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# Meta-analysis of postoperative analgesia and adverse reactions of low anterior serratus plane block in patients undergoing renal surgery

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***Abstract:*** *The purpose of this paper is to compare the effects of low anterior serratus block combined with general anesthesia and general anesthesia alone on postoperative analgesia and adverse reactions in patients undergoing renal surgery through a meta-analysis. The computer system searched Pubmed, Embase, CochraneLibrary, WebofScience, CNKI, Wanfang and VIP databases to collect the published studies on the effects of low anterior serratus block combined with general anesthesia on postoperative analgesia in patients undergoing renal surgery. RevMan5.3 was used to summarize and analyze the collected data. A total of 220 patients were included in 4 randomized controlled trials (RCTS), including 110 patients in the experimental group and 110 patients in the control group. Compared with the Control group, the experimental group showed a significant decrease at the resting pain scores at 1h after surgery (MD=-1.78, 95% CI -2.28~ -1.27, P<0.00001), at 6 hours after surgery (MD=-1.99, 95% CI -2.27~ -1.70, P<0.00001) , at 12 hours after surgery (MD=-2.07, 95% CI -2.33~ -1.82, P<0.00001) , at 24 hours after surgery (MD=-0.76, 95% CI -0.95~ -0.57, P<0.00001), at 48 hours after surgery (MD=-1.01, 95% CI -1.25~ -0.77, P<0.00001), the amount of remifentanil used during the operation,(MD=-173.97, 95% CI -224.78~ -123.76, P<0.00001), and the incidence of nausea and vomiting (MD=0.13, 95% CI 0.04~ 0.42, P=0.0005) . There was no significant difference between the two groups in the amount of propofol used during the operation (MD=-47.42, 95% CI -106.71~ -11.87, P=0.12). The selection of low anterior serratus block as the postoperative analgesic method for patients undergoing renal operation can provide good analgesic effect.*

***Keywords:*** *Ultrasound; low anterior serratus block; renal surgery; analgesia; Meta analysis*

## 1. Introduction

Laparoscopy has gradually replaced traditional open procedures as the primary choice for renal surgery, and despite the use of modern laparoscopic techniques, the incidence of pain in patients after renal surgery remains high. The causes of pain after renal surgery are multifaceted; incisions in the lower abdomen, renal injury, ureteral colic and urethral discomfort may contribute to the development of postoperative pain in patients [1]. Enhanced recovery after surgery (ERAS) and visual anesthesia techniques have become the mainstream thinking and techniques in clinical work [2].ERAS requires that clinical anesthesia incorporate the technique of regional block, so that the patient is more comfortable in the perioperative period and faster recovery, shortening the length of hospital stay. In order to adapt to the requirements of ERAS, the visualization technology of clinical anesthesia by means of ultrasound guidance has been greatly developed.Ultrasound-guided low anterior serratus block, as a novel regional block technique, was introduced by Blanco et al [3] and continuously improved, it is simple and safe to perform, and anatomically analyzed to provide effective perioperative analgesia for renal area surgery. Therefore, we collected relevant literature in recent years to explore the analgesic effects and adverse effects of general anesthesia combined with low anterior serratus block applied to patients undergoing renal surgery, and to provide relevant evidence for the clinical application of this technique.

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## 2. Data and methods

### *2.1 Search strategy*

Based on Cochrane reviews and preferred reporting items for systematic reviews and meta-analysis protocol guidelines, We searched the studies on the effects of ESPB and SAPB on postoperative analgesia in Pubmed, Embase, Cochrane Librarian.web of Science, CNKI, Wanfang, and VIP databases. To search the literature since the establishment of the database, English search terms : low anterior serratus plane block, kidney, analgesia. Chinese search term: low anterior serratus plane block, kidney, analgesia. Inclusion and exclusion criteria: Inclusion criteria :(1) Study type: randomized controlled trial; (2) Subjects: patients undergoing renal surgery, regardless of gender or age; (3) Study methods: low anterior serratus plane block and blank control must be included; (4) Research results: resting pain scores at 1h, 6h, 12h, 24h and 48h, the amount of propofol and remifentanil used during the operation, and the incidence of nausea and vomiting. Exclusion criteria :(1) review, systematic review, comment, etc.; (2) The research content and method are inconsistent; (3) Full text or valid data cannot be obtained.

