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Meta-analysis of improved thoracolumbar interfascial plane block on postoperative analgesia and adverse reactions in patients undergoing lumbar surgery

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Abstract: *The objective of this article was to analyze the analgesic effects and adverse reactions of ultrasound-guided modified thoracolumbar interfascial plane (mTLIP) block in patients undergoing lumbar surgery. We searched PubMe d, EMBASE, Springer, Cochrane Library, Chinese Biomedical Literature Database, CNKI, Wanfang Database and VIP database. Randomized controlled trial (RCT) to analyze the analgesic effect of mTLIP after lumbar surgery. Resting pain scores at 2h, 6h, 12h, 24h and 48h, respectively, the pain score of exercise state 24h after operation , the amount of sufentanil used after surgery, the number of PCIA press, the number of postoperative remedial analgesia, the incidence of adverse reactions such as nausea, vomiting and hypotension and the satisfaction rating were compared. A total of 4 RCTs meeting the criteria were obtained (n=286). Compared with the Control group, the experimental group showed a significant decrease at 2 hours post surgery (MD=-0.28, 95% CI -0.46~ -0.10, P=0.002), 12 hours post surgery (MD=-0.49, 95% CI -0.76~ -0.21, P=0.0006), 24 hours after surgery (MD=-0.54, 95% CI -0.76~ -0.31, P<0.00001) , 48 hours post surgery (MD=-0.46, 95% CI -0.66~ -0.26, P<0.00001) , the number of postoperative remedial analgesia (RR=0.35, 95% CI 0.18~ 0.67, P=0.002) , the incidence of nausea and vomiting (RR=0.35, 95% CI 0.17-0.72, P=0.004).There was no significant difference between the two groups at 6 hours post surgery, (MD=-0.21, 95% CI -0.41~ -0.00, P=0.05) ,24 hours after operation (MD=-0.21, 95% CI -0.46~ 0.04, P=0.10) ,the amount of sufentanil used after surgery (MD=-0.32, 95% CI -1.84~ 1.20, P=0.68),the number of PCIA press (MD=0.29, 95% CI -0.42~ 1.00, P=0.43) . the incidence of hypotension (RR=0.30, 95% CI 0.03~ 2.94, P=0.30). Compared with the Control group, the experimental group showed a significant increase at the satisfaction rating (MD=0.81, 95% CI 0.56~ 1.05, P< 0.00001). Ultrasound-guided mTLIP combined general anesthesia used in lumbar surgery can significantly reduce the postoperative resting state pain score, reduce the number of postoperative relief analgesia, reduce the incidence of postoperative nausea and vomiting, and higher postoperative satisfaction score.*

Keywords: *Ultrasound; modified thoracolumbar interfascial plane; lumbar surgery; analgesia; Meta-analysis*

1. Introduction

Spinal surgery involves the stripping of muscle, fascia and other tissues, which often causes severe pain in patients after surgery, affects their early postoperative activities, causes venous thrombosis in the lower extremities, and prolongs their hospitalization [1]. Multimodal analgesia for spinal surgery not only relieves patients' postoperative pain and reduces the need for postoperative opioid analgesia, but also improves spinal surgery patient satisfaction, shortens hospitalization time, and reduces surgical costs [2].Conventional measures to improve postoperative pain are mainly local infiltration anesthesia at the incision, but the results are not satisfactory. With the development of ultrasound technology, the safety and accuracy of peripheral nerve block techniques have been improved and have become an important part of multimodal analgesic protocols. Currently, common nerve block techniques used to relieve postoperative pain in the lumbar spine include bilateral erector spinae plane block (ESPB), thoracolumbar interfascial plane (TLIP) block, and modified thoracolumbar interfascial plane (mTLIP) block.The development of peripheral nerve blocks has provided effective analgesia and improved patient satisfaction in patients undergoing lumbar spine surgery, but different nerve block techniques produce different analgesic effects in the postoperative period, and the incidence of associated adverse events

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varies. Therefore, this meta-analysis compares several common types of nerve block techniques and incisional infiltration anesthesia in postoperative lumbar spine patients.

2. Data and methods

2.1 Literature search

Computer search databases include PubMed, Springer, EM-BASE, Cochrane Library, China Biomedical Literature Database, CNKI, Wanfang Database, VIP database. The retrieval period was from the establishment of the database to April 2024. Chinese keywords: ultrasound guidance, modified thoracolumbar interfascial plane block, lumbar spine, analgesia. English search words :ultrasound-guided, ultrasound, type-b ultrasonic, modified thoracolumbar fascial plane block, mTLIP, lumbar, lumbar The spine. The references of the included RCT literature were browsed, and the literature that met the research criteria was manually searched.

