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Meta-analysis of ultrasound-guided low serratus anterior plane block combined with rectus sheath block for postoperative analgesia and side effects of upper abdominal surgery

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Abstract: *The purpose of this article is to systematically evaluate the postoperative analgesia and side effects of ultrasound-guided low serratus anterior plane block combined with rectus sheath block in upper abdominal surgery. We searched PubMed, Embase, CNKI, Wanfang Database, and Chinese Biomedical Literature Database (CBM) to find randomized controlled trials on the use of ultrasound-guided low serratus anterior plane block combined with rectus sheath block in upper abdominal surgery. The search period was defined as the database establishment until April 2024. Patients included in the analysis were divided into two groups according to according to different anesthesia methods: ultrasound-guided low serratus anterior plane block combined with rectus sheath block and general anesthesia group (experimental group), simple general anesthesia group (control group). Meta-analysis was performed using RevMan 5.3 software. Finally, 4 literatures with a total of 271 patients could be included in this systematic review. The results of meta-analysis showed that compared with the control group, the experimental group can reduce at the resting state pain scores at 2 hours after surgery (MD=-1.56, 95% CI -1.72~ -1.41, P<0.00001) , the resting state pain scores at 6 hours after surgery (MD=-1.87, 95% CI -2.03~ -1.71, P<0.00001) , the resting state pain scores at 12 hours after surgery (MD=-1.50, 95% CI -1.69~ -1.31, P<0.00001), the resting state pain scores at 24 hours after surgery (MD=-0.72, 95% CI -0.88~ -0.56, P<0.00001), the resting state pain scores at 48 hours after surgery (MD=-0.01, 95% CI -0.17~ 0.15, P=0.92), the number of postoperative analgesic pump compressions (MD=-4.22, 95% CI -4.99~ -3.45, P<0.00001) , and the incidence of nausea and vomiting (RR=0.33, 95% CI 0.17~0.64, P=0.0010). There was no significant difference in the incidence of dizziness (RR=0.58, 95% CI 0.25~ 1.35, P=0.21), and the incidence of respiratory depression (RR=0.42, 95% CI 0.10~ 1.66, P=0.21) between the two groups. The upper abdominal surgery with ultrasound-guided low anterior serrated muscle plane combined with rectus sheath block technique has obvious analgesic effect and does not cause obvious adverse reactions, which is worthy of clinical promotion.*

Keywords: *Ultrasound; low serratus anterior plane block; rectus sheath block; upper abdominal surgery; analgesia; Meta analysis*

1. Introduction

When performing surgical procedures, good analgesic measures can effectively reduce the patient's postoperative stress response, which is of great significance in preventing and reducing complications, accelerating wound healing, improving immunity, and promoting the early recovery of patients [1]. Upper abdominal surgery usually requires a large surgical incision, causing great trauma to the patient, and the patient will also show severe pain after surgery. Currently, clinical analgesic methods for upper abdominal surgery mainly include intravenous self-control analgesia and epidural analgesia, which are very accurate in terms of analgesic effect, but inevitably have their own limitations, and are therefore urgently needed to find a safer and more reliable analgesic method [2]. With the clinical application of visualization technology, ultrasound-guided nerve block is widely used. Ultrasound-guided nerve block technology is characterized by easy operation and precise positioning and medication, and combined with other measures, it can be a new choice for abdominal surgery analgesia. Ultrasound-guided low anterior serratus plane block combined with rectus sheath block is an emerging regional block

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technique, which can block the range of patients' upper abdominal surgical incision, and this block method has higher localization precision, higher success rate, fewer complications, and simpler and more effective postoperative analgesic effect, which has a broad application prospect in the clinic [3].Therefore, this study wanted to investigate the postoperative analgesic effect of ultrasound-guided low anterior serratus plane block combined with rectus sheath block on patients undergoing upper abdominal surgery as well as the incidence of adverse events, and to provide relevant evidence for its generalized use in the clinic.

2. Data and methods

2.1 Search strategy

We searched PubMed, Embase, CNGI, Wanfang Database, and Chinese Biomedical Literature Database (CBM) to find randomized controlled trials (RCTS) related to the application of ultrasound-guided low serratus anterior plane block combined with rectus sheath block in upper abdominal surgery. The search period was defined as the database establishment until April 2024. The main search Terms include: low serratus anterior plane block [MeSH Terms], suprascapular [Title/Abstract],inters calene [Title/Abstract], rectus sheath block [title/abstract], upper abdominal surgery [Title/Abstract], randomized controlled trial [Publication Type], etc. The references that have been included were traced back, and the references that met the inclusion and exclusion criteria of this study were manually searched.

