

# World Journal of *Clinical Cases*

*World J Clin Cases* 2021 December 6; 9(34): 10392-10745



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Thrice Monthly Volume 9 Number 34 December 6, 2021

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**RESPONSIBLE EDITORS FOR THIS ISSUE**

Production Editor: Yan-Xia Xing; Production Department Director: Yun-Jie Ma; Editorial Office Director: Jin-Lei Wang.

**NAME OF JOURNAL**

*World Journal of Clinical Cases*

**ISSN**

ISSN 2307-8960 (online)

**LAUNCH DATE**

April 16, 2013

**FREQUENCY**

Thrice Monthly

**EDITORS-IN-CHIEF**

Dennis A Bloomfield, Sandro Vento, Bao-Gan Peng

**EDITORIAL BOARD MEMBERS**

<https://www.wjgnet.com/2307-8960/editorialboard.htm>

**PUBLICATION DATE**

December 6, 2021

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<https://www.wjgnet.com/bpg/gerinfo/208>

**ARTICLE PROCESSING CHARGE**

<https://www.wjgnet.com/bpg/gerinfo/242>

**STEPS FOR SUBMITTING MANUSCRIPTS**

<https://www.wjgnet.com/bpg/GerInfo/239>

**ONLINE SUBMISSION**

<https://www.f6publishing.com>



## Retrospective Study

# Combined lumbar muscle block and perioperative comprehensive patient-controlled intravenous analgesia with butorphanol in gynecological endoscopic surgery

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**Author contributions:** Zhu RY and Xiang SQ designed the experiment; Zhu RY and Xiang SQ contributed equally and considered as co-first authors; Chen DR drafted the work; Zhu RY collected the data; Xiang SQ analyzed and interpreted data; Zhu RY and Chen DR wrote the article.

**Institutional review board**

**statement:** This study was approved by the Central Hospital of Enshi Tujia and Miao Autonomous Prefecture Ethics Committee.

**Informed consent statement:** All study participants provided informed written consent prior to study enrollment.

**Conflict-of-interest statement:** The authors declare that there are no conflicts of interest.

**Data sharing statement:** No additional data are available.

**Country/Territory of origin:** China

**Specialty type:** Anesthesiology

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## Abstract

### BACKGROUND

Laparoscopic surgery has become a common surgical approach for the clinical treatment of intra-abdominal lesions in recent years. We hypothesized that lumbar block with postoperative patient-controlled intravenous analgesia (PCIA) by butorphanol after gynecological surgery under general anesthesia would be more effective than PCIA by butorphanol alone.

### AIM

To investigate the effect of lumbar block with PCIA by butorphanol after gynecological surgery under general anesthesia.

### METHODS

This study assessed 120 women scheduled for laparoscopic surgery at our hospital between May 2017 and May 2020. They were divided using a random number table into a research group (those who received quadratus lumborum block combined with PCIA analgesia by butorphanol) and a control group (those who received only PCIA analgesia by butorphanol), with 60 patients in each group. Demographic factors, visual analog scale scores for pain, serum inflammatory markers, PCIA compressions, Ramsay scores, and adverse events were compared between groups using a *t*-test, analysis of variance, or  $\chi^2$  test, as appropriate.

### RESULTS

There were no significant differences in demographic factors between groups (all  $P > 0.05$ ). The visual analog scale scores of the research group in the resting state

**Provenance and peer review:**

Unsolicited article; Externally peer reviewed.

