Nature and Science of Sleep

Elevate Series

Open Access Full Text Article

CLINICAL TRIAL REPORT

Effects of Continuous Erector Spinae Plane Block on the Postoperative Sleep Quality for Patients Undergoing Thoracoscopic Lung Lobe Resection Surgery: A Prospective, Randomized Controlled Trial

Qian Zhang[1,2,*], Xian Lu[3,*], Wen Zhang[4,*], Zhenyu Zhong[5,*], Lili Wang[4], Yuhan Qiao[4], Fei Ling[4], Xinyuan Qiu[4], Yueying Zhang[1,2]

[1]Department of Anesthesiology, The Affiliated Hospital of Xuzhou Medical University, Xuzhou, People's Republic of China; [2]Jiangsu Province Key Laboratory of Anesthesiology, Xuzhou Medical University, Xuzhou, People's Republic of China; [3]Shanghai Key Laboratory of Psychotic Disorders, Shanghai Mental Health Center, Shanghai Jiao Tong University School of Medicine, Shanghai, People's Republic of China; [4]Xuzhou Medical University, Xuzhou, People's Republic of China; [5]Department of Anesthesiology, The First Affiliated Hospital of Ningbo University, Ningbo, People's Republic of China

*These authors contributed equally to this work

Correspondence: Yueying Zhang, Department of Anesthesiology, The Affiliated Hospital of Xuzhou Medical University, Xuzhou, People's Republic of China, Email zyy0218@126.com

Purpose: To investigate the effect of continuous erector spinae plane block (ESPB) on postoperative sleep in patients undergoing thoracoscopic lung lobe resection surgery.

Patients and Methods: Eighty-six patients were randomly assigned into two groups: ESPB group (Group E) or control group (Group P). Group E received ESPB before induction, followed by continuous ESPB analgesia, while Group P received postoperative intravenous controlled analgesia. The Pittsburgh Sleep Quality Index (PSQI) questionnaire was used to assess postoperative sleep disturbance (PSD) on the postoperative day 3 (POD3). The St. Mary's Hospital Sleep Questionnaire (SMH) evaluated sleep quality on the day of surgery and postoperative day 1 (POD1) and postoperative day 2 (POD2). The Identity Consequence Fatigue Scale-10 (ICFS-10) was utilized to evaluate postoperative fatigue status. Numeric Rating Scale (NRS) scores at resting and coughing were recorded at extubation, 6 h, 24 h, 48 h, 72 h after surgery. Consumption of propofol, remifentanil, and remedial analgesics (bucinazine), hospital duration, occurrence of postoperative adverse reactions were documented. Interleukin-6 (IL-6) and interleukin-10 (IL-10) serum levels were measured before surgery, 12 h, 24 h, 48 h after surgery.

Results: The incidence of PSD in group E on POD3 was significantly lower than group P (75% vs 25%). Patients in group E had higher SMH scores than group P on the day of surgery and POD2. Compared with group P, the NRS scores of resting and coughing at all time points, remifentanil and bucinazine consumption, postoperative ICFS-10 scores, the incidence of nausea and vomiting, IL-6 serum levels in group E were significantly decreased. The IL-10 serum levels in group E were significantly higher than those in group P.

Conclusion: The continuous ESPB can improve postoperative sleep quality, alleviate pain, fatigue and inflammation, and reduce the incidence of postoperative nausea and vomiting.

