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Article

Comparison of Thoracic Paravertebral Block and Ultrasound-guided Erector Spinae Plane Block for Postoperative Analgesia after Video-Assisted Thoracic Surgery: A Retrospective Study

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Abstract

Objective: This study aimed to compare the value of thoracic paravertebral block and ultrasound-guided erector spinal muscle plane block in video-assisted analgesia after thoracic surgery. **Methods**: Patients undergoing video-assisted thoracic surgery at our hospital from March 2022 to May 2023 were included as the subjects of this retrospective study. According to different analgesia methods, they were divided into an ultrasound group (acoustic-guided erector spinae plane block) and a conventional group (thoracic paravertebral block). General demographic data, sufentanil dose, propofol dose, blood loss and fluid replacement volume, puncture depth and time, length of stay, complications, number of analgesic pump compression, forced vital capacity (FVC), 1 s forced expiratory volume (FEV1), peak expiratory flow rate (PEFR), visual simulation (VAS) score, and 15 recovery quality evaluation components were collected Table (QoR-15). Propensity score matching (PSM) was used to balance the baseline data of the two groups. Data were analyzed by *t* test, chi-square test, and analysis of variance. **Results**: A total of 116 patients were included in this study, including 52 in the ultrasound group and 64 in the conventional group. Before PSM, statistically significant differences in age, weight, lesion location, and surgical methodmethod existed among the groups ($p < 0.05$). PSM matching was performed in a 1:1 ratio, and a total of 82 patients were enrolled in the ultrasound and conventional groups. The baseline data of the two groups were not statistically significant. The complications, hospital stay, pressing times of analgesic pump, and puncture depth and time in the ultrasound group were lower than those in the conventional group ($p < 0.05$). Two groups of tube drawing when resting and cough VAS difference ($p > 0.05$), but after 12, 24, and 48 h, ultrasonic VAS scores were lower than those of the normal group ($p < 0.05$). When two groups of T1 lung function difference ($p > 0.05$), but the T2, T3 FVC, FEV1, and PEFR ultrasound group were higher than those of the conventional group ($p < 0.05$). No significant difference in preoperative QoR-15 score existed between the two groups ($p > 0.05$), but the postoperative QoR-15 score in the ultrasound group was higher than that in the conventional group ($p < 0.05$). **Conclusions**: Ultrasound-guided erector spinae plane block had stronger analgesic effect, which can reduce the pressing times of analgesic pump, quickly reduce pain, and improve lung function with fewer complications. Thus, it can significantly improve the quality of postoperative recovery and reduce the length of hospital stay, rendering its application worthy of promotion.

Keywords

thoracic paravertebral block; television assisted thoracic surgery; ultrasound guidance; erector spinae plane block

Introduction

One of most common clinical types of malignant tumor is lung cancer, which has high morbidity and mortality. On the global scale, the death caused by lung cancer cases malignant tumor have occupied the whole of the first, about 100,000 people left and right sides, as the body health hazard of common diseases [1]. Most patients with early symptoms are not typically diagnosed. The spread of cancer cells then continuously progresses to induce patient symptoms such as chest pain, cough, hemoptysis, serious or even the whole body lack of power, angular, or organ failure. Thus, the patient's life is directly endangered [2]. For treatment, surgery is the most common choice in clinical practice. With the improvement and development of medical technology in recent years, video-assisted thoracoscopic surgery has been proposed. It has the advantages of less trauma, less blood loss, and rapid recovery, which can achieve the purpose of prolonging the survival period of patients [3].

However, with the continuous promotion of video-assisted thoracic surgery, 60% of patients have been clinically found to still have acute pain after surgery. They even have a series of stress reactions owing to pain stimulation, thereby increasing the probability of complications [4]. With the deepening of clinical research, identifying rea-

