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Improvement in postoperative pain control by combined use of intravenous dexamethasone with dexmedetomidine after erector spinae plane block and serratus anterior plane block for thoracoscopic surgery: a randomized controlled trial

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Abstract

Background Acute pain after thoracoscopic surgery is very noticeable and often requires additional techniques or adjunctive medications to reduce it. We investigated whether intravenous dexamethasone with dexmedetomidine after erector spinae plane block and serratus anterior plane block could further decrease the incidence of moderate-to-severe pain.

Methods A total of 81 patients were randomly assigned to group C (20 mL normal saline), group S (10 mg dexamethasone + normal saline to 20 mL), or group SM (10 mg dexamethasone + 1 μg/kg dexmedetomidine + normal saline to 20 mL). All patients underwent erector spinae plane block and serratus anterior plane block 30 min before anesthesia induction and all drugs were infused intravenously 30 min after general anesthesia induction. The primary outcome was incidence of moderate-to-severe pain at 24 h on movement postoperatively. Secondary outcomes included incidence of moderate-to-severe pain on movement and at rest throughout the first two postoperative days, pain score, opioid consumption, quality of recovery and adverse effects.

Results Group SM lowered the incidence of moderate-to-severe pain on movement at 24 h postoperatively than group C (11.1% vs. 48.0%; RR 0.231; 95% CI, 0.074 to 0.725) and group S (11.1% vs. 38.5%; RR 0.289; 95% CI, 0.089 to 0.933). Group SM reduced NRS score on movement (3.0 [3.0] vs. 3.0 [2.0] vs. 3.0[1.0]; $P < 0.001$) and total opioid consumption (26.0 [6.0] vs. 32.0 [9.0] vs. 28.0 [2.5]; $P = 0.004$) within 24 h after surgery, fewer patients required rescue

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analgesia (11.1% vs. 48.0% vs. 38.5%; $P=0.009$). Group SM also lowered incidence of nausea and vomiting (7.4% vs. 32.0% vs. 30.8%; $P=0.047$) and had a higher QoR-15 score at postoperative 24 h (132.0 [10.0] vs. 123.0 [8.0] vs. 127.5 [10.8]; $P<0.001$).

Conclusions Intravenous administration of dexamethasone with dexmedetomidine after erector spinae plane block and serratus anterior plane block further decreased the incidence of moderate-to-severe pain. It also reduced NRS scores and opioid consumption, making the postoperative pain control better for thoracoscopic surgery.

Trial registration The study was registered at Chictr.org.cn with the number ChiCTR2400084435 on 05/16/2024.

Keywords Dexamethasone, Dexmedetomidine, Fascial plane block, Analgesia, Thoracoscopic surgery

Background

Thoracoscopic surgery is minimally invasive, but postoperative pain is still significant [1]. Insufficient analgesia would affect the patient's cough and sputum, increase postoperative pulmonary complications, and delay rapid recovery [2–3]. PROSPECT guidelines for thoracoscopic surgery: a systematic review and recommendations for postoperative pain management: some additional techniques or adjunctive medications are recommended to relieve acute postoperative pain [4].

Fascial plane blocks, whether erector spinae plane block or serratus anterior plane block, are far away from the spinal cord, blood vessels and pleura, effectively reducing damage and making it safer [5–6]. The combination of the two, which Mario et al. [7] believed may reduce the risk of systemic toxicity of local anesthetics, and Mo X et al. [8], which suggested can complement each other and produce a broader analgesic effect. However, due to the duration of the local anesthetic, the analgesic time of the nerve block cannot be extended to 24 h or even 48 h postoperatively, which is the most painful phase postoperatively [9].

Therefore, some adjunctive drugs are still needed, and dexamethasone and dexmedetomidine are the two most commonly used [10]. Umari M et al. [2] said that compared with other adjuvant drugs, dexamethasone and dexmedetomidine prolonged the analgesia time after peripheral nerve block more significantly, with an average of six hours for dexamethasone and four hours for dexmedetomidine. Kang RA et al. [11] added that the mechanisms of the two drugs are different, and that the combination is expected to further prolong the duration of analgesia, and the underlying mechanism may be explained by the additive model of effects, that is, the analgesic dose of the second drug significantly increases the analgesic effect produced by a single dose of a given drug.

However, the effectiveness and safety of such a multimodal analgesic protocol, emphasizing a combination of different analgesic mechanisms to optimize postoperative pain control, are unclear. As a result, we designed a randomized controlled trial to evaluate whether intravenous administration of dexamethasone with dexmedetomidine after erector spinae plane block and serratus anterior plane block could further improve analgesia control after thoracoscopic surgery. We hypothesized that this combination regimen would significantly reduce the incidence of moderate-to-severe postoperative pain and hopefully be safer and more effective.

Methods

Study design

This is a double-blind, prospective randomized controlled trial conducted from May 16, 2024 to July 31, 2024 at the Affiliated Hospital of Xuzhou Medical University. The study was approved by the Ethics Committee of The Affiliated Hospital of Xuzhou Medical University (XYFY2024-KL193-01) and was registered at the Chinese Clinical Trial Registry (ChiCTR2400084435; registration date: May 16, 2024). All subjects were provided with written informed consent to participate in this study and all experiments were performed in accordance with relevant guidelines and regulations.

Participants

A total of 81 patients aged 18–65 years who underwent elective thoracoscopic surgery at ASA I-III were included. Exclusion criteria included: contraindications to regional nerve blocks, including skin infections or bleeding disorders at the block site; allergies and contraindications to any of the drugs used in this trial; severe cardiovascular and cerebrovascular, respiratory diseases, diabetes mellitus, and abnormal liver and kidney function were present before surgery; history of chronic pain, long-term use of opioids, hormones, or non-steroidal drugs; inability to communicate normally: hearing impairment, language comprehension impairment, mental illness, etc.; bradycardia (< 50 beats/minute); BMI ≥ 30 kg/m^2; having participated in other studies.