Keywords: continuous erector spinae plane block, thoracoscopic, lung lobe resection, postoperative sleep disturbance

Introduction

Postoperative sleep disturbance (PSD) is a common yet frequently overlooked issue.[1,2] Various factors contribute to PSD, including stress and inflammatory response triggered by surgical trauma,[3,4] endocrine disorders, anesthesia and narcotic drugs,[5,6] postoperative pain and complications,[7,8] noisy external environment, and preoperative anxiety and depression.[9,10] Studies have reported that up to 78% of patients experienced PSD after thoracic surgery.[11] Sleep

Received: 28 May 2024
Accepted: 20 November 2024
Published: 9 December 2024

disruption can lead to early postoperative fatigue, paroxysmal hypoxemia, hemodynamic changes (such as hypertension, arrhythmia, and myocardial infarction),[12] hyperpathia and chronic pain,[13] adverse mood (including anxiety and depression),[14] postoperative cognitive disorders and even stroke,[15–17] all of which negatively affect postoperative recovery. Therefore, enhancing perioperative analgesia and mitigating stress and inflammation resulting from surgical trauma are essential for improving sleep quality and facilitating patient recovery in thoracoscopic surgery. Strategies such as reducing postoperative pain, surgical stress, and inflammatory responses through nerve afferent blockade and minimally invasive techniques show significant promise.

The erector spinae plane block (ESPB) is a novel technique for fascia plane anesthesia that represents a safer, less invasive, and technically simpler alternative to traditional trunk anesthesia methods. It has demonstrated effectiveness in providing postoperative analgesia following thoracoscopic surgery,[18–22] with its analgesic efficacy being non-inferior to that of thoracic epidural analgesia.[23]

Currently, most research on ESPB primarily focuses on postoperative analgesia, with limited investigation into the quality of postoperative recovery, such as sleep. Therefore, this study aims to examine the effects of continuous ESPB on postoperative sleep in patients undergoing thoracoscopic lung lobe resection and to explore its potential mechanisms.

Materials and Methods

Ethics and Registration

The study was conducted at the Affiliated Hospital of Xuzhou Medical University in Xuzhou City, Jiangsu Province, China, from April 2020 to October 2020. It received approval from the hospital's Research Ethics Committee (XYFY2020-KL082) on March 18 and complied with the principles outlined in the Declaration of Helsinki. Written informed consent was obtained from all patients participating in the study. Additionally, the study was registered with the Chinese Clinical Trial Registry (ChicTR1900025979) prior to patient enrollment.

Study Population

The estimated sample size was derived from the results of a preliminary study, which indicated an incidence of PSD of 78% in patients undergoing thoracic surgery. The expected effect size was calculated to detect a 30% reduction in PSD following surgery, employing a two-sided α of 0.05 and a power of 90%. Consequently, a total of 78 patients were deemed necessary for the study. To account for potential loss to follow-up or withdrawal of consent, a total of 86 patients were enrolled in the trial. Participants were randomly assigned to either the Continuous ESPB group (Group E) or the control group (Group P), with 43 cases in each group.

The study employed the following inclusion criteria: (1) Age: 18–75 years; (2) American Society of Anesthesiologists physical status classification (ASA) grade I–III. Patients were excluded based on the following criteria: (1) preoperative Pittsburgh Sleep Quality Index (PSQI) scores greater than 7; (2) pre-existing central nervous system diseases or mental illnesses; (3) obstructive sleep apnea syndrome (OSAS); (4) other endocrine and metabolic disorders (such as thyroid dysfunction or adrenal insufficiency); (5) severe renal or hepatic insufficiency; (6) preoperative Self-Rating Anxiety Scale scores exceeding 50; (7) preoperative Self-Rating Depression Scale cumulative scores greater than 50% of the total; (8) use of sedatives or antidepressants; (9) significant hearing or vision impairments that hinder effective communication with physicians; (10) inability to comprehend the scale's content, resulting in participant rejection; (11) allergies to local anesthetics, infections at the puncture site, abnormal coagulation function, or peripheral nervous system diseases; (12) plans for intensive care unit (ICU) admission post-surgery. Patients were also excluded if they: (1) experienced failure of continuous ESPB; (2) had a change in surgical method to thoracotomy; (3) underwent multiple lobectomies or total lung resections; (4) had unplanned ICU admissions following surgery; (5) canceled the operation; (6) required reoperation; (7) failed to complete follow-up.