sonable and effective analgesic methods has great significance. For example, thoracic paravertebral block, a common analgesic method in thoracic surgery, is primarily injected into the wedge space on both sides of the patient's spine. It can block the sympathetic nerve, reduce the secretion of catecholamine, and reduce peripheral resistance. To lessen patients' stress reaction, the purpose of the unilateral chest pain, but easy to cause low blood pressure, pneumothorax and other serious complications. Conversely, ultrasound-guided erector spinae plane block is a new type of trunk nerve block that can achieve effective analgesia by primarily by performing interfascial plane block underneath the patient's erector spinae muscle and targeting the dorsal and ventral branches of the thoracic spinal nerve. Gad *et al*. [5] performed ultrasound-guided erector spinae plane block in patients undergoing modified radical mastectomy. They found that postoperative morphine consumption, stress levels, and pain scores are significantly lower, and that complications are fewer. The quality of analgesia is significantly improved. In another randomized controlled study [6], a planar block of the erector spinae muscle is found to be effective in lumbar spine surgery for relieving postoperative pain and reducing opioid consumption without significant adverse effects. The efficacy of ultrasound-guided erector spinae plane block has been demonstrated in several studies. However, research on the clinical effectiveness of this modality in television-assisted thoracic postoperative analgesia is limited. The present study aimed to investigate the effects of ultrasound-guided erector spinae plane block on patients undergoing television-assisted thoracic surgery through a retrospective study to deepen the understanding of ultrasound-guided erector spinae plane block and to provide guidance for clinical practice.

Materials and Methods

General Information

Patients undergoing video-assisted thoracic surgery at our hospital from March 2022 to May 2023 were the subjects of this retrospective study. Different analgesic methods were divided into an ultrasound group (administered with guide shaft sma plane block) and a normal group (administered with thoracic block).

The inclusion criteria were as follows: (1) belonged to the American society of anesthesiologists (ASA) class for I–II, (2) pathology diagnosed with lung cancer and was in accordance with video-assisted thoracic surgery operation indications, (3) normal lung function with no serious postoperative complications, and (4) medical records were complete with no missing items. The exclusion criteria were as follows: (1) abnormalities in neurological, cardiovascular, respiratory, hepatic, and renal functions; (2) presence of coagulation disorders; (3) infection or anatomical variation at the puncture site; (4) history of allergy to local anaesthetics, or special conditions such as intraoperative allergy; (5) previous history of thoracic surgery; and (6) pre-existing antipsychotic medication or opioid abuse.

Methods

All patients were instructed to fast for 8 h and drink for 2 h before surgery before entering the operating room. Vital signs were routinely monitored, and the peripheral veins of the patients were opened. Invasive arterial detection was performed through local anesthesia. For anesthesia induction, we used 0.05 mg/kg midazolam (Ranbax Laboratories Ltd., Gurgaon, India. H20040047, 1 mL/5 mg) + 0.5 μg/kg sufentanil (IDT Biologika GmbH, Redburn, Germany, H20100123, 1 mL) + 2.0–2.5 mg/kg propofol (Corden Pharma S.P.A., Bergamo, Italy, H20171277, 20 mL/200 mg) + 0.6 mg/kg rocuronium (Siegfried Hameln GmbH, Langenfeld, Germany, H20140847, 5 mL/50 mg). Tracheal intubation was conducted after the onset of muscle relaxation, and the relevant parameters were adjusted as follows: respiratory rate of 12–20 breathe/min, tidal volume of 8 mL/kg, end-tidal carbon dioxide partial pressure of 35–45 mmHg, bispecific index of 40–60, and rocuronium added according to the patient's needs. For the conventional group, we selected thoracic beside block, help patients to take lateral position, make the patients with high frequency ultrasound probe and spinal midline. We then determined the T5 transverse process, adjusted the angle of the probe, observed the T5 transverse process from the ultrasonic image, pleura, ligament vertebral side clearance, and rib from the plane into the needle, will be 0.375% of the 20 mL of Ropivacaine hydrochloride (AstraZeneca AB, H20140763, 100 mg/mL, London, United Kingdom) injection in patients with pleural and rib vertebral side clearance of transverse process ligaments. We carefully checked the pleural down and spreading around vertebral side clearance. For the ultrasound group, we selected vertical plane block guided by ultrasound to assist patients with taking lateral position, instrument, ultrasonic diagnostic instrument (Nan Jing Shu Pu Si medical equipment Co., Ltd., Sono Scape S8, Jiangsu, China). The linear array probe frequency was 6–13 MHz. With the spine of patients parallel to the midline, the T5 transverse process, pleura, paravertebral space, and costotransverse ligament were observed from the ultrasound image. The needle was inserted from the plane until the needle tip was deep into the erector spinae muscle, and then 20 mL of 0.375% ropivacaine was injected.