### *2.2 Literature selection and quality evaluation*

The title and abstract were independently screened by two authors during the initial literature search, and the inclusion criteria were assessed by a third party if there were any inconsistencies. The quality assessment was conducted by two authors according to the Cochrane risk bias assessment tool. The evaluation criteria were :(1) whether random allocation was used; (2) Whether the distribution method is hidden; (3) Whether researchers and subjects are blinded; (4) Whether the research results are evaluated by blind method; (5) the integrity of the result data; (6) whether to selectively report research results; (7) Other sources of bias. The risk of bias was assessed independently for each study and assigned as low risk of bias, high risk of bias, or undefined risk of bias.

### *2.3 Statistical Methods*

Meta-analysis was performed using RevMan 5.3 software. Relative risk (RR) was used for counting variables, and mean difference (MD) was used for continuous variables. The heterogeneity of the included literatures was tested using 95% confidence interval (Cl), and P<0.05 was considered statistically significant. If $I^2$ is less than 50%, the data homogeneity is considered to be good, and the fixed effect model is selected. If $I^2$ was greater than 50%, it indicated that there was heterogeneity in the data, and sensitivity analysis, subgroup analysis or Meta regression were used to exclude heterogeneity. If heterogeneity cannot be excluded, the random effects model is selected for effect size combination.

## 3. Results

### *3.1 Literature screening results*

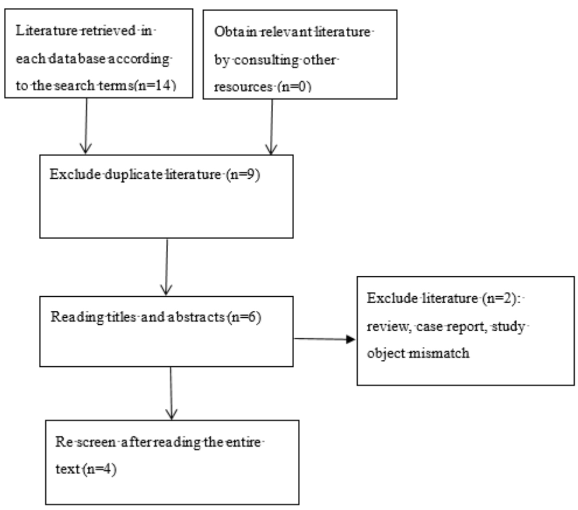


*Figure 1: Literature Screening Process*

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According to the retrieval method in the article, a total of 14 articles were retrieved, and after layer by layer screening based on inclusion and exclusion criteria, 4 RCTs [4-7]were ultimately obtained. See Figure 1.

### *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 | | 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 | |
| Liao JT 2021 [4] | 30 | 30 | 49.87 ±13.23 | 51.03 ±10.64 | 17/13 | 19/11 | 24.10±0.73 | 24.69±0.70 | 4/26 | 3/27 | 146.4 ±45 | 156±45.6 | 0.5% ropivacaine 30ml | | 1-7 |
| Liao JQ 2021 [5] | 30 | 30 | 42.2±6.1 | 39.1±8.5 | 22/8 | 16/14 | 21.4±1.3 | 20.8±1.4 | 6/24 | 8/22 | 55.9±23.3 | 57.4 ± 15.3 | 0.3% bupivacaine 25ml | | 2-4、6-8 |
| Wang CG 2021 [6] | 30 | 30 | 55.4±7.3 | 54.8±7.7 | 15/15 | 15/15 | | | | | 73.8±09.9 | 75.2±10.8 | 0.375% ropivacaine 15ml | | 3-5、8 |
| Bai LQ 2022 [7] | 20 | 20 | | | | | | | | | | | 0.25% ropivacaine 30ml | | 1-5 |
| 1, 2, 3, 4 and 5 were resting pain scores at 1h, 6h, 12h, 24h and 48h after surgery, respectively. 6 and 7 were the amount of propofol and remifentanil used during the operation, respectively. 8 was the incidence of nausea and vomiting. | | | | | | | | | | | | | | | |