Preoperative Visit, Anesthesia, Surgery and Postoperative Management

The PSQI questionnaire was employed to assess the patients' sleep status during the month preceding surgery, with a PSQI score greater than 7 indicating sleep disturbance. Preoperative sleep quality was evaluated using the St. Mary's

Hospital Sleep Questionnaire (SMH), where higher scores reflect better sleep quality. Additionally, preoperative fatigue levels were measured using the Identity Consequence Fatigue Scale-10 (ICFS-10). Anxiety and depression were assessed with the Self-Rating Anxiety Scale (SAS), where a score exceeding 50 indicates anxiety, and the Self-Rating Depression Scale (SDS), with a cumulative score greater than 50% of the total score indicating depression.

All patients received preoperative sedation with dexmedetomidine at a dosage of 1 μg/kg. Group E underwent an ultrasound-guided continuous ESPB prior to anesthesia induction. The T5 spinous process was scanned in the median sagittal position using a linear ultrasound transducer (Mindray DP 9900 plus; Mindray Bio-Medical Electronics, Shenzhen, China). An 18-gauge Tuohy needle (Stimuplex A, B Braun, Melsungen, Germany) was inserted using an in-plane superior-to-inferior approach. The tip of the needle was positioned within the fascial plane on the deep (anterior) aspect of the erector spinae muscle. An epidural catheter was then inserted to a depth of 5 cm, and 20 mL of 0.5% ropivacaine was administered for the block. Pain and temperature block levels were assessed after 15–20 minutes, with careful monitoring for complications such as pneumothorax and intraspinal block.

General anesthesia was induced using midazolam (0.04 mg/kg), etomidate (0.3 mg/kg), sufentanil (0.6 μg/kg), rocuronium (0.8 mg/kg), and dorasetron (12.5 mg). Anesthesia was maintained with sevoflurane (1–2%), remifentanil (0.1–0.3 μg/kg·min), and propofol (2–5 mg/kg·h). Following muscle relaxation, patients underwent double-lumen bronchial tube insertion guided by bronchoscopy. In instances of hypotension, defined as systolic arterial pressure <80 mmHg or mean arterial pressure <60 mmHg, additional fluids and intermittent boluses of ephedrine were administered. Atropine was provided for severe bradycardia (<45 bpm). Flurbiprofen (100 mg) was administered 30 minutes prior to the conclusion of surgery. Both groups received patient-controlled analgesia (PCA) for 48 hours post-surgery. The analgesia pump formulation for group P consisted of sufentanil (2 μg/kg) and tropisetron (10 mg) in 100 mL saline, with a background infusion of 2 mL/h, a bolus of 2 mL, and a lockout time of 15 minutes. In contrast, the formulation for group E included 0.3% ropivacaine (300 mL), with a background infusion of 6 mL/h, a bolus of 8 mL, and a lockout time of 30 minutes. Bucinazine (50 mg) was administered as an adjuvant analgesic rescue medication if the pain score was greater than or equal to four at rest. All patients received intravenous infusions of flurbiprofen axetil (50 mg) every 12 hours while in the ward, along with metoclopramide (10 mg) in cases of persistent nausea (lasting more than 30 minutes) and vomiting occurring more than twice. If severe nausea persisted despite medication, along with urinary retention, dizziness, or pruritus, the PCA pump would be temporarily discontinued. Once these symptoms improved, the PCA pump would be reconnected.

Outcomes

The primary outcome of the study was the incidence of postoperative sleep disturbance (PSD) on postoperative day 3 (POD3). Postoperative sleep disturbance was defined as PSQI scores greater than 7. The secondary outcomes included: SMH scores on the day of surgery (POD0), postoperative day 1 (POD1), and postoperative day 2 (POD2); resting and coughing NRS scores assessed at the time of extubation, as well as at 6 hours, 24 hours, 48 hours, and 72 hours post-surgery; ICFS-10 scores measured three days after surgery; remifentanil consumption; bucinazine consumption within 48 hours postoperatively; incidence of postoperative adverse reactions (including nausea, vomiting, dizziness, and pruritus); length of hospitalization; and serum levels of IL-6 and IL-10.