Randomization and blinding

One day before surgery, one researcher (YX-M) blinded to group assignment collected data and obtained written informed consent in wards. After enrollment, one researcher (ZJ-L) randomly assigned participants to the following groups: group C (20 mL normal saline),

group S (10 mg dexamethasone + normal saline to 20 mL), or group SM (10 mg dexamethasone + 1 μg/kg dexmedetomidine + normal saline to 20 mL) according to a computer-generated allocation list (simple randomization) with a 1:1:1 ratio in SPSS™ 22.0 (IBM, Chicago, IL, USA). Assignment concealment was achieved by using an opaque sealed envelope.

Before the surgery, an anesthesia nurse who was also not aware of the group assignment opened the envelope and prepared all the medications needed. Then, an experienced anesthesiologist (ZW-L) performed nerve blocks and anesthesia induction. Because of the hemodynamic properties of the drugs, it was difficult for the anesthesiologist to be completely blinded, but she was not involved in postoperative recovery and evaluation. After the surgery, a researcher (SM-Y) blinded to group assignment followed up and collected data.

Surgical procedure

All patients were operated by a fixed surgeon on a standardized procedure. Participants were placed in the lateral position, with a 5 cm cotton chest pad below the shoulder to help maximize the intercostal space at the surgical incision. A 5 cm incision was made in the 4th or 5th intercostal space at the anterior to mid-axillary line according to the widest intercostal space palpated after positioning. The tissue was separated layer by layer, gradually entered the thoracic cavity, and standardized treatment was carried out according to the surgical plan discussed before surgery. Whenever possible, the surgeon avoided cutting or persistently compressing the intercostal nerves or stretching the intercostal space. Finally, a 24 F chest tube was placed at the incision site to a depth of approximately 5 cm, which was confirmed by thoracoscopic evidence that the pleura was not compressed. At the end of the procedure, both lungs were reinflated and the incisions were closed. The chest tube was attached to a water-sealed bottle.

Anesthesia procedure

After the patient was admitted to the operatory room, ECG, IBP, SpO_2 were routinely monitored, peripheral venous access was opened, and intravenous bolus midazolam 0.02 mg/kg and sufentanil 0.08 μg/kg were injected.

Thirty minutes before surgery, the lateral erector spinae plane block and serratus anterior plane block were performed under ultrasound guidance. Three groups of patients were placed in the healthy lateral decubitus position, disinfected and spread towels, and used in-plane technology to insert needles in 2–3 cm next to the spinous processes of T4 and T5, and passed through the trapezius muscle, rhomboid muscle, and erector spinae muscle from shallow to deep, and injected 20 ml of 0.375% ropivacaine into the deep surface of the erector spinae muscle when the needle tip touched the top of the T5 transverse process [12]. The needle was inserted using an in-plane technique along the level of the midline of the 5th rib axillary to clearly visualize the superficial latissimus dorsi and the deep serratus anterior muscle, and 20 ml of 0.375% ropivacaine was injected when the needle tip reached the serratus anterior surface [13]. Assist the patient to take a supine position, and after 15 min, the sensory block plane is measured by skin cold perception test, and the combined block is considered successful if the sensory hypoesthesia or sensory loss is measured in both the anterior and posterior midlines.

After the onset of the block, anesthesia induction was started in the three groups, and etomidate 0.3 mg/kg, midazolam 0.05 mg/kg, sufentanil 0.5 μg/kg, and rocuronium bromide 0.9 mg/kg were given. Mechanical ventilation was followed by fiberoptic bronchoscope-guided tracheal intubation. Among 30 min after induction, intravenous infusion of the control group: 20 ml of normal saline; dexamethasone group: 10 mg dexamethasone + normal saline to 20 ml; dexamethasone with dexmedetomidine group: 10 mg dexamethasone + 1 μg/kg dexmedetomidine + normal saline to 20 ml. Intravenous compound inhalation anesthesia was used for maintenance: intraoperative sevoflurane inhalation 1–2%, continuous intravenous pumping of propofol 2–6 mg/kg/h, remifentanil 0.1–0.3 μg/kg/min. During the operation, the anesthesiologist adjusted the infusion rate of the drug to maintain the BIS value of 40–60 at the depth of anesthesia and kept the blood pressure and heart rate within ± 20% range compared to baseline values.

Inhalation anesthetic was stopped 30 min before the end of the operation, and then flurbiprofen cilofen 50 mg was administrated. Patient was transferred to the PACU, the double-lumen bronchial tube was removed after the extubation criteria were met, and the patient was returned to the ward when the Aldrete score ≥ 9.

The postoperative PCIA pump contained sufentanil 2 μg/kg + tropisetron 6 mg, and normal saline diluted to 100 ml. There was no background infusion volume, PCIA dose was 2 ml/time, and the locking time was 15 min. When patients felt pain, they could press the PCIA button repeatedly until feeling relief. If the postoperative NRS score ≥ 4, bucinazine hydrochloride 100 mg intramuscularly was given for relief analgesia. If the postoperative NRS score ≥ 7, tramadol hydrochloride 100 mg intramuscularly was given.

Outcome measurements

The primary outcome was incidence of moderate-to-severe pain at postoperative 24 h on movement. Movement was defined as three times of deep breath and cough once. Using NRS to evaluate the pain level, 0–10

point overall, 0 is no pain, 1–3 is mild pain, 4–6 is moderate pain, and 7–10 is severe pain [14]. We defined NRS ≥ 4 as moderate-to-severe pain.

Secondary outcomes included: (1) incidence of moderate-to-severe pain on movement and at rest at 6 h, 12 h, 24 h, 36 h and 48 h; (2) total opioid consumption (converted to morphine equivalent) within 24 h and 48 h; (3) number of patients required rescue analgesia within 24 h and 48 h; (4) time to first eating, first ambulation, and remove chest drain, length of stay; (5) QoR-15 score (0-150 point overall, the higher the score, the better the quality of recovery [15]) at 24 h; (6) possible adverse effects: nausea and vomiting, bradycardia (heart rate < 20% of baseline), hypotension (MAP < 20% of baseline), hypoxemia (SpO_2 < 90%), drowsiness, dizzy, pruritus, local/systemic infection, neurological symptoms (persistent numbness or paresthesias, weakness or non-surgical pain), etc.