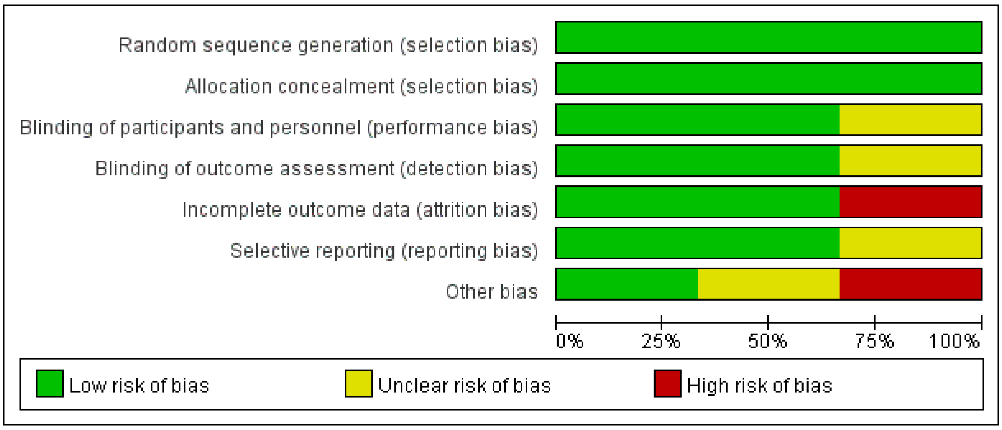


*Figure 2: Bias Risk Assessment Chart*

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

Two articles [4,7] compared the resting pain scores at 1h after surgery , without significant heterogeneity ($I^2$=34%, *P*=0.22). Using a fixed effects model, meta-analysis results showed that the resting pain scores at 1h after surgery in the experimental group were significantly lower than those in the control group (MD=-1.78, 95% CI -2.28~ -1.27, *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*=0.46). 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=-1.99, 95% CI -2.27~ -1.70, *P*<0.00001) (Figure 3-B).

Four articles [4-7] compared the resting state pain scores at 12 hours after surgery, showing significant heterogeneity ($I^2$=85%, *P*=0.0002). 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=-2.07, 95% CI -2.33~ -1.82, *P*<0.00001) (Figure 3-C).

Four articles [4-7] compared the resting state pain scores at 24 hours after surgery, showing significant heterogeneity ($I^2$=97%, *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=-0.76, 95% CI -0.95~ -0.57, *P*<0.00001) (Figure 3-D).

Three studies [4,6-7] compared the resting state pain scores at 48 hours after surgery, showing significant heterogeneity ($I^2$=96%, *P*<0.00001). Using a random effects model, meta-analysis results showed that the resting state pain scores at 48 hours after surgery in the experimental group were significantly lower than those in the control group (MD=-1.01, 95% CI -1.25~ -0.77, *P*<0.00001) (Figure 3-E).