2.2 Inclusion criteria and exclusion criteria

Reference inclusion criteria :(1) Study type was RCT, regardless of whether blind method was used. (1) Subjects: Patients undergoing lumbar surgery, regardless of race, age, sex, height, weight; ② Intervention measures: Comparison of ultrasound-guided mTLIP with other nerve block methods or blank control or local invasive anesthesia; ③ Study type: randomized controlled trial (RCT); (4) Main outcome indicators: resting pain score 2h, 6h, 12h, 24h, 48h after surgery; Pain score of exercise state 24h after operation; ; (5) Secondary outcome indicators: postoperative sufentanil dosage, number of PCIA compressions, number of postoperative relief analgesia, incidence of postoperative nausea, vomiting, hypotension and other adverse reactions and satisfaction scores. Document exclusion criteria :(1) Documents whose full text is not available or original data is required. (2) Duplicate publications. (3) Letters, reviews, case studies and animal studies.

2.3 Literature screening and data extraction

After the two researchers independently screened relevant literature according to inclusion and exclusion criteria, the basic data of each study was extracted according to the pre-extraction table, and the full text was read when necessary. In case of disagreement, we will discuss together and if no agreement can be reached, it will be resolved by arbitration by the third party evaluator.

2.4 Bias risk assessment for included studies

The methodological quality of the included literature was independently assessed by two investigators using the bias risk assessment tools recommended in the Cochrane Manual of Systematic Evaluators, including random sequence generation, assignment concealment, blind implementation, outcome data integrity, selective reporting, and other bias.

2.5 Statistical Processing

RevMan5.3 software provided by the Cochrane Collaboration was used for analysis. Continuous measurement is expressed using mean difference (MD) and its 95% confidence interval (CI), or standardized mean difference (SMD) and 95%CI if the measurement method is different. Counting variables are expressed as odds ratios (OR) and their 95%CI. X^2 test was used to analyze the heterogeneity of the included study results, $P>0.1$ or $I^2<50\%$, and fixed effect model was selected. $P\leq 0.1$ or $I^2\geq 50\%$, random effects model was used.

3. Results

3.1 Literature screening results

According to the retrieval method in the article, a total of 15 articles were retrieved, and after layer by layer screening based on inclusion and exclusion criteria, 4 RCTs [7-10] were ultimately obtained. See Figure 1.

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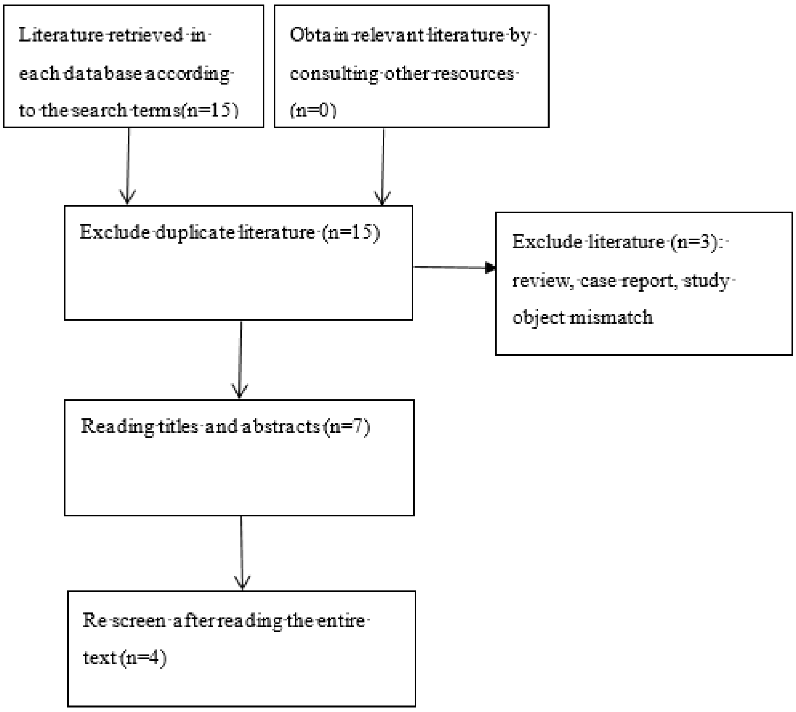