Quality Control

(1) All staff members were trained and qualified with appropriate professional backgrounds. The performance of the thoracic paraspinal block and ultrasound-guided erector spinae plane block of the doctors and nurses were ensured

to be in accordance with a unified operating procedure to reduce errors and improve the reliability of the study results.

(2) The indicators for assessing the effects of postoperative analgesia were clearly defined, and the reliability and validity of the included scales were re-tested. The objective was to ensure an objective comparison.

(3) After data collection, the data were entered into a Microsoft Excel sheet (Microsoft Corporation, v16.0.7531.1011, Washington, USA) by two people on two machines to ensure accurate data entry. According to the type of data, the correct statistical methods were selected for data analysis.

Observation Indicators

(1) Statistics each dosage sufentanil and propofol dosage, amount of blood loss and rehydration, puncture depth and time, hospitalization days and complications.

(2) Respectively, in a tube drawing, after 12, 24, and 48 h evaluation groups when resting, cough, the visual simulation (VAS) score, primarily through 10 cm swimming mark pain intensity corresponding to the location of the scale, 0 painless; 0 to 3 points and mild; 4–6 minutes and moderate; 7–10 points severe [7]. The overall Cronbach's α coefficient of the scale was 0.959, and the split-half reliability coefficient was 0.937. The reliability and validity of the scale were good and thus deemed suitable for evaluating the pain degree of patients.

(3) The pressing times of analgesia pump at 6, 12, and 24 h after operation were recorded.

(4) Before anesthesia (T1), when the tube drawing (T2), after extubation (T3), lung function select detector (Xu Zhou source electronic technology Co., Ltd., LUD-V3, Jiangsu, China) to determine each forced vital capacity (FVC), forced expiratory volume in 1 s (FEV1), peak expiratory flow rate (PEFR).

(5) The 15-item quality of recovery scale (QoR-15) of each group before and after surgery was compared. It primarily evaluated the postoperative recovery quality of patients, with a total of 15 items. The Likert 10-point scoring method was used, with a full score of 150 points. A higher score indicated better recovery quality [8]. This scale's overall Cronbach 's alpha coefficient was 0.978, and the binary reliability coefficient was 0.926. The reliability and validity were good and thus deemed suitable for the quality of postoperative recovery.

Statistical Treatment

Data were calculated using SPSS 25.0 statistical software (IBM Corp., Armonk, NY, USA). We chose propensity score matching (PSM) balance in baseline characteristics between the two groups, with the different analgesic methods as the dependent variable, age, weight, lesion location, operation way to match variables, such as Logistic regression analysis was used to calculate value of propensity score, according to 1:1 matching, set caliper value to 0.1. Count data were expressed as the percentage, and χ^2 test was used. For continuous variables, we first used the Shapiro–Wilk method to test whether normal distribution was met. The *t*-test was used for data belonging to the normal distribution of ($\bar{x} \pm s$); otherwise, data can only be expressed using the M [P25, P75], the use of non-parametric for the test. $p < 0.05$ was considered statistically significant.

Results

Comparison of Clinical Data of Each Group

A total of 116 patients were included in this study, including 52 patients in the ultrasound group and 64 in the conventional group. Before PSM, statistically significant differences in age, weight, lesion location, and surgical method existed among the groups ($p < 0.05$). After 1:1 propensity score matching, 41 patients in the conventional group and 41 patients in the ultrasound group were successfully matched, and the baseline characteristics of each group were balanced. The difference was not statistically significant ($p > 0.05$). Table 1 shows the details.

Comparison of Puncture, Anesthetic Medication, and Intake and Output Volumes per Group

Sufentanil doses, between the two groups of propofol dosage, amount of blood loss and rehydration no difference ($p > 0.05$). However, puncture depth and time of ultrasonic group were lower than those in the normal group ($p < 0.05$). Table 2 shows the details.

Changes in VAS Scores at Different Time Points of Rest and Cough per Group

At the time of extubation, no difference in VAS at rest and cough existed between the two groups ($p > 0.05$). However, at 12, 24, and 48 h after operation, the scores at rest and cough in the ultrasound group were lower than those in the conventional group ($p < 0.05$). Figs. 1,2 show the details.