The PSQI questionnaire consists of a total score and seven components, including subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, presence of sleep disorders, use of sleep medications, and daytime dysfunction in the previous month. The total score ranges from 0 to 21, with higher scores indicating poorer sleep quality. The SMH questionnaire is a self-rating tool to assess inpatients' sleep status over 24 hours. It evaluates seven aspects: depth, quality, satisfaction, daytime functioning, disturbance, and night wake frequency. A higher score on the SMH questionnaire reflects better sleep.

Statistical Analyses

All data were analyzed using SPSS software, version 25.0 (IBM SPSS). We assessed the normality of quantitative variables with the Shapiro–Wilk test and evaluated the homogeneity of variance using the Levene test. Quantitative variables were expressed as mean (SD) or median (IQR). Student's t-tests were employed to compare the mean values of

age, weight, height, and duration of surgery. Mann–Whitney *U*-tests were utilized to analyze preoperative scores for the SAS, SDS, PSQI, and SMH, as well as intraoperative remifentanil consumption, postoperative bucinazine consumption, and duration of hospitalization. Qualitative variables were reported as frequencies and proportions. The χ^2-test and Fisher's exact test were used to compare ASA classification, gender, and the incidence of PSD. Additionally, a two-way repeated-measures analysis of variance, with a Bonferroni correction for multiple comparisons, was conducted to evaluate postoperative pain scores, SMH scores, and serum levels of IL-6 and IL-10. *P*-values less than 0.05 for two-tailed tests were considered statistically significant.

Results

A total of 86 cases were initially included in the study, with 5 cases subsequently excluded (3 cases converted to thoracotomy and 2 cases admitted to the ICU post-surgery), resulting in 81 cases available for statistical analysis. The demographic data, including gender, age, BMI, ASA grade, smoking status, and surgery duration, were comparable between the two groups. Additionally, there were no significant differences in preoperative SAS and SDS scores, PSQI scores, and ICFS-10 scores between the groups. Continuous ESPB was successfully performed on all patients in Group E, and no ESPB-related adverse events (such as local anesthetic toxicity, pneumothorax, bleeding, or infection) were reported in this study.

Patients in Group E exhibited higher SMH scores than those in Group P on both POD0 and POD2 ($P < 0.05$), with a more pronounced difference observed on POD0. Additionally, when compared to preoperative baseline values, SMH scores were lower in both groups on the day of surgery and 1–2 days postoperatively. The incidence of PSD in Group E on POD3 was significantly lower than that in Group P (75% vs 25%, $P < 0.01$) (Table 1).

In comparison to Group P, the NRS scores for resting and coughing in Group E were significantly reduced at all time points following surgery ($P < 0.01$) (Table 2). The total consumption of remifentanil and bucinazine in Group E was significantly lower than that in Group P ($P < 0.05$). Furthermore, the postoperative ICFS-10 scores and the incidence of postoperative nausea and vomiting in Group E were significantly lower than those in Group P ($P < 0.05$) (Table 3). While

Table 1 Comparison of PSQI Scores, PSD Incidences and SMH Scores After Surgery

	Group E (n=41)	Group P (n=40)
PSQI score [*M*(*IQR*)]	4 (2)**	10 (5)
PSD (%)	25**	75
SMH POD0 [*M*(*IQR*)]	23.5 (8)*	17.5 (5)
SMH POD1 [*M*(*IQR*)]	27 (6)	25 (10)
SMH POD2 [*M*(*IQR*)]	29 (6)*	26 (9)

Notes: *: $P < 0.05$, **: $P < 0.01$.
Abbreviations: PSQI, Pittsburgh Sleep Quality Index questionnaire; PSD, Postoperative Sleep Disturbance; SMH, St. Mary's Hospital Sleep questionnaire; POD0, surgery day; POD1, postoperative day 1; POD2, postoperative day 2.