Figure 1: Literature Screening Process

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

literature	sample size		Age (years)		Gender (male/female)		BMI(kg/cm^2)		ASA classification (Level I/II)		Surgical time (min)		Local anesthetic dosage		Blocking mode of control group	Outcome indicators
	TLIP 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		
Hu L 2020 [3]	29	30	61.5±11.0	61.6±11.8	16/13	18/12	23.4±2.1	24.1±1.9			134.0±22.5	143.2±34.3	0.375% ropivacaine 20ml	0.375% ropivacaine 20m	TLIP block	7-8、10-12
Zeng JF 2022 [4]	37	37	43.08±9.07	43.67±8.72	14/23	16/21	22.98±2.41	23.08±2.32	17/20	19/18			0.25% bupivacaine 20ml	0.5% bupivacaine 20ml	Incision infiltration	4-6、9-10
Sun GY 2023 [5]	30	30	49.6±11.6	50.6±10.2	16/14	14/16					203.2±56.3	207.1±60.4	0.4% Ropivacaine 20 mL+20 μg dexmedetomidine	-	-	1-6、8-10、12
Peng HL 2023 [6]	51	42	45. 71 ±6. 24	46. 07 ±6. 47	28/23	23/19			30/21	24/18			0.375% ropivacaine 20ml	0.375% ropivacaine 20m	ESPB	1-5、7-11

1, 2, 3, 4 and 5 were resting pain scores at 2h, 6h, 12h, 24h and 48h, respectively. 6 was the pain score of exercise state 24h after operation; 7 was the amount of sufentanil used after surgery; 8 is the number of PCIA press; 9 was the number of postoperative remedial analgesia; 10 and 11 were the incidence of adverse reactions such as nausea, vomiting and hypotension;12 is the satisfaction rating.

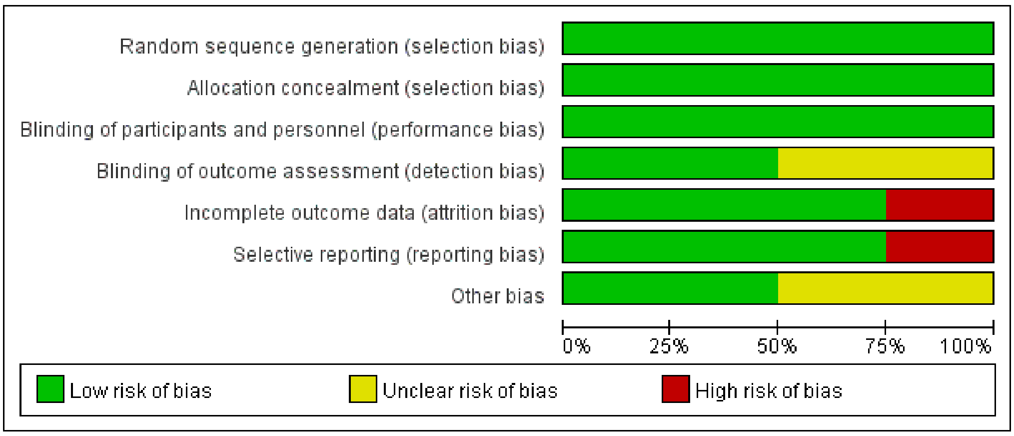

Figure 2: Bias Risk Assessment Chart

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

Two articles [5-6] compared the resting state pain scores at 2 hours post surgery, without significant heterogeneity (I^2=0%, *P*=1.00). Using a fixed effects model, meta-analysis results showed that the resting state pain scores at 2 hours post surgery in the experimental group were significantly lower than those in the control group (MD=-0.28, 95% CI -0.46~ -0.10, *P*=0.002) (Figure 3-A).

Two articles [5-6] compared the resting state pain scores at 6 hours post surgery, without significant heterogeneity (I^2=30%, *P*=0.23). Using a fixed effects model, meta-analysis results showed that there was no significant difference between the two groups in resting pain scores at 6 hours after operation. (MD=-0.21, 95% CI -0.41~ -0.00, *P*=0.05) (Figure 3-B).

Two articles [5-6] compared the resting state pain scores at 12 hours post surgery, showing significant heterogeneity (I^2=84%, *P*=0.01). 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 post surgery (MD=-0.49, 95% CI -0.76~ -0.21, *P*=0.0006) (Figure 3-C).