Comparison of Complications per Group

The complication rate of the ultrasound group was 7.32%, which was lower than that of the conventional group (24.39%) ($p < 0.05$). Table 3 shows the details.

Comparison of Pressing Times of Analgesia Pump per Group

The pressing times of analgesic pump in the ultrasound group were less than those in the conventional group at 6, 12, and 24 h after operation ($p < 0.05$). Table 4 shows the details.

Table 1. Comparison of clinical data per group.

Clinical data	Before Matching				After Matching			
	Ultrasound group (n = 52)	Regular group (n = 64)	χ^2/t	p	Ultrasound group (n = 41)	Regular group (n = 41)	χ^2/t	p
Gender								
Male	23	29	0.014	0.907	20	22	0.195	0.659
Female	29	35			21	19		
Age (years)	53.47 ± 6.32	58.12 ± 6.75	3.796	<0.001	55.24 ± 6.57	56.02 ± 6.88	0.525	0.601
Height (cm)	168.41 ± 11.50	167.92 ± 12.03	0.223	0.824	167.51 ± 11.66	167.02 ± 11.33	0.193	0.848
Body weight (kg)	62.67 ± 7.38	66.41 ± 8.12	2.569	0.012	64.90 ± 6.86	65.29 ± 7.05	0.254	0.800
ASA Classification								
Level I	34	39	0.243	0.622	25	22	0.449	0.503
Level II	18	25			16	19		
Degree of education								
Junior high school and below	21	25	0.227	0.893	15	18	0.979	0.613
High school and junior college	15	21			12	13		
Bachelor degree or above	16	18			14	10		
Operation time (min)	96.34 ± 10.25	93.78 ± 10.06	1.352	0.179	94.68 ± 9.86	95.20 ± 10.12	0.236	0.814
Location of the lesion								
Left side	36	31	5.084	0.024	23	20	0.440	0.507
Right side	16	33			18	21		
Classification of pathology								
Squamous cell carcinoma	28	35	0.008	0.928	25	21	0.792	0.373
Adenocarcinoma	24	29			16	20		
Smoking								
Yes	39	42	1.197	0.274	28	25	0.480	0.488
No	13	22			13	16		
Surgical methods								
Lobectomy of lung	22	39	3.994	0.046	22	24	0.198	0.656
Partial pneumonectomy	30	25			19	17		

ASA, American society of anesthesiologists.

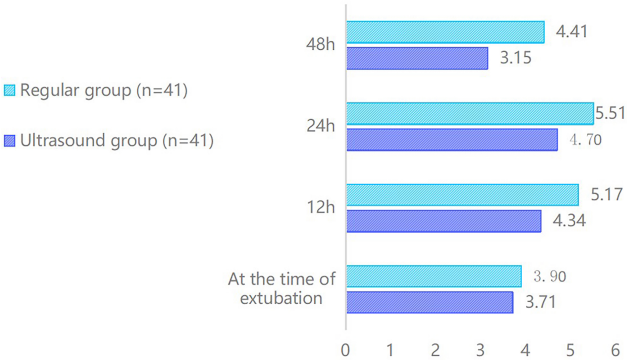

Fig. 1. Changes in VAS scores at different time points at rest for each group (score). VAS, visual simulation.

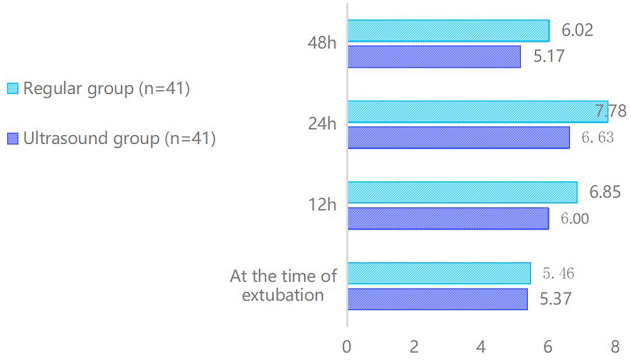

Fig. 2. Changes in VAS scores at different time points during coughing per group (score).