2.2 Inclusion and exclusion criteria

Include RCTs published in both Chinese and English. The subjects were adult patients who underwent elective upper abdominal surgery and were divided into two groups according to different anesthesia methods : ultrasound-guided low serratus anterior plane block combined with rectus sheath block and general anesthesia group, simple general anesthesia group. Exclusion criteria: randomized cross-controlled trials, case reports, reviews, dissertations, etc., republished literature, and literature without relevant outcome indicators.

2.3 Literature screening and data extraction

Literature retrieval, preliminary screening and re-screening were conducted independently by two authors in strict accordance with the inclusion and exclusion criteria, data extraction and quality evaluation were carried out, and verification was carried out after completion. In case of differences, discussion was resolved or the third author assisted in determining. Data extraction includes :(1) general information, including author's name and publication date; (2) Study characteristics, including the number of cases in the experimental group and the control group, BMI, operation time, ASA grade, and the concentration, type and dose of local anesthetic drugs; (3) Outcome indicators, including the resting pain scores at 2h, 6h, 12h, 24h and 48h after surgery, the number of postoperative analgesic pump compressions, the postoperative nausea and vomiting, dizziness and respiratory depression.

2.4 Quality evaluation

The RCT bias risk assessment tool recommended in Cochrane Manual of Systematic Review 5.1.0 was used to evaluate the quality of the included literature. The specific evaluation scheme mainly includes the following seven aspects :(1) random method; (2) Distribution hiding; (3) the implementation of the blind method of researchers and subjects; (4) The implementation of the results evaluator blind method; (5) Result integrity; (6) Selective reporting; (7) Other bias.

2.5 Statistical Analysis

Meta-analysis was performed using RevMan 5.3 software. The measurement data are expressed as the standard mean difference (SMD) and its 95% confidence interval (CI). Binary variables are expressed as relative risk (RR) and 95%CI. Heterogeneity was tested by x^2 test. If P>0.1 and I^2<50%, the fixed effect model was selected for analysis. If P≤0.1 or I^2≥50%, the causes of heterogeneity were further analyzed, and the factors that may lead to heterogeneity were subgroup analyzed. If clinical heterogeneity was not found in the study, the random effects model was used for analysis. Funnel plots were drawn to evaluate publication bias in the included literature.

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3. Results

3.1 Literature search results

12 literatures were initially retrieved, and 4 literatures [4-7] were finally included after layer by layer screening, with a total of 271 patients. See Figure 1.

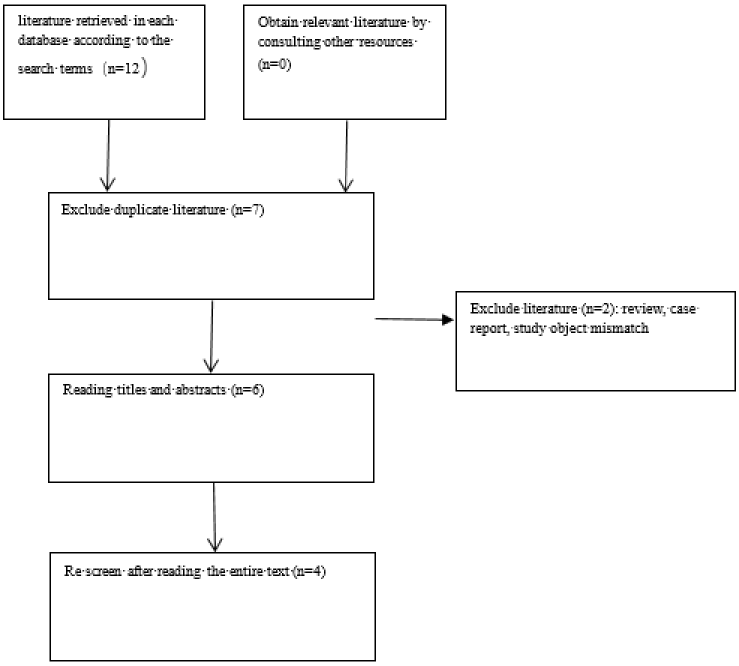

Figure 1: Literature Screening Process

3.2 Basic information and bias risk assessment of included literature

The basic characteristics of the included literature are shown in Table 1; The risk assessment of literature bias is shown in Figure 2.