Sample size calculation

The incidence of moderate-to-severe pain after thoracoscopic surgery is 55%, and previous studies have shown that nerve block can reduce it by about 25%. This study hypothesized that dexamethasone with dexmedetomidine would make sense to reduce moderate-to-severe pain by an additional 20% after thoracoscopic surgery. Using PASS15.0 calculation, the test power was defined as 90%, the test level was 0.05, the sample size was 63, and the dropout rate of 20% was considered, 27 cases were included in each group, and 81 cases were planned to be included in this study.

Statistical analysis

SPSS 26.0 software was used for statistical analysis. For quantitative data, Shapiro-Wilk's test to determine its normality; The normally distributed continuous data were expressed as mean ± SD. One-way ANOVA was used for comparison at the same time point between the three groups, and repeated measures ANOVA was used for comparison at different time points within the group. The non-normally distributed continuous data were expressed as median (interquartile range), and the Kruskal-Wallis H test was used for comparison between the three groups at the same time point. The Friedman test was used for comparison at different time points within the group. The count data were expressed as rates, and the chi-square test or Fisher's exact probability method was used for comparison. The Kruskal-Wallis H test was used for the comparison of grade data. Survival data were analyzed by Kaplan-Meier curve, and the differences between groups were compared by log-rank test. In the case of statistically significant differences between multiple groups, post-hoc analysis was performed using Bonferroni correction, and the significance criterion for each pairwise comparison was $P < 0.0167$ after correction; Otherwise, $P < 0.05$ indicated that the difference was statistically significant.

Results

A total of 81 patients were included and randomized. During the study period, 3 patients were transferred to thoracotomy due to difficult surgery or excessive bleeding, and finally 78 patients were included in the intention-to-treat analysis (Fig. 1).

The baseline characteristics and intraoperative data of the three groups were well balanced, but the intraoperative dose of remifentanil was significantly lower in group S and group SM compared with group C ($P < 0.05$; Table 1). In terms of vital signs, compared with group C, group SM and group S both seemed to be smoother (Fig. 2).

Group SM significantly lowered the incidence of moderate-to-severe pain on movement at 24 h postoperatively than group C (11.1% vs. 48.0%; RR 0.231; 95% CI, 0.074 to 0.725) and group S (11.1% vs. 38.5%; RR 0.289; 95% CI, 0.089 to 0.933). At rest at 24 h after surgery, the result was consistent with which on movement (7.4% vs. 32.0% vs. 30.8%; $P = 0.047$). There was no significant difference between the three groups in the incidence of moderate-to-severe pain at other time points (Fig. 3).

Moreover, group SM slightly reduced NRS scores on movement (3.0 [3.0] vs. 3.0 [2.0] vs. 3.0[1.0]; $P < 0.001$) and at rest (3.0 [2.0] vs. 2.0 [1.0] vs. 2.0[1.0]; $P = 0.030$) at postoperative 24 h compared with group C and group S. Group SM also reduced NRS scores on movement at 48 h postoperatively (2.0 [1.0] vs. 2.0 [1.0] vs. 2.0 [1.0]; $P = 0.017$). However, at other time points, movement and resting NRS scores were similar (Fig. 4).

In addition, the effective analgesia time of group SM was significantly longer than that of group C and group S (1500.0 [785.0] vs. 915.0 [366.5] vs. 1073.0 [668.5]; $P<0.001$). Group SM consumed more opioids within 24 h postoperatively (26.0 [6.0] vs. 32.0 [9.0] vs. 28.0 [2.5]; $P = 0.004$), and fewer people required salvage analgesia (11.1% vs. 48.0% vs. 38.5%; $P = 0.009$; Table 2).

There were no significant differences in adverse effects, including bradycardia, hypotension, hypoxemia, pruritus, wound infection, and hematoma at the puncture site. There was a significant difference in the incidence of nausea and vomiting between the three groups (7.4% vs. 32.0% vs. 30.8%; $P = 0.047$). One patient of group C developed drowsiness and dizziness (Table 2).

There was also no significant difference in postoperative quality of recovery between the three groups. However, QoR-15 score at 24 h postoperatively, group SM was significantly improved compared with group C and group S (132.0 [10.0] vs. 123.0 [8.0] vs. 127.5 [10.8]; $P < 0.001$; Table 2).