Two articles [5-6] compared the resting state pain scores at 24 hours after surgery, showing significant heterogeneity (I^2=87%, *P*=0.005). 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 (MD=-0.54, 95% CI -0.76~ -0.31, *P*<0.00001) (Figure 3-D).

Three studies [4-6] compared the resting state pain scores at 48 hours post surgery, showing significant heterogeneity (I^2=79%, *P*=0.008). 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 48 hours post surgery (MD=-0.46, 95% CI -0.66~ -0.26, *P*<0.00001) (Figure 3-E).

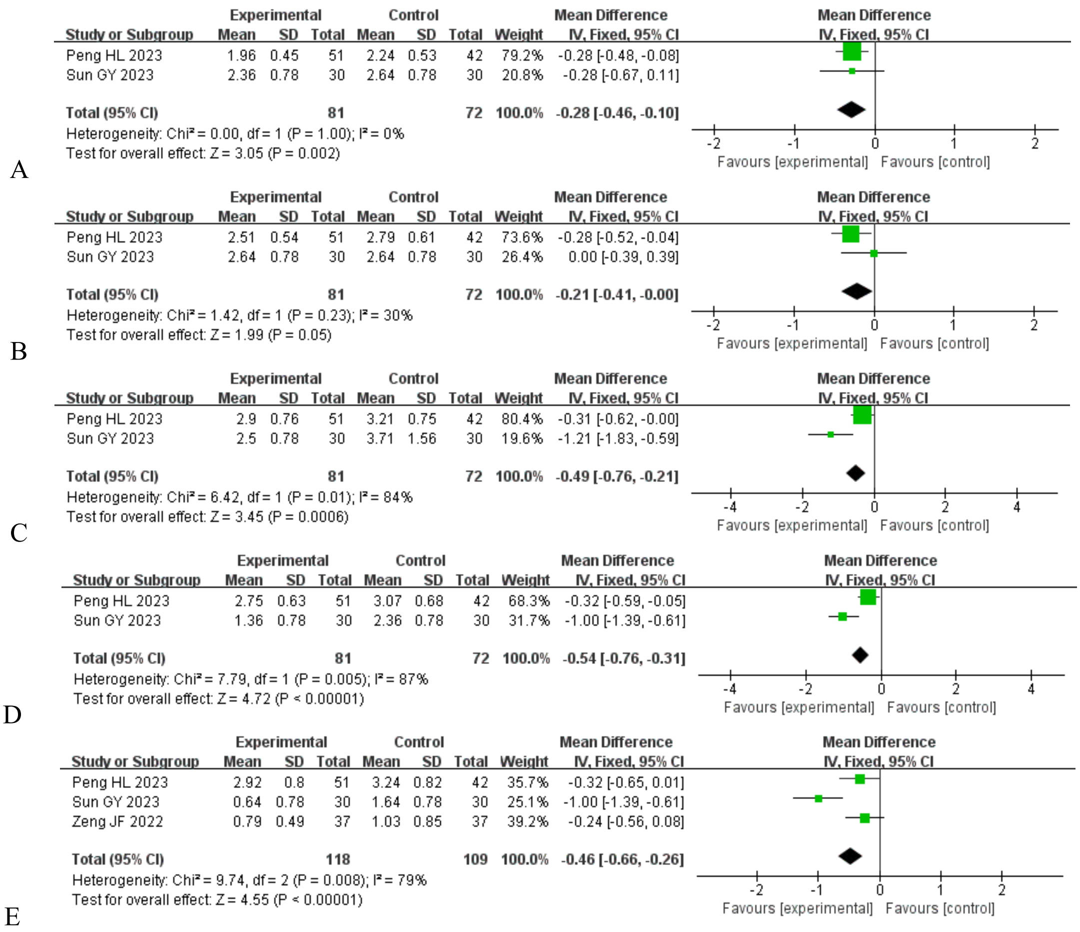

Figure 3: Resting state pain scores at different time points after surgery

3.2.2 Pain scores in exercise state 24 hours after operation between the two groups

Two articles [4-5] compared the pain scores in exercise state 24 hours after operation without

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significant heterogeneity (I^2=0%, *P*=0.64). Using a fixed effects model, meta-analysis results showed that there was no significant difference between the two groups in exercise state 24 hours after operation. (MD=-0.21, 95% CI -0.46~ 0.04, *P*=0.10) (Figure 4).