Table 2 Comparison of NRS Scores at Each Time Point After Surgery ($\bar{x} \pm s$)

		Extubation	6h	24h	48h	72h
Resting NRS	Group E (n=41)	2.34±0.82**	2.54±0.84**	2.22±0.87**	1.71±0.51**	1.19±0.40**
	Group P (n=40)	3.28±0.78	3.30±0.82	3.38±0.98	2.70±0.91	1.93±0.57
Coughing NRS	Group E (n=41)	3.15±0.82**	3.10±0.74**	2.51±0.64**	2.12±0.40**	1.63±0.49**
	Group P (n=40)	3.85±0.58	3.95±0.71	3.50±0.82	2.98±0.69	2.08±0.47

Note: **: $P < 0.01$.
Abbreviation: NRS, Numeric Rating Scale.

Table 3 Comparison of Anesthetic Drugs, Bucinazine Consumption, Hospital Duration, and Adverse Reactions

	Group E (n=41)	Group P (n=40)
Propofol (mg, $\bar{x} \pm s$)	346.47±125.72	397.50±138.60
Remifentanil [mg, *M*(*IQR*)]	1.2 (0.73)*	1.5 (1)
Bucinazine [mg, *M*(*IQR*)]	0 (0)*	0 (100)
ICFS-10 ($\bar{x} \pm s$)	29.34±1.35*	32.85±2.20
Hospital duration (d)	7 (2)	7 (3)
Nausea, n (%)	3 (7.3)*	10 (25)
Vomiting, n (%)	2 (4.9)*	9 (22.5)

Note: *: $P < 0.05$.
Abbreviation: ICFS-10, The Identity Consequence Fatigue Scale-10.

Table 4 IL-6 and IL-10 Serum Levels at Different Time Points After Surgery

		Pre-Operation	12h	24h	48h
IL-6 (pg/mL)	Group E (n=41)	47.92±15.12	126.68±40.13	178.64±95.07**	87.95±24.48*
	Group P (n=40)	45.16±11.18	150.39±52.75	269.92±108.10	113.50±47.30
IL-10 (pg/mL)	Group E (n=41)	115.98±34.58	183.11±31.26	215.52±45.04**	158.87±35.78*
	Group P (n=40)	113.14±32.39	138.85±24.10	183.61±32.79	137.20±35.91

Notes: *: $P < 0.05$, **: $P < 0.01$.
Abbreviations: IL-6, Interleukin-6; IL-10, Interleukin-10.

the incidences of adverse reactions such as dizziness, dyspnea, pruritus, and drowsiness of the two groups were similar. The serum levels of IL-6 at 24 hours and 48 hours post-surgery were significantly lower in Group E compared to Group P. Additionally, the serum levels of IL-10 in Group E were higher than those in Group P (Table 4). There was no significant difference in propofol consumption or duration of hospital stay between the two groups.

Discussion

Our study showed that continuous ESPB can improve postoperative sleep quality, alleviate pain, fatigue and inflammation, and decrease the occurrence of postoperative nausea and vomiting.

Sleep disorders following thoracic surgery are primarily linked to postoperative pain, discomfort caused by the drainage tube, coughing, sputum production, and postoperative nausea and vomiting. Additionally, disturbances such as alarms from ward monitors and infusion pumps, the snoring of other patients in the same ward, and noise from medical work areas—including treatment carts and ringing phones—can also contribute to sleep disorders in postoperative patients. Furthermore, complications such as pneumonia, atelectasis, and hypoxia may impact sleep quality for these patients to varying degrees. In our study, patients undergoing thoracoscopic lobectomy experienced significant sleep disturbances from the first to the third postoperative night. Sleep quality was poorest on the first night but showed notable improvement by the third night, although it remained lower than preoperative levels. This finding aligns with the research conducted by Gögenur.[24]