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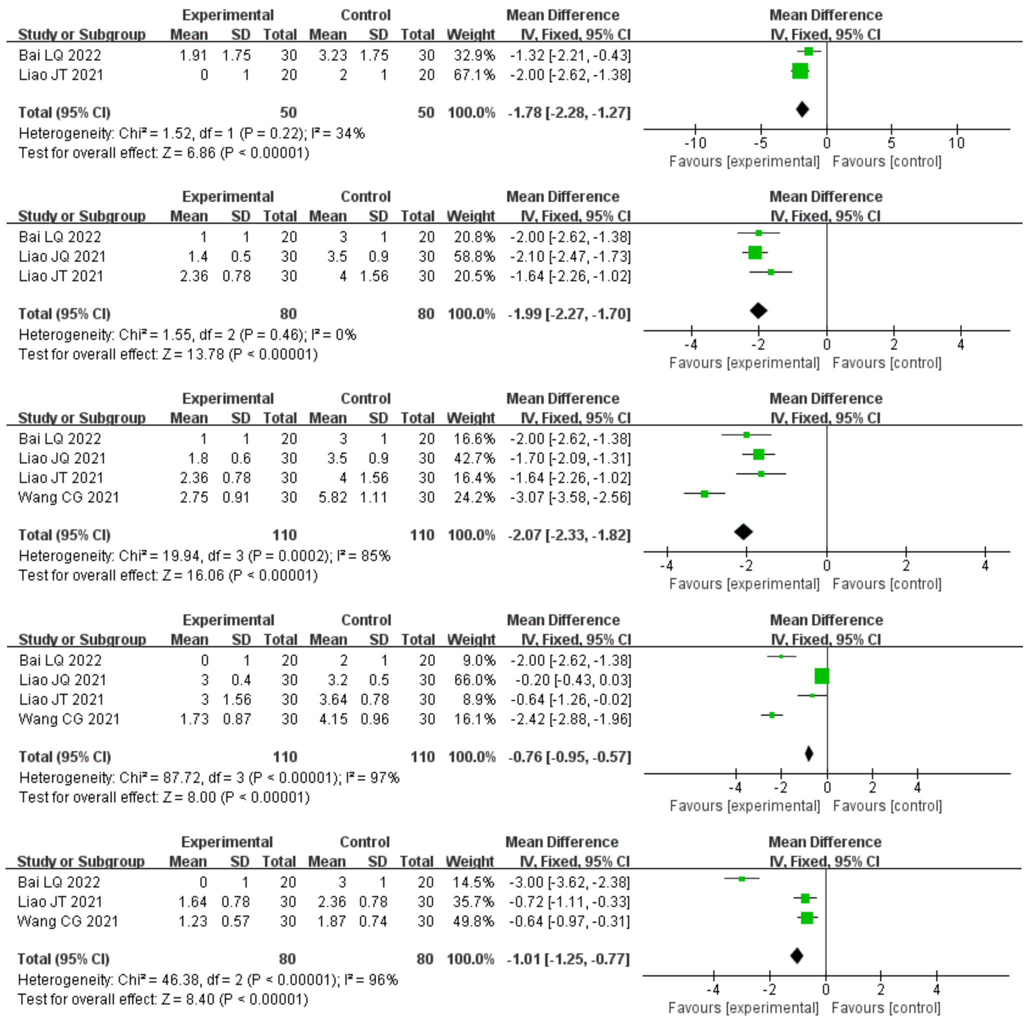


*Figure 3: Resting state pain scores at different time points after surgery*

### *3.2.2 The amount of propofol and remifentanil used during the operation*

Two articles [4-5] compared the amount of propofol used during the operation, showing significant heterogeneity ($I^2$=89%, $P$=0.002). Using a random effects model, meta-analysis results showed that there was no significant difference between the two groups in the amount of propofol used during the operation (MD=-47.42, 95% CI -106.71~ -11.87, $P$=0.12) (Figure 4-A).

Two articles [4-5] compared the amount of remifentanil used during the operation, showing significant heterogeneity ($I^2$=90%, $P$=0.002). Using a random effects model, meta-analysis results showed that the amount of remifentanil used during the operation in the experimental group were significantly lower than those in the control group (MD=-173.97, 95% CI -224.78~ -123.76, $P$<0.00001) (Figure 4-B).