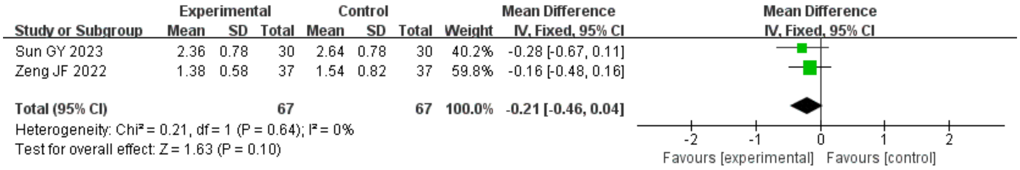

Figure 4: Pain scores in exercise state 24 hours after operation

3.2.3 Secondary indexes related to postoperative analgesia

Two articles [3,6] compared the amount of sufentanil used after surgery, showing significant heterogeneity (I^2=83%, *P*=0.02). Using a random effects model, meta-analysis results showed that there was no significant difference between the two groups (MD=-0.32, 95% CI -1.84~ 1.20, *P*=0.68) (Figure 5-A).

Three articles [3,5-6] compared the number of PCIA press, showing significant heterogeneity (I^2=92%, *P*<0.00001). Using a random effects model, meta-analysis results showed that there was no significant difference between the two groups (MD=0.29, 95% CI -0.42~ 1.00, *P*=0.43) (Figure 5-B).

Three articles [4-6] compared the number of postoperative remedial analgesia, without significant heterogeneity (I^2=0%, *P*=0.42). Using a fixed effects model, meta-analysis results showed that the number of postoperative remedial analgesia in the experimental group were significantly lower than those in the control group (RR=0.35, 95% CI 0.18~ 0.67, *P*=0.002) (Figure 5-C).

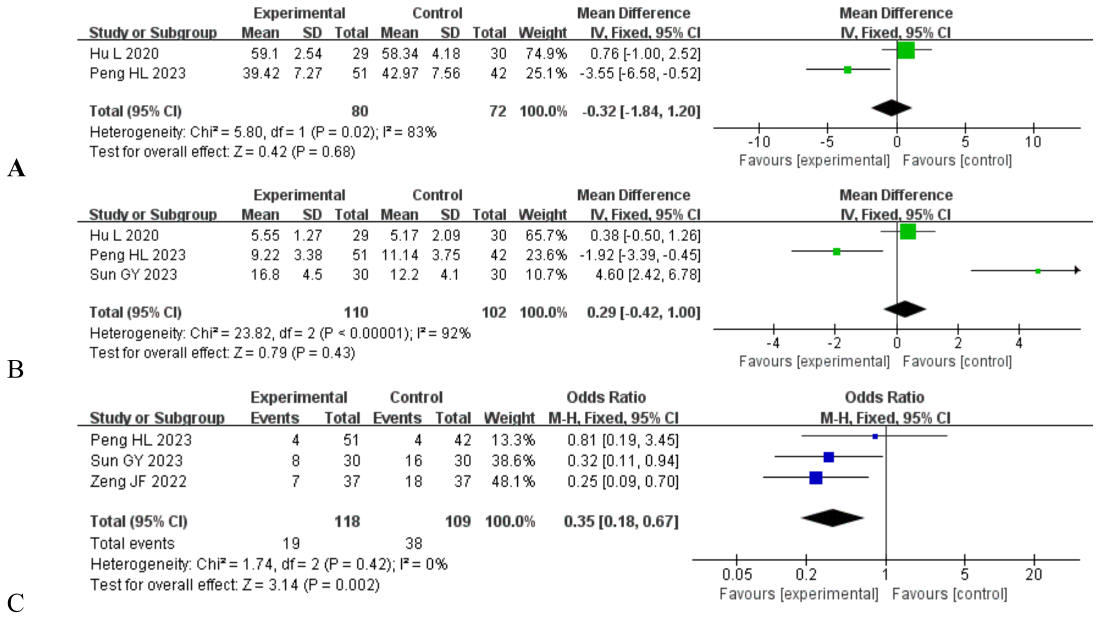

Figure 5: Secondary indexes related to postoperative analgesia

3.2.4 Postoperative adverse reaction

Four articles [3-6] compared the incidence of nausea and vomiting without significant heterogeneity (I^2=11%, *P*=0.34). 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=0.35, 95% CI 0.17-0.72, *P*=0.004) (Figure 6-A).