Table 1: Basic characteristics of included studies

sample size		Age (years)		Gender (male/female)		BMI(kg/cm^2)		ASA classification (Level I/II)		Surgical time (min)		Local anesthetic dosage		Outcome indicators
Experimental group	Control group	Experimental group	Control group	Experimental group	Control group	Experimental group	Control group	Experimental group	Control group	Experimental group	Control group	Experimental group	Control group	
20	20											0.25% ropivacaine 45ml		2-9
33	33	46.5±8.2	48.1±8.9	18/15	16/17	23.4±3.8	25.8±4.5					0.25% ropivacaine 40ml		1-4、7-8
34	35	50.26 ± 8.26	53.71 ± 9.03	18/16	21/14	21.62 ± 3.18	22.74 ± 2.87	19/15	18/17	179.60 ± 47.83	181.75 ± 31.91	0.375% ropivacaine 45ml		4、6-7、9
48	48	46.25±3.37	45.63±3.42	26/22	30/18	23.52±2.16	24.61±1.69					0.25% ropivacaine 20ml		1-9

1, 2, 3, 4 and 5 were resting pain scores at 2h, 6h, 12h, 24h and 48h after surgery, respectively. 6 is the number of postoperative analgesic pump compressions; 7, 8 and 9 were postoperative nausea and vomiting, dizziness and respiratory depression, respectively.

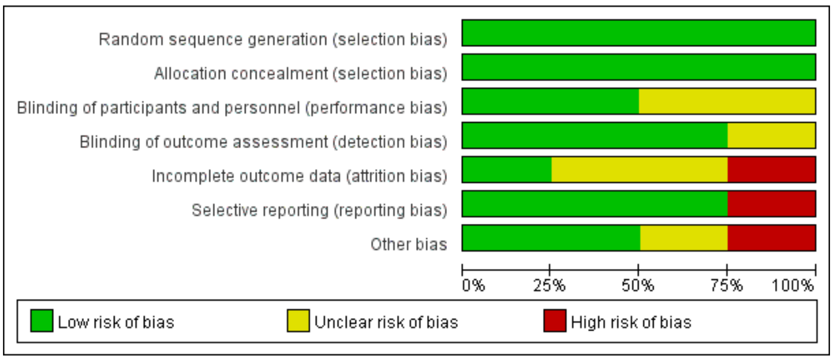

Figure 2: Bias Risk Assessment Chart

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3.2.1 Resting state pain scores at different time points after surgery for two groups of patients

Two articles [5,7] compared the resting state pain scores at 2 hours after surgery, showing significant heterogeneity (I^2=97%, P<0.00001). Using a random effects model, meta-analysis results showed that the resting state pain scores at 2 hours after surgery in the experimental group were significantly lower than those in the control group (MD=-1.56, 95% CI -1.72~ -1.41, P<0.00001) (Figure 3-A).

Three articles [4-5,7] compared the resting state pain scores at 6 hours after surgery, without significant heterogeneity (I^2=0%, P=0.77). Using a fixed effects model, meta-analysis results showed that the resting state pain scores at 6 hours after surgery in the experimental group were significantly lower than those in the control group (MD=-1.87, 95% CI -2.03~ -1.71, P<0.00001) (Figure 3-B).

Three articles [4-5,7] compared the resting state pain scores at 12 hours after surgery, showing significant heterogeneity (I^2=73%, P=0.03). Using a random effects model, meta-analysis results showed that the resting state pain scores in the experimental group were significantly lower than those in the control group at 12 hours after surgery (MD=-1.50, 95% CI -1.69~ -1.31, P<0.00001) (Figure 3-C).

Four articles [4-7] compared the resting state pain scores at 24 hours after surgery, showing significant heterogeneity (I^2=92%, P<0.00001). Using a random effects model, meta-analysis results showed that the resting state pain scores at 24 hours after surgery in the experimental group were significantly lower than those in the control group (MD=-0.72, 95% CI -0.88~ -0.56, P<0.00001) (Figure 3-D).

Two studies [4,7] compared the resting state pain scores at 48 hours after surgery, showing without significant heterogeneity (I^2=0%, P=0.96). Using a fixed effects model, meta-analysis results showed that there was no significant difference between the two groups in resting pain scores at 48 hours after surgery. (MD=-0.01, 95% CI -0.17~ 0.15, P=0.92) (Figure 3-E).