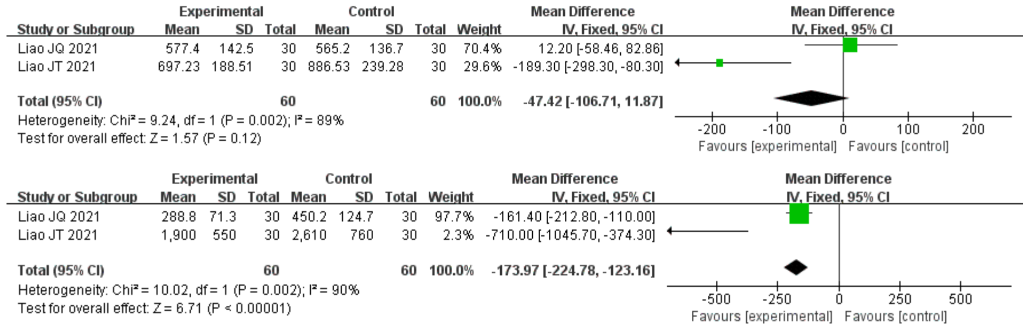


*Figure 4: The amount of propofol and remifentanil used during the operation*

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#### *3.2.3 The incidence of nausea and vomiting*

Two articles [5-6] compared the incidence of nausea and vomiting, showing without significant heterogeneity (I2=0%, P=0.7). Using a fixed effects model, meta-analysis results showed that incidence of nausea and vomiting in the experimental group were significantly lower than those in the control group (MD=0.13, 95% CI 0.04~ 0.42, *P*=0.0005) (Figure 5).

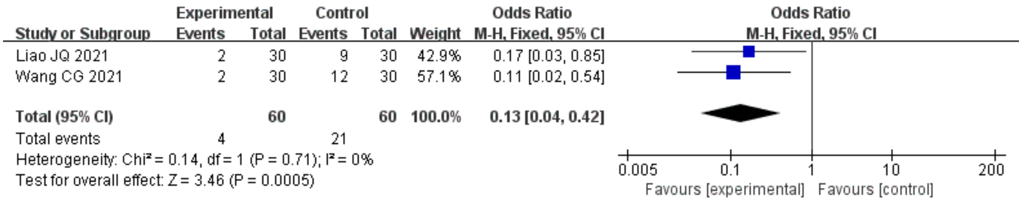


*Figure 5: The incidence of nausea and vomiting*

#### *3.2.4 Publication bias*

A funnel plot was drawn based on the resting pain scores at 12h after surgery. The funnel plot was symmetrically distributed, and the results indicated a relatively small publication bias. (Figure 6)

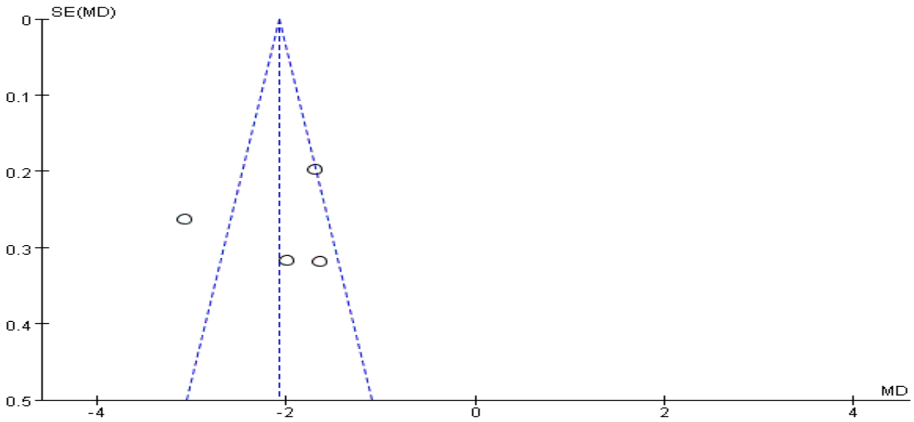


*Figure 6: Funnel plot of publication bias in the resting pain scores at 12h after surgery*

## 4. Discussion

Perioperative pain management in urologic renal surgery has been a challenge due to the specific incision sites, predominantly lumbar and lower abdominal incisions, but relatively fixed body surface incisions. The pain stimulus of renal surgery mainly originates from the T8 to T12 spinal cutaneous branches, and the analgesic methods for renal surgery mainly include intravenous opioids, epidural analgesia, and regional nerve blocks, of which intravenous opioids are prone to cause circulatory and respiratory depression in the postoperative period [8].Epidural analgesia is effective, but there are more complications, difficult to care for and other shortcomings, and in patients receiving anticoagulation therapy is limited [9-10]; regional nerve block in surgery has been widely studied, compared with the paravertebral, lumbar and erector spinae nerve block, ultrasound-guided anterior serratus nerve block operation is relatively simple, the structure of the more easily recognizable, and avoids the risk of misplacement of local anesthetic into the epidural space resulting in extensive epidural block. It also avoids the risk of extensive epidural block caused by local anesthetic drugs mistakenly entering the epidural space [11].