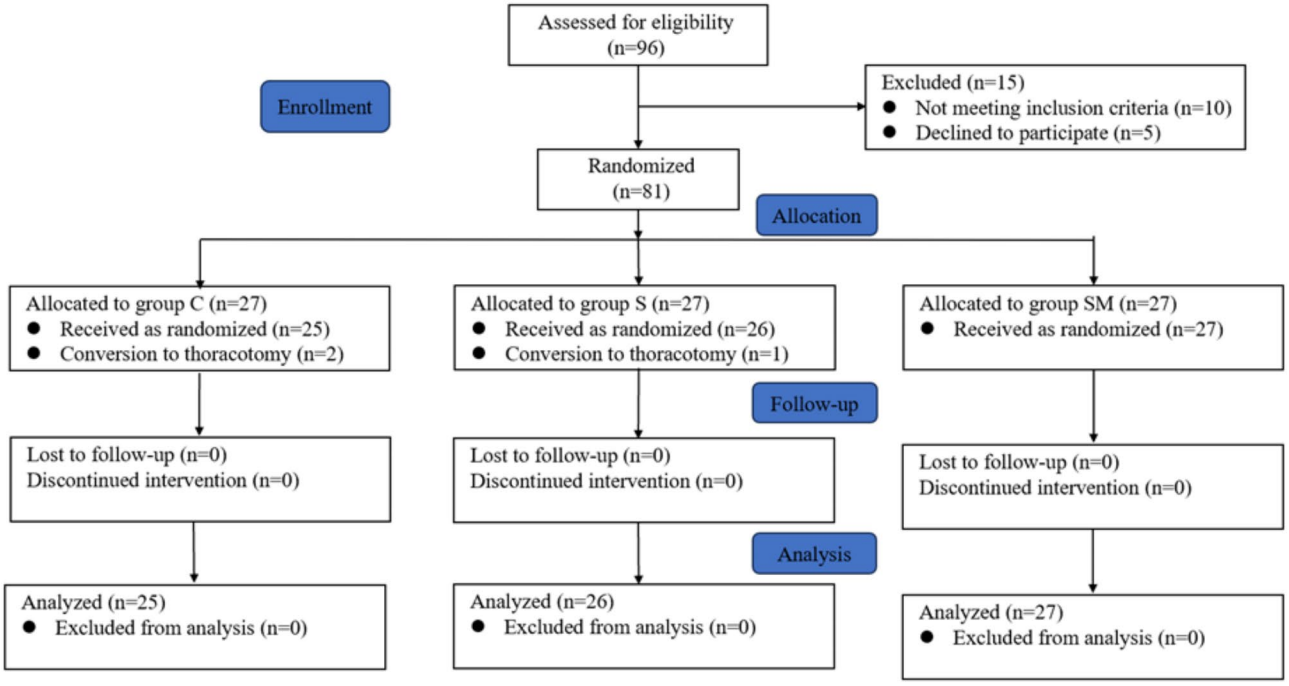

Fig. 1 Consort flowchart of the study

Table 1 Patient demographic and surgical data

Variables	Group C ($n=25$)	Group S ($n=26$)	Group SM ($n=27$)	*P*-value
Sex (M/F)	10/15	11/15	11/16	0.985
Age (yr)	51.3 ± 10.7	53.0 ± 10.4	50.7 ± 10.6	0.723
BMI (kg/m^2)	24.6 ± 4.1	23.1 ± 2.7	23.4 ± 2.8	0.242
ASA (I/II/III)	8/14/3	10/12/4	10/12/5	0.920
Comorbidities (%)				0.770
Hypertension	7 (28.0)	7 (26.9)	8 (29.6)	
Coronary heart disease	2 (8.0)	1 (3.8)	2 (7.4)	
Cerebral infarction	5 (20.0)	7 (25.9)	4 (15.4)	
Arrhythmia	1 (4.0)	0	0	
Prior analgesic use (%)	5 (20)	5 (19.2)	4 (14.8)	0.869
Side of surgery (L/R)	12/13	13/13	13/14	0.987
Type of surgery (%)				0.104
Wedge Resection	3 (12.0)	3 (11.5)	6 (22.2)	
Segmentectomy	16 (64.0)	10 (38.5)	11 (40.7)	
Lobectomy	2 (8.0)	8 (30.8)	4 (14.8)	
Segmentectomy + Wedge Resection	4 (16.0)	1 (3.8)	4 (14.8)	
Lobectomy + Wedge Resection	0	4 (15.4)	2 (7.4)	
Duration of surgery (min)	75.0 ± 39.4	82.5 ± 37.1	79.2 ± 46.0	0.808
Dosage of propofol (mg)	224.2 ± 95.6	232.3 ± 94.6	205.2 ± 105.2	0.591
Dosage of sufentanil (ug)	32.2 ± 8.2	35.0 ± 7.1	35.0 ± 8.0	0.335
Dosage of remifentanil (mg)	1.5 ± 0.6	1.0 ± 0.5[a]	0.9 ± 0.6 [a]	<0.001

Values are presented as mean ± SD or number (%)

Compared with Group C, [a] $P < 0.05$

Abbreviation: BMI, body mass index; ASA, American Society of Anesthesiologists

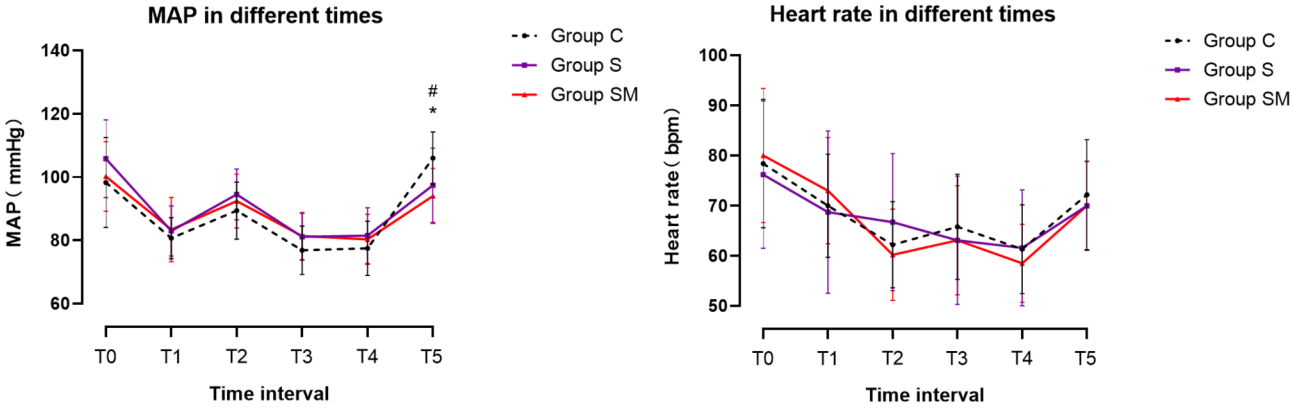

Fig. 2 MAP and heart rate in different times. Data are expressed as mean ± SD. By Bonferroni adjustment, *: Group SM vs. group C, $P < 0.05$; #: Group S vs. group C, $P < 0.05$