Pain following thoracic surgery primarily comprises incisional pain and discomfort associated with drainage tubes. Research indicates that the ESPB effectively alleviates both incision-related pain and visceral pain resulting from thoracoscopy.[18,19] The discomfort associated with chest drainage tubes is largely attributed to irritation of the parietal pleura. Additionally, ESPB can help mitigate this discomfort. Both groups exhibited postoperative NRS scores within the

clinically acceptable range. According to the minimal clinically important difference proposed by Myles et al,[25] an improvement of 1 point is considered clinically significant. In Group E, the reduction in rest pain observed after extubation, as well as at 24 and 48 hours post-surgery, demonstrates clinical significance. Furthermore, the improvement in cough pain at both 6 and 24 hours after surgery also reaches clinical significance. Although opioids are effective in relieving pain, they can also alter sleep patterns.[26,27] Since preoperative ESPB in Group E can produce effects similar to those of a paravertebral nerve block, it is reasonable to conclude that the intraoperative dosage of remifentanil was lower than that in Group P. Group E primarily relied on ESPB for postoperative analgesia, thereby avoiding the use of sufentanil, and the dosage of bucinazine was also reduced. Thus, it can reduce the sleep disturbance caused by opioids and the adverse reactions such as nausea and vomiting.

Research indicates that pro-inflammatory cytokines, such as interleukin-6 (IL-6), interleukin-1 (IL-1), and tumor necrosis factor-α (TNF-α), which are triggered by surgical trauma and postoperative pain, can directly affect the central nervous system, thereby disrupting normal sleep patterns.[3,4] Conversely, interleukin-10 (IL-10) serves as a crucial anti-inflammatory factor that promotes neutrophil apoptosis. Notably, the postoperative IL-6 levels in Group E were significantly lower compared to those in Group P, while the IL-10 levels were higher in Group E than in Group P, aligning with the findings of Qiao et al.[28] Consequently, another potential explanation for the reduced incidence of PSD in Group E may be the attenuation of the inflammatory response through continuous ESPB, which mitigates its adverse effects on sleep.

Postoperative fatigue is significantly correlated with the postoperative circadian sleep-wake rhythm pattern.[24] Group E exhibited notably lower postoperative fatigue scores compared to Group P, indicating that the use of ESPB can effectively reduce fatigue in patients following surgery. One possible explanation for this finding is that patients in the experimental group experienced improved sleep quality and reduced pain, which enabled them to participate in early mobility and lung function exercises. This positive feedback loop not only enhanced patient satisfaction during hospitalization but also facilitated earlier recovery. However, the duration of the postoperative hospital stay did not differ significantly between the two groups in this study, likely due to the standard duration of hospital stays following thoracic surgery at our facility, as well as the individual preferences of the patients regarding hospitalization.

This study had several limitations: (1) Polysomnography and electroencephalography were not employed to assess sleep quality among patients due to the complexity and high costs associated with monitoring. (2) Blinding was incomplete, there were significant differences in the connection positions and parameter settings of the postoperative analgesia pump between the two groups. (3) The absence of single rooms led to unavoidable noise, light, and medical activities in collective wards, which hindered the maintenance of a consistent postoperative hospital environment and may have influenced sleep outcomes. (4) The study focused solely on the sleep status of patients who underwent thoracoscopic surgery within three days post-surgery, without exploring the potential impacts beyond one month or longer.

Conclusion

The continuous ESPB can reduce the incidence of postoperative sleep disturbances, improve overall postoperative sleep quality, alleviate pain, fatigue, and inflammation, and decrease the occurrence of postoperative nausea and vomiting.

Data Sharing Statement

The individual deidentified participant data in our study could be shared with readers. Readers can obtain the data by emailing the corresponding author (zyy0218@126.com). We did not include specific data and documents from previous reports in our study. All the data in our study are available for 10 years.