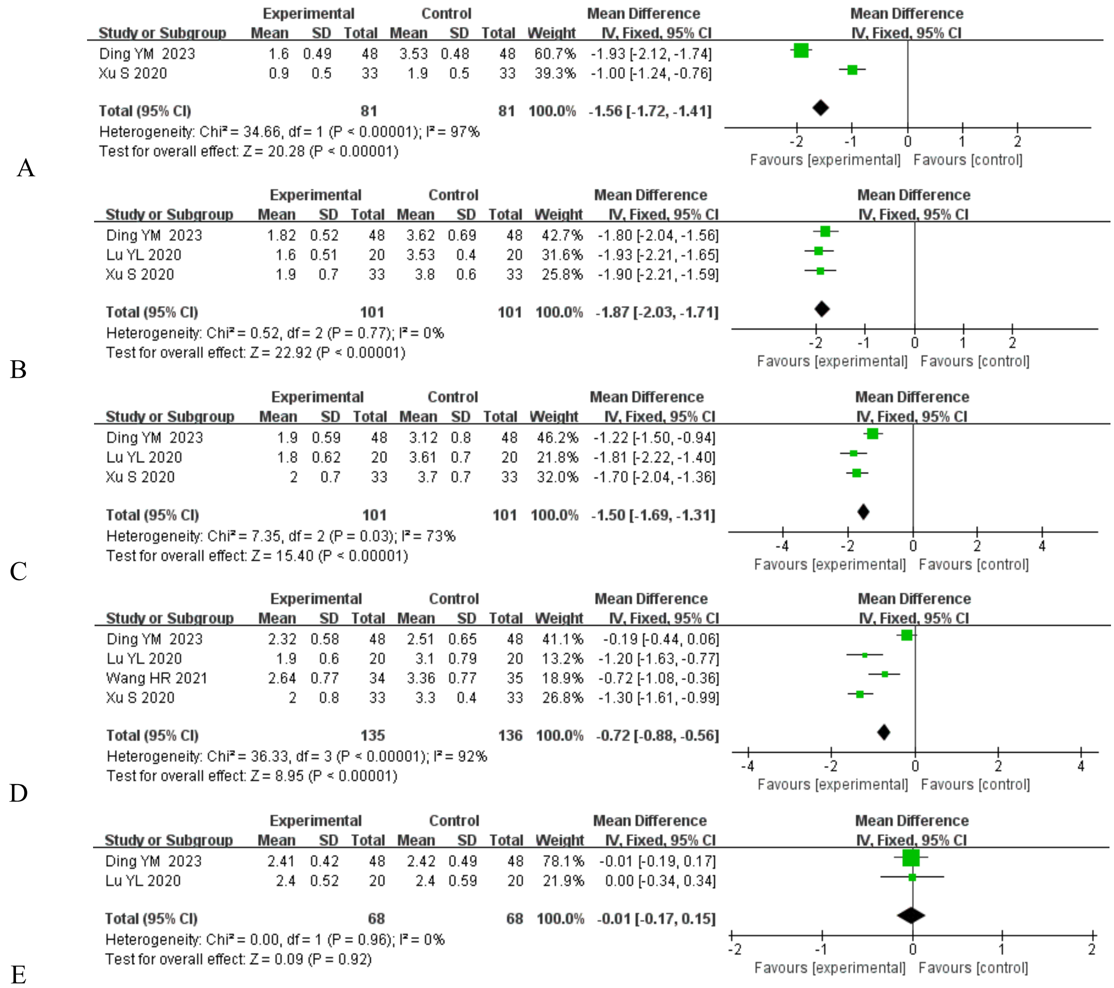

Figure 3: Resting state pain scores at different time points after surgery

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3.2.2 The number of postoperative analgesic pump compressions

Three studies [4,6-7] compared the number of postoperative analgesic pump compressions, showing without significant heterogeneity (I^2=0%, *P*=0.50). Using a fixed effects model, meta-analysis results showed that the number of postoperative analgesic pump compressions in the experimental group were significantly lower than those in the control group. (MD=-4.22, 95% CI -4.99~ -3.45, *P*<0.00001) (Figure 4).