Ultrasound-guided serratus anterior plane block is an injection of a local anesthetic drug into the superficial or deep surface of the serratus anterior muscle at the level of the fifth rib in the midaxillary line, which is widely used for analgesia in thoracic and breast surgery [12-13]. Low serratus anterior plane block is the injection point moved down to the midaxillary line at the level of the eighth rib, can also be applied to the epigastric surgery analgesia [14-15]. The superficial position of the serratus anterior muscle makes it easy to be localized by ultrasound, and the adjacent muscles, ribs and pleura can be clearly visualized, and the drugs can be injected in the superficial or deep surface of the serratus anterior muscle without the need to see the specific nerves, so ultrasound-guided serratus anterior planar block has the advantages of visualization, safety, simplicity and effectiveness[16]. The position of anterior serratus plane block can be selected lying position, can be carried out at the same time with the induction of general anesthesia, patient comfort is high, does not affect the surgical process, convenient to carry out the implementation [17-18].Theoretically and anatomically, ultrasound-guided low anterior serratus plane block can bring desirable postoperative analgesia to patients undergoing renal surgery, but there is less evidence at present, so this study investigated the postoperative analgesic effect and the occurrence of adverse events by including the relevant literature in recent years for Meta-analysis.

## 5. Conclusion

The results of this Meta-analysis suggest that the resting pain scores of patients undergoing renal surgery with combined ultrasound-guided low anterior serratus planar block were significantly lower at 1, 6, 12, 24, and 48 hours postoperatively compared with general anesthesia alone, and the probable reason for this is the nociceptive afferents that are directly blocked by the ultrasound-guided anterior serratus nerve block. In the low anterior serratus block, the medicinal fluid can diffuse to T7 ~ T11, and the incisional pain afferents of renal surgery are mainly from the dermal branch of T10 ~ L12 segments [19]. Therefore, low anterior serratus nerve block may directly block the dermatomal branch of this segment to relieve the pain and stress caused by surgical stimulation.Remifentanil use was also significantly lower in patients with combined nerve block compared to controls, and the incidence of nausea and vomiting was also significantly reduced, suggesting that general anesthesia combined with a low anterior serratus block can reduce the use of opioids and the incidence of related adverse events.

In conclusion, the results of this study suggest that the selection of low anterior serratus muscle block as a postoperative analgesic method can provide good postoperative analgesia for patients undergoing renal surgery, and reduce the use of opioids, reduce the incidence of related adverse events, and contribute to the rapid recovery of the patients in the postoperative period.

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.

## References

*[1] Aniskevich S,Taner CB,Perry DK,et al. Ultrasound-guided transversus abdominis plane blocks for patients undergoing laparoscopic hand-assisted nephrectomy:a randomized,placebo-controlled trial[J]. Local Reg Anesth,2014,7(1):11-16.*

*[2] Garmpis N, Dimitroulis D, Garmpi A, et al. Enhanced recovery after surgery: is it time to change our strategy regarding laparoscopic colectomy? [J]. In Vivo, 2019, 33(3):669-674.*

*[3] Blanco R,Parras T,McDonnell JG,et al. Serratus plane block: a novel ultrasound-guided thoracic wall nerve block [J] .Anaesthesia, 2013,68( 11) : 1107 - 1113.*

*[4] Liao Jiatao, Li Bixi, Song Xiaoyang, et al. Study on analgesic effect of ultrasound-guided low serratus anterior plane block in robot-assisted nephrectomy [J]. Journal of Medical Research, 2021,50(1):141-144,36.*