Author Contributions

All authors made substantial contributions to conception and design, acquisition of data, or analysis and interpretation of data; took part in drafting the article or revising it critically for important intellectual content; agreed to submit to the current journal; gave final approval of the version to be published; and agree to be accountable for all aspects of the work.

Disclosure

The authors report no conflicts of interest in this work.

References

1. Bartosiak K, Schwabe M, Lucey B, Lawrie C, Barrack R. Sleep disturbances and disorders in patients with knee osteoarthritis and total knee arthroplasty. *J Bone Joint Surg Am*. 2022;104(21):1946–1955. doi:10.2106/JBJS.21.01448
2. Bakry AM, Abdelmohty H, Badawy AE, Shorbagy MS, Eldib OS. Sleep disturbance: the overlooked side after open heart surgery in adults. *Asian Cardiovasc Thorac Ann*. 2022;30(3):300–306. doi:10.1177/02184923211024099
3. Margraf A, Ludwig N, Zarbock A, et al. Systemic inflammatory response syndrome after surgery: mechanisms and protection. *Anesth Analg*. 2020;131(6):1693–1707. doi:10.1213/ANE.0000000000005175
4. Hillman DR. Sleep loss in the hospitalized patient and its influence on recovery from illness and operation. *Anesth Analg*. 2021;132(5):1314–1320. doi:10.1213/ANE.0000000000005323
5. Eacret D, Veasey SC, Blendy JA. Bidirectional relationship between opioids and disrupted sleep: putative mechanisms. *Mol Pharmacol*. 2020;98 (4):445–453. doi:10.1124/mol.119.119107
6. Ellis JD, Mayo JL, Gamaldo CE, et al. Worsening sleep quality across the lifespan and persistent sleep disturbances in persons with opioid use disorder. *Clin Sleep Med*. 2022;18(2):587–595. doi:10.5664/jcsm.9676
7. Haack M, Simpson N, Sethna N, Kaur S, Mullington J. Sleep deficiency and chronic pain: potential underlying mechanisms and clinical implications. *Neuropsychopharmacology*. 2020;45(1):205–216. doi:10.1038/s41386-019-0439-z
8. Bisson EF, Mummaneni PV, Michalopoulos GD, et al. Sleep disturbances in cervical spondylotic myelopathy: prevalence and postoperative outcomes-an analysis from the quality outcomes database. *Clin Spine Surg*. 2023;36(3):112–119. doi:10.1097/BSD.0000000000001454
9. Lee MJ, Nho WY, Jung H, et al. High prevalence of depression and sleep-wake disorders among female emergency medicine residents in South Korea. *Ann Med*. 2022;54(1):846–855. doi:10.1080/07853890.2022.2053568
10. Goksu M, Kadirogullari P, Seckin KD. Evaluation of depression and sleep disorders in the preoperative and postoperative period in stage 4 endometriosis patients. *Eur J Obstet Gynecol Reprod Biol*. 2021;264:254–258. doi:10.1016/j.ejogrb.2021.07.037
11. Pu Y, Xu W, Dai W, et al. Longitudinal patterns of patient-reported sleep disturbances after surgery for lung cancer. *Sleep Breath*. 2024;28 (1):441–448. doi:10.1007/s11325-023-02877-2
12. Luo M, Song B, Zhu J. Sleep disturbances after general anesthesia: current perspectives. *Front Neurol*. 2020;11:629. doi:10.3389/fneur.2020.00629
13. Varallo G, Giusti EM, Manna C, et al. Sleep disturbances and sleep disorders as risk factors for chronic postsurgical pain: a systematic review and meta-analysis. *Sleep Med Rev*. 2022;63:101630. doi:10.1016/j.smrv.2022.101630
14. Thota D. Evaluating the relationship between fitbit sleep data and self-reported mood, sleep, and environmental contextual factors in healthy adults: pilot observational cohort study. *JMIR Form Res*. 2020;4(9):e18086. doi:10.2196/18086