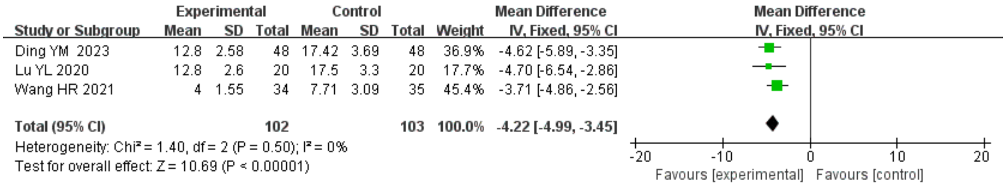

Figure 4: The number of postoperative analgesic pump compressions

3.2.3 Postoperative adverse reaction

Four articles [4-7] compared the incidence of nausea and vomiting without significant heterogeneity (I^2=0%, *P*=0.50). Using a fixed effects model, meta-analysis results showed that the incidence of nausea and vomiting in the experimental group was significantly lower than that in the control group (RR=0.33, 95% CI 0.17~0.64, *P*=0.0010) (Figure 5-A).

Three articles [4-5,7] compared the incidence of dizziness, showing without significant heterogeneity (I^2=0%, *P*=0.99). Using a fixed effects model, meta-analysis results showed that there was no significant difference between the two groups (RR=0.58, 95% CI 0.25~ 1.35, *P*=0.21) (Figure 5-B).

Three articles [4,6-7] compared the incidence of respiratory depression, showing without significant heterogeneity (I^2=0%, *P*=0.77). Using a fixed effects model, meta-analysis results showed that there was no significant difference between the two groups (RR=0.42, 95% CI 0.10~ 1.66, *P*=0.21) (Figure 5-C).

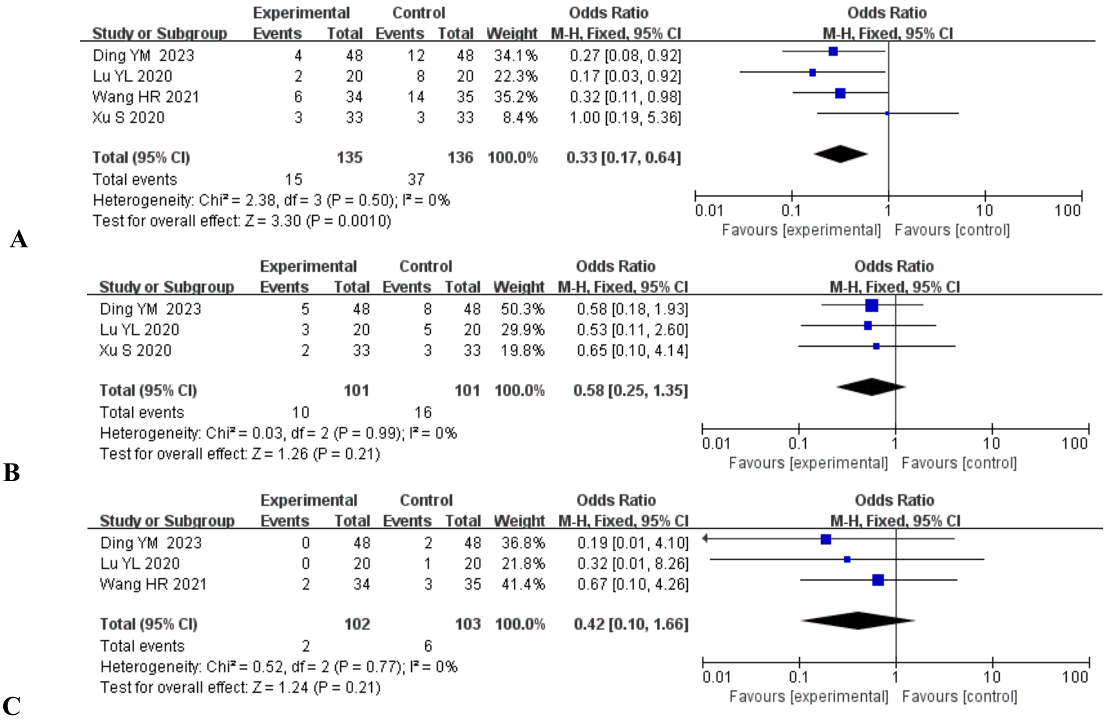

Figure 5: Postoperative adverse reaction

3.2.4 Publication bias

A funnel plot was drawn based on the resting state pain scores at 24 hours after surgery. The funnel plot was symmetrically distributed, and the results indicated a relatively large publication bias. (Figure 6)

