and bupivacaine-methylprednisolone on pain after lumbar discectomy. Spine (Phila Pa 1976) 2006; 31: 2221-2226.
[21] Gao Z, Xiao Y, Wang Q and 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. Ann Transl Med 2019; 7: 668.

[22] Siddique A, Sadaf S and Ahmad S. Comparison of Bupivacaine versus Bupivacaine plus Dexamethasone in erector spinae plane block for post-thoracotomy analgesia. Medical Journal of South Punjab 2024; 5: 14-20.

[23] Tanabe K, Ishihara T, Nakamura Y, Yoshimura N, Yamaguchi S, Suetsugu R and Iida H. Risk factors of hyperglycemia after nerve blockade with dexamethasone in non-diabetes mellitus patients: a cohort study. Pain Physician 2021; 24: E87-E93.