Changes in Lung Function per Group

At T1, no significant differences in pulmonary function indices existed between the two groups ($p > 0.05$). However, FVC, FEV1, and PEFR in the ultrasound group were higher than those in the conventional group at T2 and T3 ($p < 0.05$). Fig. 3 shows the details.

Comparison of Hospitalization Days and QoR-15 Scores per Group

Before operation, no difference in QoR-15 score existed between the two groups ($p > 0.05$). After operation, the QoR-15 score of the ultrasound group was higher than that of the conventional group ($p < 0.05$). The length of

Table 2. Comparison of puncture, anesthetic medication, and intake and output volumes per group ($\bar{x} \pm s$).

Group	Dose of sufentanil (μg)	Dose of propofol (mg)	Penetration depth (cm)	Puncture time (min)	Blood loss volume (mL)	Fluid replacement volume (mL)
Ultrasound group (n = 41)	42.17 ± 5.06	803.56 ± 92.41	4.85 ± 1.61	5.10 ± 1.70	79.63 ± 8.23	834.12 ± 90.76
Regular group (n = 41)	43.07 ± 5.15	811.24 ± 93.06	6.51 ± 2.15	6.29 ± 2.08	81.12 ± 8.72	820.95 ± 89.23
t	0.798	0.375	3.957	2.837	0.796	0.663
p	0.427	0.709	<0.001	0.006	0.429	0.510

Table 3. Comparison of complications per group [n (%)].

Group	Itchy skin	Nausea and vomiting	Pneumothorax	Spinal nerve root injury	Incidence rate
Ultrasound group (n = 41)	1	1	1	0	3 (7.32)
Regular group (n = 41)	4	3	2	1	10 (24.39)
χ^2					4.479
p					0.034

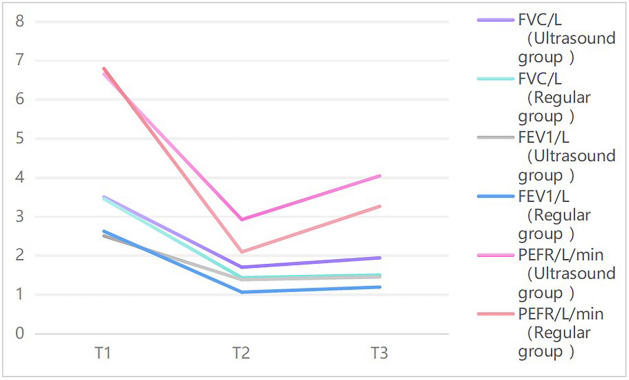

Fig. 3. Changes in lung function per group. FVC, fvcforced vital capcacity; FEV1, forced expiratory volume in one second; PEFR, peak expiratory flow rate.

hospital stay in the ultrasound group was shorter than that in the conventional group ($p < 0.05$). Details are given in Table 5 and Fig. 4.

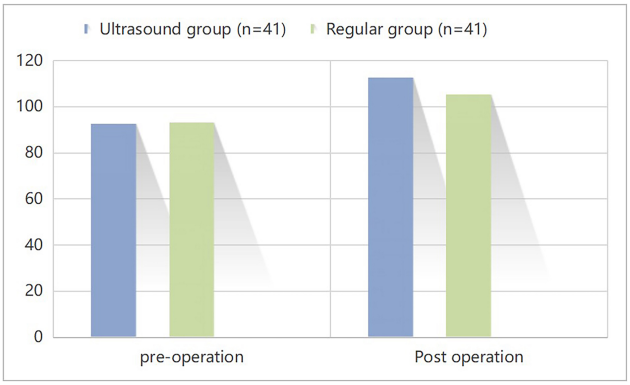

Fig. 4. Comparison of QoR-15 scores between groups (score). QoR-15, 15-item quality of recovery scale.

Discussion

Pain control after thoracic surgery is crucial owing to the fact that adequate postoperative analgesia prevents serious postoperative complications, such as pneumonia and respiratory failure [9]. Paravertebral blocks, as an anaesthetic intervention to reduce postoperative pain in thoracic surgery patients, are used to achieve analgesic benefit in wide-ranging surgical procedures [10]. Erector spinae plane block is a relatively new method of paraspinal fascial plane block proposed by Forero in 2016. It was primarily used to relieve pain during abdominal and thoracic surgeries and has gained high application value [11].