**Peer-review report's scientific quality classification**

Grade A (Excellent): 0  
Grade B (Very good): 0  
Grade C (Good): C  
Grade D (Fair): 0  
Grade E (Poor): 0

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**Received:** August 6, 2021

**Peer-review started:** August 6, 2021

**First decision:** September 1, 2021

**Revised:** September 8, 2021

**Accepted:** October 14, 2021

**Article in press:** October 14, 2021

**Published online:** December 6, 2021

**P-Reviewer:** Rafique M

**S-Editor:** Wang JL

**L-Editor:** Filipodia

**P-Editor:** Wang JL



12 h and 24 h postoperatively were significantly lower than those of the control group ( $P < 0.05$ ). Two hours after surgery, there were no significant differences in the levels of serum tumor necrosis factor- $\alpha$ , interleukin (IL)-6, or IL-8 between groups ( $P > 0.05$ ). The serum tumor necrosis factor- $\alpha$  levels of the research group 24 h postoperatively were significantly lower than those of the control group ( $P < 0.05$ ). The levels of serum IL-6 and IL-8 in the study group 24 h and 48 h postoperatively were significantly lower than those in the control group ( $P < 0.05$ ).

**CONCLUSION**

Lumbar block with PCIA with butorphanol after gynecological surgery under general anesthesia significantly improves the analgesic effect and reduces the degree of inflammation, instances of PCIA compression, and adverse reactions.

**Key Words:** Quadratus lumborum block; Butorphanol; Patient-controlled intravenous analgesia; Analgesic effect

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**Core Tip:** A total of 120 cases of patients undergoing laparoscopic surgery in our hospital were taken as the research subjects, and it was confirmed that gynecological surgery combined with patient-controlled intravenous analgesia combined with butorphanol can significantly improve the analgesic effect, reduce the degree of inflammation, reduce the times of patient-controlled intravenous analgesia compression, and adverse reactions in patients.

**Citation:** Zhu RY, Xiang SQ, Chen DR. Combined lumbar muscle block and perioperative comprehensive patient-controlled intravenous analgesia with butorphanol in gynecological endoscopic surgery. *World J Clin Cases* 2021; 9(34): 10540-10548

**URL:** <https://www.wjgnet.com/2307-8960/full/v9/i34/10540.htm>

**DOI:** <https://dx.doi.org/10.12998/wjcc.v9.i34.10540>

**INTRODUCTION**

After the establishment of CO<sub>2</sub> pneumoperitoneum during gynecological laparoscopic surgery, the focal tissues need to be completely removed, resulting in surgical trauma. General anesthesia guarantees adequate analgesia and sedation during laparoscopic surgery and maintains hemodynamic stability during the operation[1,2]. However, if postoperative pain is not effectively controlled, the neuroendocrine-immune network is activated, the risk of postoperative complications is increased, and patients can experience negative emotions and sleep disorders, which are not conducive to physical or mental health[3]. Inhibiting the immune function of patients with gynecological malignancies can also lead to tumor escape, increasing the risk of tumor recurrence or metastasis after surgery[4-8]. Therefore, active analgesic therapy is needed after gynecological laparoscopic surgery[9,10].

Patient-controlled intravenous analgesia (PCIA) is a common and convenient analgesic method after general anesthesia. Patients control the release of analgesic drugs by pressing an analgesic pump as required to obtain pain relief. However, the excessive use of anesthetics can cause a variety of adverse reactions[11]. Therefore, some scholars have suggested that early postoperative multimodal analgesia can be used to accelerate rehabilitation, and regional block is an important aspect of multimodal analgesia that can reduce surgical stress and the required dose of anesthetics[12,13]. Here, the results of a study exploring the effects of lumbar block combined with PCIA with butorphanol on postoperative analgesia after gynecological surgery under general anesthesia are reported[11,13].



## MATERIALS AND METHODS

### General information

We selected 120 women scheduled for laparoscopic surgery in our hospital between May 2017 and May 2020 and randomly divided them into two equal groups (both  $n = 60$ ) depending on if they received lumbar block with PCIA by butorphanol (research group) or PCIA by butorphanol alone (control group). The inclusion criteria were as follows: (1) Patients who underwent gynecological laparoscopic surgery; (2) Age 37-years-old to 75-years-old; (3) No missing information; and (4) The patients or their families gave informed consent before the implementation of this study, which was approved by the medical ethics committee. The exclusion criteria were as follows: (1) Unconfirmed pathological diagnosis; (2) Acute myocardial infarction, mental illness, or chronic renal dysfunction; (3) Alzheimer's disease or language and communication disorders; (4) Other malignant tumors; or (5) Missing data.