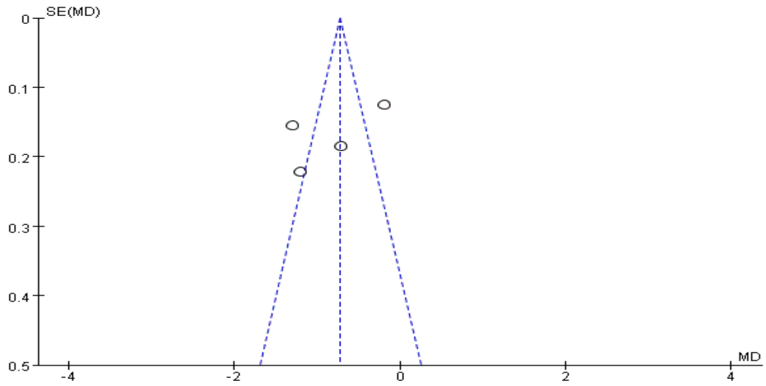

Figure 6: Funnel plot of publication bias in the resting state pain scores at 24 hours after surgery

4. Discussion

Laparoscopic surgery in abdominal surgery often leads to severe pain in patients due to the pulling of the phrenic nerve by the artificial pneumoperitoneum and the stimulation of carbon dioxide gas in the abdominal cavity in the postoperative period, and even induces a systemic stress reaction, jeopardizing the body's immune system [8]. As for open abdominal surgery, due to its incision trauma and wide range, severe pain is more common in the postoperative period, and prolonged severe pain will also cause adverse effects such as postoperative sleep disorders and slow recovery, prolonging the patient's hospitalization time [9].Therefore, effective and safe postoperative analgesia can not only eliminate the patient's tension and pain, but also reduce the stress response of the body, which is conducive to accelerating surgical recovery. With the development of accelerated rehabilitation surgery, the improvement of comfort requirements has put forward higher requirements for doctors, and multimodal analgesia is widely used in the clinic, and ultrasound-guided abdominal wall nerve block is widely used in abdominal surgery anesthesia and analgesia as a part of multimodal analgesia [10-11].

Regional nerve block techniques are widely used in the field of anesthesia, especially in the implementation of ultrasound-guided nerve block technology advantages are more obvious, which can achieve precise positioning, so that the puncture risk and the reduction of complications is greatly reduced. Ultrasound-guided anterior serratus plane block, as a new method of local anesthesia, has been used to control pain in the anterolateral chest wall through ultrasound localization at the level of the mid-axillary line and the 5th rib by injecting a certain amount of local anesthetic into the superficial or deep anterior serratus muscle and blocking the intercostal nerves of the 3rd to 6th ribs, the long thoracic nerve, and the thoracic dorsal nerves, and has been used in breast surgery, rib fracture, and open-heart surgery [12-13]. In view of the fact that chest wall nerve block can provide effective analgesia for the abdominal cutaneous innervation area, and the effect is most obvious in the upper abdominal wall incision.It has been shown that moving the needle entry plane down 3 rib spaces can significantly enhance the range of abdominal block, which makes it possible to meet the analgesic requirements of liver surgical incisions [14], and, together with the rectus abdominis muscle sheath block technique, it can make up for the shortcomings of the anterior serratus plane block plane, which cannot cover the anterior chest wall. From the theoretical block range and anatomy, sound-guided low anterior serratus plane block combined with rectus sheath block can achieve satisfactory analgesia for patients undergoing upper abdominal surgery, therefore, this meta-analysis included recent correlation literature to analyze and assess its postoperative analgesic effects and adverse effects.

The results of this Meta-analysis suggest that compared with general anesthesia alone, ultrasound-guided low anterior serratus plane block combined with rectus sheath block in patients undergoing upper abdominal surgery significantly reduced resting state pain scores at 2 hours postoperatively, 6 hours postoperatively, 12 hours postoperatively, 24 hours postoperatively, and 48 hours postoperatively, demonstrating that the chest wall nerve block combined with the abdominal nerve block can provide effective abdominal dermatomal innervation area analgesic effect and the duration of action was prolonged [15-16]. Compared with the control group, the number of postoperative analgesic pump presses and the incidence of nausea and vomiting were also significantly reduced in the experimental group.

In summary, the results of this study suggest that ultrasound-guided low anterior serratus plane block combined with rectus sheath block is used in patients undergoing upper abdominal surgery for a

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significant decrease in postoperative resting pain scores and a long-lasting effect, but also significantly reduces the amount of opioids, and there is no increase in the incidence of adverse events. Therefore, ultrasound-guided low anterior serratus plane block and rectus sheath block can effectively inhibit patients' postoperative pain with good safety, maximize patients' clinical prognosis, and accelerate patients' recovery.

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