In the current work, we compared the analgesic effect of thoracic paravertebral block and ultrasound-guided erector spinae plane block. Results showed no difference in the dose of sufentanil, the dose of propofol, the amount of blood loss, and the amount of rehydration fluids between the two groups. However, the ultrasound group's depth of puncture and time was lower than that of the conventional group. This finding indicated a certain effect of the two modalities. Conversely, ultrasound-guided erector spinae plane block can reduce the depth of puncture and shorten the puncture time of, thereby reducing the harm to patients. Thoracic paravertebral block is a common analgesic mode in thoracic surgery. Sen *et al.* [12] used thoracic paravertebral block in patients undergoing radical resection of lung cancer. They found that this method can improve the postoperative analgesic effect and reduce the amount of opioids. Zhen *et al.* [13] also experimentally analyzed this phenomenon. In patients with lung cancer undergoing thoracic surgery and administered with ultrasound-guided paravertebral nerve block anesthesia, they found that the stress and hemodynamic response of the patients is effectively improved. The occurrence of adverse events is also reduced. Thus, thoracic paravertebral block has some analgesic effect. However, some studies have pointed out that thoracic

Table 4. Groups of analgesia pump on the number of comparisons [time (P25, P75)].

Group	6 h after surgery	12 h after surgery	24 h after surgery
Ultrasound group (n = 41)	0.00 (0.00,1.00)	2.00 (1.00,2.00)	2.00 (1.00,2.00)
Regular group (n = 41)	1.00 (1.00,2.00)	2.00 (2.00,2.00)	2.00 (1.50,3.00)
Z	–6.168	–3.279	–2.355
p	<0.001	<0.001	0.019

Table 5. Comparison of hospitalization days per group ($\bar{x} \pm$ s, d).

Group	Length of stay
Ultrasound group (n = 41)	5.66 ± 1.78
Regular group (n = 41)	6.80 ± 2.18
t	2.594
p	0.011

paravertebral block can easily cause epidural hematoma or spinal cord injury, and excessive use of drugs can greatly harm the respiratory movement, muscle strength, and circulatory system of patients. Furthermore, this mode has many contraindications, including the use of anticoagulants, coagulopathy, or hemodynamic instability, thereby ultimately limiting its clinical application [14,15]. Ultrasound-guided erector spinae plane block can monitor the position and depth of the puncture needle in real time through ultrasound. It can help doctors accurately locate the target area, choose the optimal point and angle of the needle, reduce the difficulty and time of puncture, and prevent unnecessary puncture and adjustment.

A previous study [16] has reported that prophylactic analgesia with trunk nerve block before skin incision can effectively reduce pain within 24–48 h after surgery, reduce the dosage of analgesic drugs, and enable quick patient recover after surgery. Furthermore, owing to the advancements in ultrasonic visualization technology in recent years, clinical findings of vertical plane block guided by ultrasound. Lin *et al*. [17] examined patients with lumbar intervertebral fusion after taking a vertical spinal cord plane block. They found showed that the patients' postoperative pain obviously decreases. Thus, their 24 h postoperative morphine consumption also decreases, significantly reducing the incidence of postoperative nausea and vomiting and increasing patient satisfaction on the postoperative analgesia effect. Orhon Ergun *et al*. [18] also analyzed this phenomenon on patients undergoing video-assisted thoracoscopic surgery to receive erector spinae plane block. They found that the total dose of morphine is significantly reduced, and the VAS and QoR-40 scores more significantly improve. Thus, this method can reduce the demand for opioids after surgery and improve postoperative pain management. The results of the current study showed no difference in VAS at rest and cough between the two groups at the time of extubation. However, the scores at rest and cough in the ultrasound group were lower than those in the conventional group at 12, 24, and 48 h after operation. No significant difference in QoR-15 score existed between the two groups before operation, but the score in the ultrasound group was higher than that in the conventional group after operation. The number of analgesic-pump presses in the ultrasound group was less than that in the conventional group at 6, 12, and 24 h postoperatively. Usually, ultrasound technology can clearly show the muscle, fascia, and other tissue structures to help the local anesthetic be accurately injected into the patient's erector spinae muscle plane. The outcome is increased effective blocking of the transmission path of pain. The erector spinae muscle plane block can further directly block nerve conduction through the action of a local anesthetic, quickly achieving the analgesic effect. Coupled with the fact that the erector spinae muscle plane block can inhibit the change in neuroplasticity, pain is significantly reduced because the patient's sensory nerve fibers and nociceptive center sensitization decrease. Conversely, the analgesic range of thoracic paraspinal block is relatively limited and provide analgesia only within a certain range around the injection site. It cannot achieve the analgesic effect of the entire thoracic segment. The pain-reducing mechanism of an ultrasound-guided erector spinae plane block primarily lies in its accurate positioning, wide analgesic range, inhibition of neuroplasticity, and reduction of opioid use. As a result, the quality of patients' postoperative recovery improves.