Patients in the research group were 37-years-old to 75-years-old, with an average age of  $57.7 \pm 7.8$  years. Patients in the control group were 40-years-old to 75-years-old, with an average age of  $55.8 \pm 7.1$  years. There was no significant difference in age between the two groups ( $P > 0.05$ ).

### Anesthesia and postoperative analgesia method

Both groups received laparoscopic surgery under general anesthesia, routine electrocardiogram monitoring after entering the room, and detection for bispectral index by sticking electrodes on the forehead. Anesthesia was induced by successive intravenous injection of 0.05 mg/kg midazolam, 3.0 mg/kg fentanyl, 1.5-2.0 mg/kg propofol, and 0.15 mg/kg cisatracurium. Endotracheal intubation was performed after the eyelash reflex disappeared and was connected to the anesthesia machine for mechanical ventilation, with a tidal volume of 6-8 mL/kg and respiratory rate of 8-12 breaths/min. Fentanyl (1 µg/kg) was injected intravenously before skin incision, with continuous maintenance by 4-6 mg/kg propofol and 0.1-0.2 µg/kg/min remifentanyl. Cisatracurium was injected intermittently to maintain muscle relaxation with a bispectral index value of 45-55. When systolic blood pressure was higher than basal systolic blood pressure by 25%, nitroglycerin was used to control blood pressure. When systolic blood pressure was lower than basal systolic blood pressure by 25%, ephedrine or norepinephrine was adopted to boost blood pressure. Atropine was given when the heart rate was below 50 bpm, and esmolol was given when it was above 100 bpm. Propofol administration was stopped before skin suturing and remifentanyl at the end of operation.

The control group was given PCIA analgesia by butorphanol at the end of the operation. The PCIA formula consisted of 0.125 mg/kg butorphanol, 8 mg tropisetron, and normal saline to 100 mL. The background infusion dose was 2 mL, a single dose was 3 mL, and the locking time was 15 min.

The research group was treated with quadratus lumborum block combined with the same PCIA analgesia protocol as the control group. Quadratus lumborum block was performed as follows. The patient was placed in the lateral position with local disinfection and a towel. The ultrasonic probe was placed horizontally on the anterior superior iliac spine near the axillary midline. An oval muscle was seen at the aponeurosis formed by the transverse abdominal muscle, referred to as the quadratus lumbalis. The classic "clover" structure was seen when the ultrasonic probe was tilted caudally. After performing puncture 0.5-1.0 cm behind the ultrasonic probe, 1-2 mL of 2% lidocaine was injected for local anesthesia. With the guidance of ultrasound, the needle was inserted from the dorsal side toward the ventral side to the posterolateral edge of the quadratus psoas muscle. If no gas or liquid was pumped back, 1-2 mL of normal saline was injected to confirm the position. After local injection of 20 mL 0.375% ropivacaine, local anesthetic drugs could be seen in the psoas quadratus muscle after the formation of an anechoic shadow under ultrasound. The contralateral side was blocked by the same method. If local anesthetic poisoning occurred during the injection, the injection was stopped immediately, and oxygen and sedation treatment were administered. Patients with convulsions were given an intravenous injection of propofol and succinylcholine. If circulatory failure occurred, immediate supportive treatment such as rapid fluid infusion, pressors, and cardiostimulant and auxiliary ventilation was administered. Cardiopulmonary resuscitation was performed in the event of cardiac arrest.