Two articles [3,6] compared the incidence of hypotension without significant heterogeneity (I^2=0%, *P*=0.93). Using a fixed effects model, meta-analysis results showed that there was no significant difference between the two groups (RR=0.30, 95% CI 0.03~ 2.94, *P*=0.30) (Figure 6-B).

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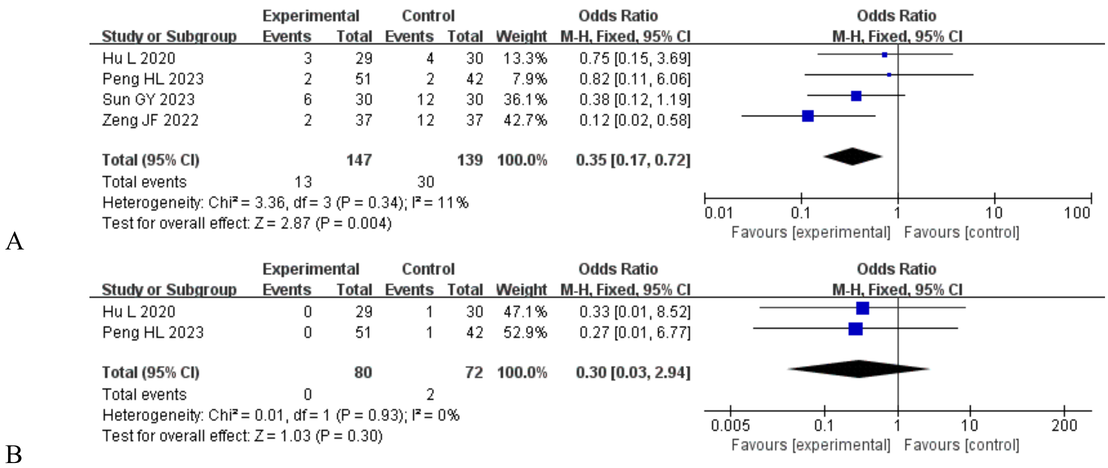

Figure 6: Postoperative adverse reaction

3.2.5 Satisfaction rating

Two articles [3,5] compared the satisfaction rating, showing significant heterogeneity (I^2=78%, *P*=0.03). Using a random effects model, meta-analysis results showed that the experimental group was significantly higher than the control group (MD=0.81, 95% CI 0.56~ 1.05, *P*< 0.00001) (Figure 7).

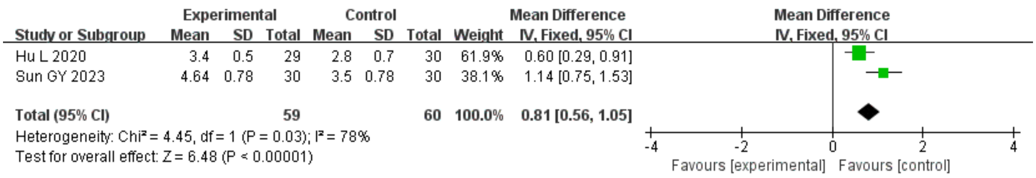

Figure 7: Satisfaction rating

3.2.6 Publication bias

A funnel plot was drawn based on the incidence of nausea and vomiting. The funnel plot was symmetrically distributed, and the results indicated a relatively small publication bias. (Figure 8)

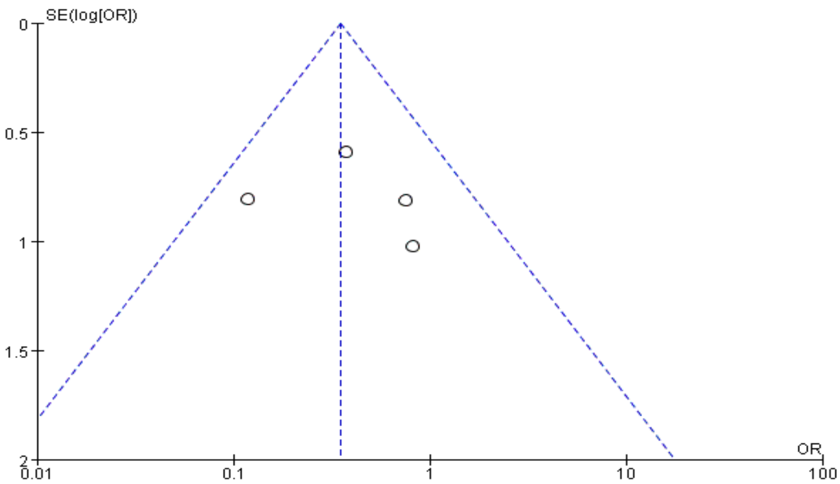

Figure 8: Funnel plot of publication bias in the incidence of nausea and vomiting