*[5] Liao Jiaqi, Tian Yi, LIAO Haiming. Effect of ultrasound-guided low anterior serration plane block on analgesia after percutaneous nephrolithotomy [J]. Journal of Clinical Anesthesiology, 2021, 37(12): 1254-1257.*

*[6] Wang Chunguang, Wang Chongyu, Bian Xiaocui, et al. Analgesic effect of low anterior serratus plane block on patients undergoing renal cancer surgery [J]. Journal of Nantong University (Med Edition), 2019, 41 (3):278-280.*

*[7] Bai Leqin, LAI Wei-Rong, MA Hua-Bin. Analysis of postoperative analgesia effect of ultrasound-guided low anterior serranus plane block in PCNL (percutaneous nephrolithotomy) [J]. Chinese Science and Technology Journal Database (Abstract Edition) Medicine and Health, 2022,(01):175-177.*

*[8] Huang MM,Su ZT,Becker R,et al. Complications after open and robotic-assisted radical prostatectomy and association with post - operative opioid use: an analysis of Data from the Preventer Trial[J].BJU International, 2020.*

ISSN 2706-6819 Vol.6, Issue 5: 90-96, DOI: 10.25236/IJFM.2024.060512

*[9] Kang XH,Bao FP,Xiong XX,et al. Major complications of epiduralanesthesia: a prospective study of 5083 cases at a single hospital[J].Acta Anaesthesiol Scandinav, 2014, 58(7): 858 - 866.*

*[10] Wong GK,Arab AA,Chew SC,et al. Major complications related to epidural analgesia in children: a 15 - year audit of 3,152 epidurals[J]. Canadian J Anaesthe, 2013, 60(4): 355 - 363.*

*[11] Jian Meiru, Liu Gang, Sun Qiaoxia, et al. Application of anterior serratus muscle block in general anesthesia radical mastectomy for breast cancer [J]. Shandong medicine, 2019, 59( 3) : 71 - 74.*

*[12] Park MH, Kim JA, Ahn HJ, et al. A randomised trial of serratus anterior plane block for analgesia after thoracoscopic surgery[J]. An-aesthesia, 2018, 73(10) : 1260 -1264.*

*[13] Chong M, Berbenetz N, Kumar K, et al. The serratus plane block for postoperative analgesia in breast and thoracic surgery: a systematic review and meta analysis[J]. Reg Anesth Pain Med, 2019.*

*[14] Hou Xueqi, Chai Bin, Lin Wenxin, et al. Effects of ultrasound-guided rhomboid- intercostal muscle-low anterior serratus plane block on postoperative analgesia in patients undergoing laparoscopic nephrectomy [J]. Journal of Clinical Anesthesiology, 2020, 36(4): 322-325.*

*[15] Fernšndez Martín MT, López Álvarez S, Sanllorente Sebastišn R. Serratus anterior plane block for upper abdominal incisions hasbeen previously reported[J]. Anaesth Intensive Care, 2019, 47(5):472-473.*

*[16] Saad FS, El Baradie SY, Abdel Aliem M, et al. Ultrasound-guided serratus anterior plane block versus thoracic paravertebral block for perioperative anaerobic anaerobias in thoracotomy[J] .Saudi J Anaesth, 2018, 12(4): 565-570.*

*[17] Jack JM, McLellan E, Versyck B, et al. The role of serratus an-terior plane and pectoral nerves blocks in cardiac surgery, thoracic surgery and trauma:a qualitative systematic review[J] . An-aesthesia, 2020, 75(10): 1372-1385.*

*[18] Qiu Y, Wu J, Huang Q, et al. Acute pain after serratus anteriorplane or thoracic paravertebral blocks for video assisted thoracoscopic surgery: A noninferiority randomized trial[J]. Eur J Anaesthesiol, 2021, 38(Suppl 2): S97-S105.*

*[19] Elsharkawy H,Maniker R,Bolash R,et al. Rhomboid intercostal and subserratus plane block: a cadaveric and clinical evaluation[J].Regional Anesth Pain Med, 2018,43( 7) : 745 - 751.*