### Measurements

The measurements compared between the groups were as follows. The analgesic effect

was assessed by a 10-point visual analog scale (VAS) for pain[14]. The more severe the pain, the higher the VAS score. The number of PCIA compressions and the levels of inflammatory factors [serum tumor necrosis factor (TNF)- $\alpha$ , interleukin (IL)-6, and IL-8] were assessed at different timepoints. The Ramsay score[15] was used to assess patients' levels of consciousness (1 point, the patient is restless and irritable; 2 points, the patient is quiet and cooperative; 3 points, the patient is sleepy and can follow instructions; 4 points, the patient is asleep but can be woken up; 5 points, the patient is asleep, sluggish, and only responds to strong stimulation; and 6 points, the patient is deeply asleep and hard to wake up). The incidence rates of postoperative anesthesia-related adverse reactions were also compared.

To measure serum inflammatory factors, 3 mL of peripheral venous blood were collected at 4, 12, 24, and 48 h after the operation and centrifuged at 3500 rpm for 10 min within 1 h of collection. TNF- $\alpha$ , IL-6, and IL-8 were detected by enzyme-linked immunosorbent assay (Shanghai Enzyme-linked Biotechnology Co., Ltd., Shanghai, China) on a RT-96A microplate reader (Shenzhen Mindray Medical Electronics Co., Ltd., Shenzhen, China).

### **Statistical processing**

SPSS 21.0 software (IBM, Armonk, NY) was used for data processing. All measurements were normally or approximately normally distributed and expressed as mean  $\pm$  SD. The *t*-test was used to compare non-repeated data between groups. Repeated measurement data were analyzed by repeated-measures analysis of variance. The least significant difference *t*-test was used to compare timepoints. Count data were analyzed by the  $\chi^2$  test. Statistical significance was established at  $P = 0.05$ .

## **RESULTS**

### **Comparison of general information between groups**

There was no significant difference in age, gender, weight, or height between the two groups ( $P > 0.05$ ) (Table 1).

### **Comparison of VAS score for postoperative analgesia between groups**

There was no significant difference in VAS scores at rest or while coughing within 2 h postoperation between the two groups ( $P > 0.05$ ). The VAS scores of the research group at rest were significantly lower within 12 h and 24 h postoperation compared to the control group ( $P < 0.05$ ). The VAS scores of the research group while coughing were significantly lower within 4 h and 12 h postoperation compared to the control group ( $P < 0.05$ ) (Table 2).

### **Comparison of inflammatory factors between groups at different timepoints**

There were no significant differences in the levels of serum TNF- $\alpha$ , IL-6, or IL-8 within 2 h postoperation between groups ( $P > 0.05$ ). Serum TNF- $\alpha$  levels in the research group at 24 h postoperation were significantly lower than the control group ( $P < 0.05$ ), while those of IL-6 and IL-8 were significantly lower 24 h and 48 h postoperation ( $P < 0.05$ ) (Table 3).

### **Comparison of instances of PCIA compression at different timepoints between groups**

The number of PCIA compressions within 12 h, 24h, and 48 h postoperation was significantly lower in the research group compared to the control group ( $P < 0.05$ ) (Table 4).

### **Ramsay scores of both groups at different timepoints**

The Ramsay scores of the two groups were not significantly different within 12 h, 24 h, or 48 h postoperation ( $P > 0.05$ ) (Table 5).

### **Comparison of adverse reactions between groups**

Nausea and dizziness (5.00% and 1.67%, respectively) were significantly less frequent in the research group compared to the control group (18.33% and 11.67%, respectively) ( $P < 0.05$ ). There were no significant differences in the incidences of vomiting, urinary retention, or drowsiness ( $P > 0.05$ ) (Table 6).