4. Discussion

Lumbar spine surgery is one of the commonly used procedures in the clinical treatment of orthopedic lumbar spine diseases, and in the perioperative period, if you want to effectively alleviate the postoperative pain and stress reaction of patients, you should apply effective anesthesia to the patients, which can further promote the prognosis of the patients' recovery. Incisional infiltration is a local anesthetic solution infiltrated into the surgical area. Although incisional infiltration is inexpensive, easy

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to perform, and can be effective in a short period of time, the local anesthetic injection process is blind, there are differences in the ability of the injected tissues to absorb local anesthetics, and it only provides analgesia to the site of administration [7].ESPB is a novel interfascial planar nerve block technique, which was first proposed by Forero et al [8] in 2016.The erector spinae muscle is the longest and largest of the dorsal muscles, with a wider coverage, and when anesthetic is injected into the erector spinae muscle between the transverse processes of the vertebral body, local anesthetic is able to pass through the connective tissues in the intertransverse processes and infiltrate along the patient's dorsal and ventral spinal nerves, providing analgesia for the skin of the torso and the viscera in the body [9].Clinical case reports have confirmed that ESPB can provide good analgesia for postoperative spinal surgery patients, and is simple, easy to implement, safe and reliable [10].

TLIP block is a newly proposed interfascial plane block technique in recent years, first described by Hand et al [11] in 2015, which aims to block the posterior branch of spinal nerves in the thoracolumbar segment, and achieved good analgesic results in clinical applications. , whose classic technique is to inject a local anesthetic solution between the multifidus and longissimus muscles by advancing the needle from lateral to medial [12]. mTLIP block was proposed by Ahiskalioglu et al [13] in 2019. mTLIP is modified in terms of the direction of the needle and the site of the injected medication compared to the traditional medial approach, and the local anesthetic is injected into the interspace of the longest muscle and iliac ribs from the medial side to lateral side The local anesthetic is injected into the gap between the longest muscle and the iliocostalis muscle from medial to lateral, and through the diffusion between the fascia, the posterior root branches of the spinal nerves that travel in this fascia are effectively blocked, and the surgical area of the thoracolumbar fracture can be covered [14].Different block modalities have their own advantages and disadvantages, and in order to compare the therapeutic effects of different postoperative analgesic regimens on patients undergoing lumbar spine surgery, the above analgesic modalities were comparatively analyzed in this study.

5. Conclusions

The results of this Meta-analysis suggest that compared with local infiltration anesthesia, ESPB block and TLIP block, lumbar spine surgery patients using mTLIP block had significantly lower resting pain scores at 2h, 12h, 24h and 48h postoperatively, as well as lower number of postoperative therapeutic analgesia and incidence of nausea and vomiting. This may be due to the fact that the drug diffusion range of mTLIP block is more limited, which can avoid spreading to the non-operative area, so the analgesic effect is better [15]. Moreover, the ultrasound imaging of mTLIP block technique is easier to identify the fascia between the longest muscle and the iliac rib muscle, and the puncture is more accurate, which shortens the operation time and thus potentially reduces the incidence of related adverse events [9].As a result patient satisfaction is higher.

In summary, the results of this study suggest that the use of guided mTLIP combined with general anesthesia in lumbar spine surgery significantly reduces postoperative resting state pain scores, decreases the number of postoperative relief analgesia, reduces the incidence of postoperative nausea and vomiting, and improves postoperative satisfaction scores.

This systematic evaluation study has the following shortcomings: (1) some studies in the included literature were not identical in terms of anesthesia protocols, ultrasound localization modalities and imaging methods, and local anesthetic drug concentration and dosage, which may increase clinical heterogeneity; (2) relatively few high-quality papers were included; (3) the way in which pain levels were assessed varied among studies, so measurement bias may be induced; and (4) the funnel plot suggests the possibility of a publication bias. Combined with the above shortcomings, the conclusions of this study need to be validated by multicenter, large-sample, and high-quality RCTs due to the limitation of the number of original studies.

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