15. O'Gara BP, Gao L, Marcantonio ER, et al. Sleep, pain, and cognition: modifiable targets for optimal perioperative brain health. *Anesthesiology*. 2021;135(6):1132–1152. doi:10.1097/ALN.0000000000004046
16. Lu Y, Li YW, Wang L, et al. Promoting sleep and circadian health may prevent postoperative delirium: a systematic review and meta-analysis of randomized clinical trials. *Sleep Med Rev*. 2019;48:101207. doi:10.1016/j.smrv.2019.08.001
17. Wang X, Hua D, Tang X, et al. The role of perioperative sleep disturbance in postoperative neurocognitive disorders. *Nat Sci Sleep*. 2021;13:1395–1410. doi:10.2147/NSS.S320745
18. Moorthy A, Eochagain AN, Dempsey E, Buggy D. Ultrasound-guided erector spinae plane catheter versus video-assisted paravertebral catheter placement in minimally invasive thoracic surgery: comparing continuous infusion analgesic techniques on early quality of recovery, respiratory function and chronic persistent surgical pain: study protocol for a double-blinded randomised controlled trial. *Trials*. 2021;22(1):965. doi:10.1186/s13063-021-05863-9
19. Moorthy A, Ní Eochagáin A, Dempsey E, et al. Postoperative recovery with continuous erector spinae plane block or video-assisted paravertebral block after minimally invasive thoracic surgery: a prospective, randomised controlled trial. *Br J Anaesth*. 2023;130(1):e137–e147. doi:10.1016/j.bja.2022.07.051
20. Gams P, Bitenc M, Danojevic N, et al. Erector spinae plane block versus intercostal nerve block for postoperative analgesia in lung cancer surgery. *Radiol Oncol*. 2023;57(3):364–370. doi:10.2478/raon-2023-0035
21. Pişkin Ö, Gökçe M, Altınsoy B, et al. Effects of continuous erector spinae plane block on postoperative pain in video-assisted thoracoscopic surgery: a randomized controlled study. *Gen Thorac Cardiovasc Surg*. 2022;70(1):64–71. doi:10.1007/s11748-021-01687-1
22. Uda Y, Byrne K, Brahmbhatt A, et al. A pilot randomized-controlled trial evaluating the erector spinae plane block in thoracic and breast surgery. *Can J Anaesth*. 2020;67(10):1371–1380. doi:10.1007/s12630-020-01759-5
23. van den Broek RJC, Postema JMC, Koopman JSHA, et al. Continuous erector spinae plane block versus thoracic epidural analgesia in video-assisted thoracoscopic surgery: a prospective randomized open-label non-inferiority trial. *Reg Anesth Pain Med*;2024. rapm–2023–105047. doi:10.1136/rapm-2023-105047
24. Gögenur I, Bisgaard T, Burgdorf S, et al. Disturbances in the circadian pattern of activity and sleep after laparoscopic versus open abdominal surgery. *Surg Endosc*. 2009;23(5):1026–1031. doi:10.1007/s00464-008-0112-9
25. Myles PS, Myles DB, Galagher W, et al. Measuring acute postoperative pain using the visual analog scale: the minimal clinically important difference and patient acceptable symptom state. *Br J Anaesth*. 2017;118(3):424–429. doi:10.1093/bja/aew466
26. Cronin AJ, Keifer JC, Davies MF, et al. Postoperative sleep disturbance: influences of opioids and pain in humans. *Sleep*. 2001;24(1):39–44. doi:10.1093/sleep/24.1.39
27. Dimsdale JE, Norman D, DeJardin D, et al. The effect of opioids on sleep architecture. *J Clin Sleep Med*. 2007;3(1):33–36.
28. Qiao Y, Lu X, Jiang W, et al. Application of ultrasound-guided erector spinal muscle plane block in analgesia during laparoscopic radical gastrectomy. *J Pract Med*. 2019;35(8):1273–1277.Chinese.