Table 1 Comparison of general data between the two groups

General data	Study group, <i>n</i> = 60	Control group, <i>n</i> = 60	<i>t</i> / $\chi^2$ value	<i>P</i> value
Age (yr)	57.7 $\pm$ 7.8	55.8 $\pm$ 7.1	1.395	0.166
Weight (kg)	55.9 $\pm$ 5.4	57.0 $\pm$ 6.1	-1.046	0.298
Height (cm)	158.9 $\pm$ 5.2	159.6 $\pm$ 6.0	-0.683	0.496
Systolic pressure (mmHg)	122.4 $\pm$ 8.4	121.3 $\pm$ 7.0	0.779	0.437
Diastolic pressure (mmHg)	74.1 $\pm$ 6.0	75.6 $\pm$ 7.5	-1.210	0.229
Heart rate (times/min)	81.5 $\pm$ 8.0	80.4 $\pm$ 8.5	0.730	0.467
Operation time (min)	105.7 $\pm$ 16.4	107.1 $\pm$ 20.0	-0.419	0.676
Anesthesia time (min)	124.8 $\pm$ 15.0	126.4 $\pm$ 14.3	-0.598	0.551
ASA grade, <i>n</i> (%)			0.616	0.432
I	39 (65.00)	43 (71.67)		
II	21 (35.00)	17 (28.33)		
Diabetes, <i>n</i> (%)			2.596	0.107
Yes	11 (18.33)	5 (8.33)		
No	49 (81.67)	55 (91.67)		
Coronary heart disease, <i>n</i> (%)			1.081	0.298
Yes	3 (5.00)	6 (10.00)		
No	57 (95.00)	54 (90.00)		
Dyslipidemia, <i>n</i> (%)			1.677	0.195
Yes	11 (18.33)	17 (28.33)		
No	49 (81.67)	43 (71.67)		
Disease type, <i>n</i> (%)			3.597	0.308
Fibroid	22 (36.67)	30 (50.00)		
Cervical carcinoma	16 (26.67)	10 (16.67)		
Endometrial carcinoma	12 (20.00)	8 (13.33)		
Others	10 (16.67)	12 (20.00)		

## DISCUSSION

PCIA is a common postoperative analgesia method that produces transient analgesic effects through the intravenous injection of general anesthesia drugs. Patients can induce the delivery of analgesia according to their own needs; the delivery system is convenient to use, and analgesia is quick in onset[3]. Butorphanol is a mixed-receptor-agonist antagonist that can stimulate the corresponding receptors in the central nervous system to produce dual effects. This drug has several advantages, including the production of a strong, long-lasting analgesic effect with no adverse effects on respiratory function and a low-risk for dependence[16]. Blanco *et al*[17] found a good analgesic effect with patient-controlled analgesia with dexmedetomidine and butorphanol in patients undergoing hysteroscopic ectopic pregnancy surgery; this drug combination can inhibit the increase in cortisol, adrenocorticotrophic hormone, and blood glucose levels and reduce the stress response of the body. However, butorphanol cannot be used in combination with opioids, and its analgesic effect is limited when it is used alone and may lead to nausea, vomiting, lethargy, delirium, and other adverse reactions[18].

Quadratus lumborum block is a trunk nerve block technique that provides good postoperative analgesia for abdominal and lower extremity surgery[19]. One study has shown that the use of quadratus lumborum block in elderly patients after laparoscopic radical resection of rectal cancer reduces the consumption of opioids during general anesthesia, postoperative patient delirium, the consumption of opioids after surgery, and the occurrence of adverse reactions, in addition to yielding good postoperative

**Table 2 Comparison of visual analog scale scores of postoperative analgesia between the two groups (mean  $\pm$  SD, points)**