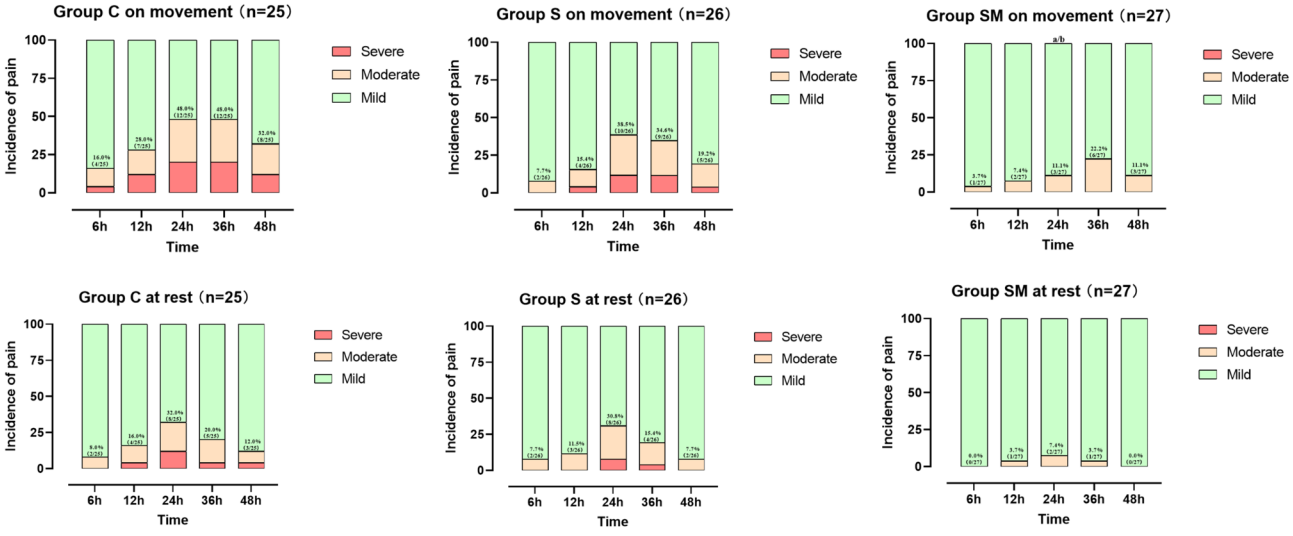

Fig. 3 Incidence of moderate-to-severe pain on movement and at rest. By Bonferroni adjustment, **a**: Group SM vs. group C, $P < 0.05$; **b**: Group SM vs. group S, $P < 0.05$

Discussion

In this randomized controlled trial, we demonstrated that intravenous dexamethasone with dexmedetomidine after erector spinae plane block and serratus anterior plane block could further decreased the incidence of moderate-to-severe pain. It also reduced NRS scores and opioid consumption, lowered the incidence of nausea and vomiting and improved quality of recovery for thoracoscopic surgery.

Possible mechanism of action

Recent years, some studies have shown that both dexamethasone and dexmedetomidine combined with nerve block can improve postoperative pain for thoracoscopic surgery [16]. The potential analgesic effects of glucocorticoids as adjunctive agents may be due to their anti-inflammatory properties, including inhibition of pro-inflammatory factors and induction of anti-inflammatory cytokines, decreased prostaglandin synthesis, and possibly reduced nerve cell excitability [17]. The peripheral analgesic effect of dexmedetomidine may be through the activation of peripheral α_2 adrenergic receptors and inhibition of C and Aδ fibers of peripheral nerves, and the central analgesic effect involves nerve remodeling of the dorsal horn of the spinal cord and regulation of NMDA receptors [18]. The mechanism of action of the two drugs are different, generally, the effects of combining the two may be found to be additive, subadditive or supra-additive (i.e.synergistic) [11].

Analgesic efficacy compared with previous studies

This trial chose the incidence of moderate-to-severe pain on movement at 24 h postoperatively as the primary outcome. Reducing it can effectively lower the occurrence of postoperative complications and chronic pain, and promote the rapid recovery of patients, which is a close to

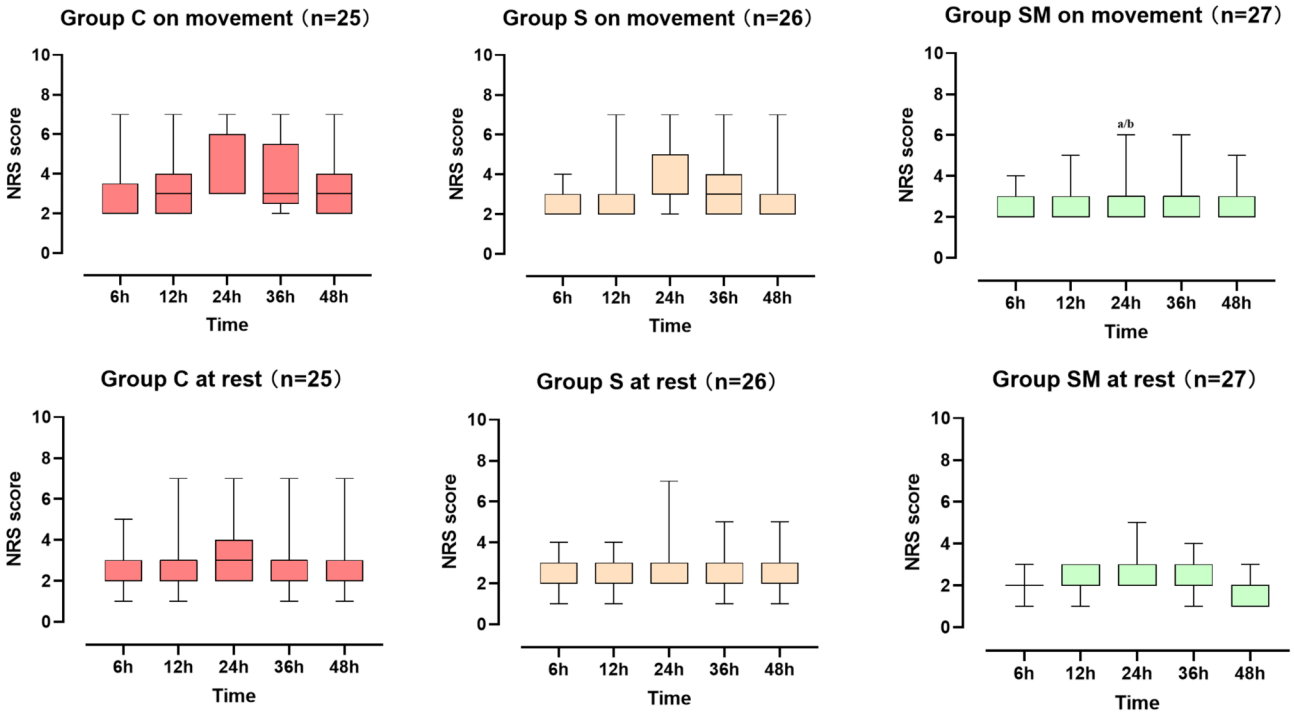

Fig. 4 NRS scores on movement and at rest. By Bonferroni adjustment, **a**: Group SM vs. group C, $P < 0.05$; **b**: Group SM vs. group S, $P < 0.05$