Pirsaharkhiz *et al*. [19] stated that thoracic surgeons are committed to integrating enhanced recovery after surgery into clinical practice primarily to reduce the dose of anesthetics, prevent complications, and shorten the hospital stay. Chaudhary *et al*. [20] pointed out that erector spinae plane block improves acute and chronic pain control and also preserves lung function. All of these conclusions were similar to the results of this paper. We also found that the complications and hospitalization days in the ultrasound group were less than those in the conventional group. No difference in the pulmonary function indices existed between the two groups at T1, but FVC, FEV1, and PEFR were higher than those in the conventional group in the ultrasound group at T2 and T3. Considering that the advantages of ultrasound-guided erector spinae plane block in analgesia have been confirmed, once the patient's pain was reduced, the patient can be guided to breathe more easily and reduce the body's stress response. In turn, lung function improves and the patient's postoperative recovery becomes quicker. He or she can then undergo rehabilitation

exercise at an early stage to perform normal respiratory activities as early as possible, which further promotes the recovery of the lung function. Additionally, when ultrasound-guided vertical spine muscle plane block in the puncture, usually with the transverse process of the bone as the target, can play a protective role, the needle can be prevented from deeply penetrating other tissues. The outcomes were reduced emergence of complications and length of hospitalization. By contrast, thoracic paraspinal block has a relatively limited analgesic range and a relatively short-lived analgesic effect. It may require multiple injections to maintain the analgesic effect, thereby increasing the risk of complications. At the same time, this method involves the injection of local anaesthetics, and if the operation is inaccurate, the nerves and blood vessels may be injured by mistake, resulting in complications such as sensory abnormalities and haematoma.

Notably, this work had some limitations. First, the study design was a retrospective one that cannot completely exclude potential confounders and information bias. It may have also introduced recall bias and uncertainty in information retrieval, which can negatively affect the veracity of the results. Second, we selected a self-assessment scale to assess patients' pain, which can be affected by subjective factors. Third, the small size and short term of our research may affect its reproducibility and validity because it was unable to reflect the long-term effects and safety of the two techniques. In the future, we expect that clinical settings will have an increase in sample size to enable long-term follow-ups. Accordingly, we can carry out extensive multicenter studies to more comprehensively assess the analgesic efficacy and safety of ultrasound-guided vertical spinal plane block after thoracic spine surgery.

Conclusions

Ultrasound-guided erector spinae plane block had a stronger analgesic effect. It can reduce the pressing times of analgesic pump, reduce pain, and improve lung function with fewer complications. Thus, it can significantly improve the quality of postoperative recovery and reduce the length of hospital stay, rendering its application worthy of promotion.

Availability of Data and Materials

Data to support the findings of this study are available on reasonable request from the corresponding author.

Author Contributions

HH and SZ performed the research. ZW provided help and advice on the experiments. HH, SZ and ZW contributed to the analysis and interpretation of the data. All authors contributed to editorial changes in the manuscript. All authors read and approved the final manuscript. All authors have participated sufficiently in the work to take public responsibility for appropriate portions of the content and agreed to be accountable for all aspects of the work in ensuring that questions related to its accuracy or integrity.

Ethics Approval and Consent to Participate

The study was approved by the ethics committee of Baoding No.2 Central hospital (No.20220420). In patients with retrospective study design, can identify hidden identity information, not to obtain informed consent.

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Conflict of Interest

The authors declare no conflict of interest.

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