VAS scores	2 h after operation	4 h after operation	12 h after operation	24 h after operation	48 h after operation
At resting state					
Study group ( <i>n</i> = 60)	2.29 $\pm$ 0.59	2.78 $\pm$ 0.81	2.90 $\pm$ 0.78	2.45 $\pm$ 0.65	1.75 $\pm$ 0.63
Control group ( <i>n</i> = 60)	2.15 $\pm$ 0.52	3.07 $\pm$ 0.85	3.31 $\pm$ 0.88	2.81 $\pm$ 0.74	1.90 $\pm$ 0.50
<i>t</i> value	1.379	-1.913	-2.701	-2.831	-1.445
<i>P</i> value	0.171	0.058	0.008	0.005	0.151
At cough state					
Study group ( <i>n</i> = 60)	2.50 $\pm$ 0.64	3.10 $\pm$ 0.75	3.08 $\pm$ 0.81	2.94 $\pm$ 0.86	2.26 $\pm$ 0.78
Control group ( <i>n</i> = 60)	2.37 $\pm$ 0.59	3.54 $\pm$ 0.88	3.51 $\pm$ 0.89	3.12 $\pm$ 0.90	2.43 $\pm$ 0.83
<i>t</i> value	1.157	-2.948	-2.768	-1.120	-1.156
<i>P</i> value	0.250	0.004	0.007	0.265	0.250

VAS: Visual analog scale.

**Table 3 Comparison of inflammatory factor levels at different times after operation between the two groups (mean  $\pm$  SD)**

Indexes	2 h after operation	24 h after operation	48 h after operation
TNF- $\alpha$ (pg/mL)			
Study group ( <i>n</i> = 60)	161.5 $\pm$ 27.5	228.5 $\pm$ 32.4	230.6 $\pm$ 35.1
Control group ( <i>n</i> = 60)	157.8 $\pm$ 25.3	242.7 $\pm$ 29.6	238.2 $\pm$ 31.8
<i>t</i> value	0.767	-2.506	-1.243
<i>P</i> value	0.445	0.014	0.216
IL-6 (pg/mL)			
Study group ( <i>n</i> = 60)	51.77 $\pm$ 6.83	89.47 $\pm$ 9.20	83.65 $\pm$ 8.11
Control group ( <i>n</i> = 60)	54.02 $\pm$ 8.16	95.71 $\pm$ 10.36	97.20 $\pm$ 9.54
<i>t</i> value	-1.638	-3.489	-8.382
<i>P</i> value	0.104	0.001	0.000
IL-8 (pg/mL)			
Study group ( <i>n</i> = 60)	71.5 $\pm$ 13.9	94.6 $\pm$ 18.6	88.2 $\pm$ 15.7
Control group ( <i>n</i> = 60)	73.6 $\pm$ 12.5	102.5 $\pm$ 20.4	97.8 $\pm$ 16.4
<i>t</i> value	-0.870	-2.217	-3.275
<i>P</i> value	0.386	0.029	0.001

IL: Interleukin; TNF- $\alpha$ : Tumor necrosis factor- $\alpha$ .

analgesic effects[20].

In this study, VAS scores at rest and while coughing and the number of PCIA compressions were used to evaluate the analgesic effect, and the Ramsay score was used to evaluate the sedative effect. It was found that the combination of lumbar block and postoperative PCIA with butorphanol after gynecological surgery under general anesthesia helped to improve the analgesic and sedative effects and reduce the number of PCIA compressions. This is because the quadratus lumborum blocks the injection of local anesthetics between the quadratus lumborum and its surrounding thoracolumbar fascia under the guidance of ultrasound; thus, local anesthetics diffuse to the paravertebral space along the thoracolumbar and intrathoracic fascia and result in an indirect paravertebral block, which has dual analgesic effects on the abdominal wall and viscera. Simultaneously, the sympathetic nerves and receptors sensitive to local anesthetics are distributed in the thoracolumbar fascia, and quadratus lumborum

**Table 4 Comparison of patient-controlled intravenous analgesia compression times at different times after operation between the two groups (mean  $\pm$  SD, times)**

Groups	<i>n</i>	12 h after operation	24 h after operation	48 h after operation
Study group	60	1.47 $\pm$ 0.60	2.18 $\pm$ 0.56	2.64 $\pm$ 0.62
Control group	60	3.13 $\pm$ 1.02	4.30 $\pm$ 0.94	4.16 $\pm$ 0.90
<i>t</i> value		-10.866	-15.008	-10.773
<i>P</i> value		0.000	0.000	0.000