Table 2 Postoperative analgesic efficacy, adverse reactions and quality of recovery

Variables	Group C ($n = 25$)	Group S ($n = 26$)	Group SM ($n = 27$)	*P*-value
Duration of effective analgesia (min)	915.0 [366.5]	1073.0 [668.5]	1500.0 [785.0] [a, b]	<0.001
Total consumption of opioids (mg)				
0–24 h after surgery	32.0 [9.0]	28.0 [2.5]	26.0 [6.0] [a, b]	0.004
24–48 h after surgery	26.0 [4.0]	25.0 [4.5]	24.0 [2.0]	0.074
Number of patients required rescue analgesia (%)				
0–24 h after surgery	12 (48.0)	10 (38.5)	3 (11.1) [a, b]	0.009
24–48 h after surgery	8 (32.0)	4 (15.4)	1 (3.7) [a]	0.021
Postoperative adverse reactions				
Nausea and vomiting	8 (32.0)	8 (30.8)	2 (7.4) [a, b]	0.047
Bradycardia	0	0	0	1.000
Hypotension	1 (4.0)	1 (3.8)	1 (3.7)	1.000
Hypoxemia	0	0	0	1.000
Drowsiness	1 (4.0)	0	0	0.321
Dizzy	1 (4.0)	0	0	0.321
Pruritus	0	0	0	1.000
Wound infection	0	0	0	1.000
Hematoma at the puncture site	0	0	0	1.000
Time to first eating after surgery (h)	7.0 [3.0]	7.0 [3.0]	7.0 [4.0]	0.416
Time to first ambulation after surgery (h)	20.0 [6.0]	20.0 [6.0]	18.0 [6.0]	0.056
Time to remove chest drain after surgery (days)	3.0 [1.0]	3.0 [2.0]	3.0 [1.0]	0.399
Length of stay after surgery (days)	5.0 [3.0]	5.0 [2.3]	4.0 [2.0]	0.162
QoR-15 score 24 h after surgery	123.0 [8.0]	127.5 [10.8]	132.0 [10.0] [a, b]	<0.001

Values are presented as median [IQR] or number (%)

Compared with Group C, [a]$P < 0.05$; Compared with Group S, [b]$P < 0.05$

Abbreviation: QoR-15, 15-item quality of recovery

clinical and meaningful indicator [19]. The incidence of moderate-to-severe pain after thoracoscopic surgery is about 55% [20–21], and nerve block techniques can significantly reduce it to about 30% [22]. The results of this study showed that intravenous dexamethasone with dexmedetomidine after erector spinae plane block and serratus anterior plane block further reduced it to 11.1%, which reached the desired target. The less invasive technique of local analgesia is a common analgesic measure after thoracoscopic surgery. Wu Z et al. [23] used paravertebral nerve block, and the incidence of moderate-to-severe pain after thoracoscopic surgery was 26.1%. Zhang A et al. [24] added S-ketamine to the self-controlled analgesia of patients undergoing thoracoscopic surgery, and the incidence of moderate-to-severe pain in the early postoperative period was only reduced to 35.8%. In this study, a multimodal regimen of regional analgesia combined with intravenous analgesia was used to significantly control the incidence of moderate-to-severe postoperative pain. In addition, the postoperative NRS scores on movement and at rest in this trial were both reduced by 1, achieving a minimal clinical difference [25]. That is, patients perceived the improvement in postoperative pain as clinically significant.

Kang RA et al. [11] did a study about the effect of intravenous infusion of dexamethasone with dexmedetomidine on the analgesic effect of brachial plexus block in patients undergoing shoulder arthroscopic surgery, and the results showed that the time to first salvage analgesia was up to 66 h, which could not be explained by individual pharmacokinetic properties, unless their combination showed a synergistic effect. The result of our study did not observe such a significant effective analgesic duration, which was about 20 h. The reason may be that the surgeries were different, and thoracoscopic surgery was chosen in this study, which was more painful than shoulder arthroscopic surgery, leading to a shorter duration of analgesia. It was also possible that the definitions of effective analgesia were different, which was defined as the time from the onset of the block to the first postoperative use of salvage analgesics, while we defined it as the time between the onset of the block and the first postoperative compression of the analgesic pump, and the time to the outcome of this study would have been earlier. After further analysis, we found that the more likely cause was that Kang RA et al. [11] started PCIA analgesia when the patient had a VAS score of more than 2 point at rest and celecoxib 200 mg orally every 12 h after surgery, this overly complete multimodal analgesia may have resulted in significant pain in the control group, while the mixed group was treated with analgesia at the time when it should have been painful, which led to a significant prolongation in his primary outcome measure. Hong B et al. [26] showed that the analgesic time was not much longer after using dexamethasone with dexmedetomidine, but slightly shorter than in our study, which was 13.2 h. This may be due to the fact that the outcome measure was the time to onset of pain after surgery. Dexamethasone can prolong the analgesic time of nerve block for about 6 h, dexmedetomidine for about 4 h [2], and the combined use could be extended for about 9 h. The effect of use can be explained by additive, which is more in line with the drug interaction to a certain extent. At the same time, the combination regimen consumed fewer opioids, and although it did not achieve minimal clinical differences which is 10 mg difference in morphine equivalent [27], the number of people who treated them for salvage analgesia was significantly reduced (11.1% vs. 48.0 vs. 38.5%).