**Table 5 Ramsay score comparison of two groups at different times after operation (mean  $\pm$  SD, points)**

Group	<i>n</i>	12 h after operation	24 h after operation	48 h after operation
Study group	60	2.40 $\pm$ 0.57	2.33 $\pm$ 0.60	2.18 $\pm$ 0.56
Control group	60	2.57 $\pm$ 0.61	2.50 $\pm$ 0.74	2.31 $\pm$ 0.68
<i>t</i> value		-1.577	-1.382	-1.143
<i>P</i> value		0.117	0.170	0.255

**Table 6 Comparison of related adverse reactions between the two groups, *n* (%)**

Group	<i>n</i>	Nausea	Vomiting	Urinary retention	Dizziness	Drowsiness
Study group	60	3 (5.00)	1 (1.67)	0 (0.00)	1 (1.67)	1 (1.67)
Control group	60	11 (18.33)	2 (3.33)	2 (3.33)	7 (11.67)	3 (5.00)
<i>t</i> value		5.175	0.342	2.034	4.821	1.034
<i>P</i> value		0.023	0.559	0.154	0.028	0.309

block can reduce the activity of the sympathetic nerves and control blood pressure, thus playing a sedative role.

The inflammatory response is an important factor that causes pain. TNF- $\alpha$ , IL-6, and IL-8 are all classical inflammatory factors. When trauma occurs, mononuclear macrophages activate and release a large amount of TNF- $\alpha$ , which not only causes direct tissue damage but also stimulates the synthesis of proinflammatory factors such as IL-6 and IL-8, causing an increased inflammatory response. In this study, these inflammatory indicators were detected at different timepoints postoperation and showed that quadratus lumborum block combined with butorphanol PCIA under general anesthesia can reduce the degree of inflammation in patients after gynecological surgery, which is an important mechanism of pain relief and promotes rehabilitation.

This study also found that quadratus lumborum block combined with butorphanol PCIA after gynecological surgery under general anesthesia is beneficial for reducing adverse reactions such as nausea and dizziness. This may be related to a reduction in the numbers of PCIA compressions and the dosage of general anesthesia drugs.

Quadratus lumborum block combined with butorphanol PCIA in postoperative analgesia for gynecological surgery with general anesthesia not only has application advantages but is closely related to the reduction of inflammation, which has clinical value. However, VAS scores are strongly subjective and are greatly affected by patient tolerance, underlying diseases, and other factors, which may have impacted the results. Thus, it is necessary to identify more objective pain indicators to further prove the analgesic effect of this combination of techniques.

## CONCLUSION

In conclusion, after gynecological surgery with general anesthesia, quadratus lumborum block combined with butorphanol PCIA significantly improved the analgesic effect and reduced the degree of inflammation, the number of PCIA

compressions, and adverse reactions.

## ARTICLE HIGHLIGHTS

### Research background

Laparoscopic surgery has become a common surgical method for clinical treatment of intra-abdominal lesions.

### Research motivation

This study explored the role and influence of butorphanol in patient-controlled intravenous analgesia (PCIA) lumbar spine block after general anesthesia gynecological surgery.

### Research objectives

To explore the possible application prospect of butorphanol in PCIA lumbar block after general anesthesia gynecological surgery.

### Research methods

The investigation was conducted on 120 female patients who underwent laparoscopic surgery in our hospital from May 2017 to May 2020.

### Research results

The serum tumor necrosis factor- $\alpha$  levels of the research group 24 h postoperatively were significantly lower than those of the control group ( $P < 0.05$ ). The levels of serum interleukin-6 and interleukin-8 in the study group 24 h and 48 h postoperatively were significantly lower than those in the control group ( $P < 0.05$ ).

### Research conclusions

PCIA lumbar block with butorphanol after general anesthesia and gynecological surgery can significantly improve the analgesic effect.

### Research perspectives

Quadratus lumborum block combined with butorphanol postoperative PCIA has significantly better analgesic effects and may be more widely used.

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