Other strengths

There were no significant differences in adverse effects, including bradycardia, hypotension, hypoxemia, pruritus, wound infection, and hematoma at the puncture site. One patient of control group developed drowsiness and dizzines, but after symptomatic treatment, it naturally improved after one day of observation. Beloeil [28] studied that intravenous dexmedetomidine predisposed to cause hypotension and bradycardia, but it was not found in this study. The reason may be that this trial used a low-dose, low-rate intravenous infusion of dexmedetomidine, which greatly avoided the occurrence of adverse reactions [29]. In addition, a significant reduction in the incidence of postoperative nausea and vomiting was found in patients in dexamethasone with dexmedetomidine group, which may be related to the reduction of opioids after the enhanced analgesic effect [30]. It may also be related to dexamethasone being anti-inflammatory and releasing endorphins, dexmedetomidine decreasing sympathetic activity and catecholamine release, thus directly reducing the incidence of postoperative nausea and vomiting [31–32].

There was a significant difference in QoR-15 score at 24 h after surgery, reaching the minimum clinical difference, which is 6 [33]. That means patients in dexamethasone with dexmedetomidine group have better quality of recovery at postoperative 24 h, which is of great clinical significance. This may be due to a reduction in pain, nausea and vomiting, resulting in a faster and better recovery. However, there were no significant differences in other postoperative recovery, including time to first feeding, first bed exit, chest drain removal, and length of hospital stay, possibly because the surgeon followed the protocol and equally treated the patients.

Limitations

There were still some limitations to this study. First, the mixed effects of the two drugs and two nerve blocks still needs to be further studied to understand the underlying

mechanism of action and long-term effects (beyond 48 h). Second, we only chose a little dose of dexamethasone and dexmedetomidine, it lacks the dose-response studies and comparisons with alternative drug combinations. Finally, this is a single-center, small-sample study that still needs to be validated in more clinical centers and with larger samples.

Conclusions

This randomized controlled trial showed that intravenous administration of dexamethasone with dexmedetomidine after erector spinae plane block and serratus anterior plane block further decreased the incidence of moderate-to-severe pain. It also reduced NRS scores and opioid consumption, lowered the incidence of nausea and vomiting and improved quality of recovery for thoracoscopic surgery.

Abbreviations

ASA	American Society of Anaesthesiologists
BMI	Body mass index
ECG	Electrocardiogram
HR	Heart rate
IBP	Invasive blood pressure
SpO_2	Peripheral capillary oxygen saturation
BIS	Bispectral index
PACU	Post-anesthetic care unit
PCIA	Patient-controlled intravenous analgesia
NRS	Numerical rating scale
QoR-15	Quality of recovery scale-15
NMDA	N-methyl-D-aspartate

Supplementary Information

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Supplementary Material 1

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Author contributions

The study was supported by Linlin Zhao and Su Liu, and was fully participated and managed by Li Zhang, Zhibiao Xu and Yuyun Liu. Zijie Ling, Sumin Yuan and Yuxiang Meng collected the datas. Ziwei Li was responsible for the whole process of anesthesia, and Shoujie Feng was in charge of the operation. All authors contributed equally to the manuscript and read and approved the final version of the manuscript.

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Data availability

All data generated or analyzed during this study were included in the published article. Further inquiries about the datasets can be available from the corresponding authors on reasonable request.

Declarations

Ethics approval and consent to participate

This is a double-blind, prospective randomized controlled trial conducted from May 16, 2024 to July 31, 2024 at the Affiliated Hospital of Xuzhou Medical University. The study was approved by the Ethics Committee of The Affiliated Hospital of Xuzhou Medical University (XYFY2024-KL193-01) and was registered at the Chinese Clinical Trial Registry (ChiCTR2400084435; registration date: May 16, 2024). All subjects were provided with written informed consent to participate in this study and all experiments were performed in accordance with relevant guidelines and regulations.

Consent for publication

Not Applicable.

Competing interests

The authors declare no competing interests.

CONSORT guidelines

Our study fully adhered to CONSORT guidelines.

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References

1. Bendixen M, Jørgensen OD, Kronborg C, Andersen C, Licht PB. Postoperative pain and quality of life after lobectomy via video-assisted thoracoscopic surgery or anterolateral thoracotomy for early stage lung cancer: a randomised controlled trial. Lancet Oncol. 2016;17(6):836–44.
2. Umari M, Carpanese V, Moro V, et al. Postoperative analgesia after pulmonary resection with a focus on video-assisted thoracoscopic surgery. Eur J Cardiothorac Surg. 2018;53(5):932–8.
3. Flores RM, Alam N. Video-assisted thoracic surgery lobectomy (VATS), open thoracotomy, and the robot for lung cancer. Ann Thorac Surg. 2008;85(2):S710–5.
4. Feray S, Lubach J, Joshi GP, Bonnet F, Van de Velde M, PROSPECT Working Group *of the European Society of Regional Anaesthesia and Pain Therapy. PROSPECT guidelines for video-assisted thoracoscopic surgery: a systematic review and procedure-specific postoperative pain management recommendations. Anaesthesia. 2022;77(3):311–25.
5. Chin KJ, Versyck B, Pawa A. Ultrasound-guided fascial plane blocks of the chest wall: a state-of-the-art review. Anaesthesia. 2021;76(Suppl 1):110–26.
6. Chin KJ, Versyck B, Elsharkawy H, Rojas Gomez MF, Sala-Blanch X, Reina MA. Anatomical basis of fascial plane blocks. Reg Anesth Pain Med. 2021;46(7):581–99.
7. Tedesco M, Capuano P, Toscano A, Sepolvere G. Combined erector spinae plane block and serratus anterior plane block for thoracic surgery: is two better than one? Minerva Anestesiol. 2023;89(9):842–4.
8. Mo X, Jiang T, Wang H, et al. Erector spinae plane block combined with serratus anterior plane block versus thoracic paravertebral block for postoperative analgesia and recovery after thoracoscopic surgery: A randomized controlled Non-inferiority clinical trial. Curr Med Sci. 2023;43(3):615–22.
9. McClellan KJ, Faulds D. Ropivacaine: an update of its use in regional anaesthesia. Drugs. 2000;60(5):1065–93.
10. Helander EM, Menard BL, Harmon CM, et al. Multimodal analgesia, current concepts, and acute pain considerations. Curr Pain Headache Rep. 2017;21(1):3.
11. Kang RA, Jeong JS, Yoo JC, et al. Improvement in postoperative pain control by combined use of intravenous dexamethasone with intravenous Dexmedetomidine after interscalene brachial plexus block for arthroscopic shoulder surgery: A randomised controlled trial. Eur J Anaesthesiol. 2019;36(5):360–8.

12. Kot P, Rodriguez P, Granell M, et al. The erector spinae plane block: a narrative review. Korean J Anesthesiol. 2019;72(3):209–20. https://doi.org/10.4097/kja.d.19.00012.
13. Jackson JC, Tan KS, Pedoto A, et al. Effects of serratus anterior plane block on early recovery from thoracoscopic lung resection: A randomized, blinded, Placebo-controlled trial. Anesthesiology. 2024;141(6):1065–74.
14. Breivik H, Borchgrevink PC, Allen SM, et al. Assessment of pain. Br J Anaesth. 2008;101(1):17–24.
15. Stark PA, Myles PS, Burke JA. Development and psychometric evaluation of a postoperative quality of recovery score: the QoR-15. Anesthesiology. 2013;118(6):1332–40.
16. Cheng XQ, Cheng J, Zhou YN, et al. Anti-nociceptive effects of Dexmedetomidine infusion plus modified intercostal nerve block during Single-port thoracoscopic lobectomy: A Double-blind, randomized controlled trial. Pain Physician. 2021;24(5):E565–72.
17. Gasbjerg KS, Hägi-Pedersen D, Lunn TH, et al. Effect of dexamethasone as an analgesic adjuvant to multimodal pain treatment after total knee arthroplasty: randomised clinical trial. BMJ. 2022;376:e067325.
18. Lv X, Zhang H, Gao J, et al. Intraoperative Dexmedetomidine on postoperative pain in Gastrointestinal surgery: an observational study. Int J Surg. 2023;109(4):887–95. https://doi.org/10.1097/JS9.0000000000000360.
19. Makkad B, Heinke TL, Sheriffdeen R, et al. Practice advisory for preoperative and intraoperative pain management of thoracic surgical patients: part 1. Anesth Analg. 2023;137(1):2–25.
20. Kwon ST, Zhao L, Reddy RM, et al. Evaluation of acute and chronic pain outcomes after robotic, video-assisted thoracoscopic surgery, or open anatomic pulmonary resection. J Thorac Cardiovasc Surg. 2017;154(2):652–e6591.
21. Bayman EO, Parekh KR, Keech J, Larson N, Vander Weg M, Brennan TJ. Preoperative patient expectations of postoperative pain are associated with moderate to severe acute pain after VATS. Pain Med. 2019;20(3):543–54.
22. Chen N, Qiao Q, Chen R, Xu Q, Zhang Y, Tian Y. The effect of ultrasound-guided intercostal nerve block, single-injection erector spinae plane block and multiple-injection paravertebral block on postoperative analgesia in thoracoscopic surgery: A randomized, double-blinded, clinical trial. J Clin Anesth. 2020;59:106–11.
23. Wu Z, Wang Q, Wu C, et al. Paravertebral vs epidural anesthesia for Video-assisted thoracoscopic surgery: A randomized trial. Ann Thorac Surg. 2023;116(5):1006–12.
24. Zhang A, Zhou Y, Zheng X, et al. Effects of S-ketamine added to patient-controlled analgesia on early postoperative pain and recovery in patients undergoing thoracoscopic lung surgery: A randomized double-blinded controlled trial. J Clin Anesth. 2024;92:111299.
25. Laigaard J, Pedersen C, Rønsbo TN, Mathiesen O, Karlsen APH. Minimal clinically important differences in randomised clinical trials on pain management after total hip and knee arthroplasty: a systematic review. Br J Anaesth.
26. Hong B, Oh C, Jo Y, et al. The effect of intravenous dexamethasone and Dexmedetomidine on analgesia duration of supraclavicular brachial plexus block: A randomized, Four-Arm, Triple-Blinded, Placebo-Controlled trial. J Pers Med. 2021;11(12):1267. Published 2021 Dec 1.
27. Xu Y, Ye M, Liu F, et al. Efficacy of prolonged intravenous Lidocaine infusion for postoperative movement-evoked pain following hepatectomy: a double-blinded, randomised, placebo-controlled trial. Br J Anaesth. 2023;131(1):113–21.
28. Beloeil H, Garot M, Lebuffe G, et al. Balanced Opioid-free anesthesia with Dexmedetomidine versus balanced anesthesia with remifentanil for major or intermediate noncardiac surgery. Anesthesiology. 2021;134(4):541–51.
29. Zheng L, Fang T, Zhang W, et al. Beneficial effects of Low-Dose intravenous Dexmedetomidine premedication in patient undergoing laparoscopic cholecystectomy under general anesthesia: A prospective, Double-Blind, randomized controlled trial. Drug Des Devel Ther. 2024;18:443–52. Published 2024 Feb 13.
30. Feng CD, Xu Y, Chen S, et al. Opioid-free anaesthesia reduces postoperative nausea and vomiting after thoracoscopic lung resection: a randomised controlled trial. Br J Anaesth. 2024;132(2):267–76.
31. Chu CC, Hsing CH, Shieh JP, Chien CC, Ho CM, Wang JJ. The cellular mechanisms of the antiemetic action of dexamethasone and related glucocorticoids against vomiting. Eur J Pharmacol. 2014;722:48–54.
32. Zhu H, Wang S, Wang R, Li B, Zhang J, Zhang W. Effect of Dexmedetomidine on postoperative nausea and vomiting in female patients undergoing radical thoracoscopic lung cancer resection. Front Pharmacol. 2024;15:1353620. Published 2024 Jan 25.
33. Myles PS, Myles DB. An updated minimal clinically important difference for the QoR-15 scale. Anesthesiology. 2021;135(5):934–5.

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