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Application of different approaches of ultrasound-guided quadratus lumborum block in hysteroscopic surgery

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Abstract: Objective To investigate the effects of ultrasound-guided quadratus lumborum block (QLB) via different approaches on stress, microcirculation, and postoperative analgesia in patients undergoing hysteroscopic surgery. **Methods** A total of 80 patients scheduled for hysteroscopic surgery at the 910th Hospital of the Joint Logistic Support Force from September 2020 to September 2023 were selected as the study subjects. They were randomly divided into a control group and an observation group using a random number table method. Both groups received ultrasound-guided QLB for analgesia. The control group underwent the anterior approach to the quadratus lumborum muscle (n=40), while the observation group underwent anterolateral approach to the lateral supra-arcuate ligament (n=40). The Visual Analog Scale (VAS) was used to assess pain levels at 2 hours (T1), 4 hours (T2), 12 hours (T3), and 24 hours (T4) postoperatively. Differences in stress indicators [angiotensin Ⅱ (Ang-Ⅱ), cortisol (Cor)]and microcirculation indicators (loop morphology score and blood flow state score in nailfold microcirculation) were compared between the two groups. The incidence of postoperative 24-hour analgesic rescue, analgesic satisfaction, and the occurrence of adverse reactions were recorded for both groups. **Results** Repeated measures analysis of variance showed that for VAS scores, stress indicators, and microcirculation indicators, the between-group effects and time effects were statistically significant (P< 0.05), but the between-group × time interaction effects for stress and microcirculation indicators were not statistically significant (P>0.05). The VAS scores and serum levels of Ang-Ⅱ and Cor, as well as loop morphology and blood flow state scores at T1 to T4 in the observation group, were lower than those in the control group (P<0.05). The incidence of 24-hour postoperative analgesic rescue in the observation group was lower than that in the control group (12.50% *vs* 37.50%, χ^2=6.667, P=0.010), and analgesic satisfaction was superior to the control group (Z=3.452, P=0.001). There was no statistically significant difference in the incidence of adverse reactions between the control group and observation group (25.00% *vs* 10.00%, χ^2=3.117, P=0.078). **Conclusion** For patients undergoing hysteroscopic surgery, ultrasound- guided QLB at the lateral supra-arcuate ligament demonstrates superior effects on postoperative stress, microcirculation, and analgesia compared to the anterior approach QLB, with a high safety profile.

Keywords: Ultrasound; Quadratus lumborum block; Hysteroscopy; Stress; Microcirculation; Postoperative analgesia

Hysteroscopy is a surgical procedure performed by entering the uterine cavity through a hysteroscope [1]. Hysteroscopy is mainly used to treat diseases such as uterine fibroids, polyps, uterine adhesion separation, and uterine septum resection. Patients are susceptible to the effects of pneumoperitoneum, trauma, etc., postoperatively, leading to postoperative pain [2]. Therefore, effective pain management can not only significantly improve patient postoperative comfort but also reduce the occurrence of postoperative complications and accelerate patient recovery [3]. Quadratus lumborum block (QLB) is a nerve block anesthesia technique commonly used for analgesia in lumbar and abdominal surgeries, aiming to block branches of the thoracolumbar spinal nerves including the iliohypogastric nerve and ilioinguinal nerve [4]. QLB has been widely used in abdominal and hip surgeries both domestically and internationally, characterized by good block effect and wide block range. QLB also has positive effects in reducing nausea and vomiting and shortening postoperative bed rest time [5]. Some studies suggest that due to different puncture approaches, QLB also has significant differences in clinical effects [6]. In view of this, this study will deeply explore the effects of different ultrasound-guided approaches of QLB on postoperative stress, microcirculation, and analgesic efficacy in patients.

1 Data and Methods

1.1 General Data

This study was a prospective study. A total of 80 patients undergoing hysteroscopic surgery treated at the 910th Hospital of the Joint Logistics Support Force from September 2020 to September 2023 were included as study subjects. The patients were divided into a control group and an observation group using a random number table.

(1) Inclusion criteria [7]:

① All patients met the surgical treatment indications;

② Patients and their families gave informed consent for this study;

③ Normal mental status.

(2) Exclusion criteria:

① Complicated with mental illness or cognitive dysfunction;

② Presence of liver or kidney function abnormalities;

③ History of drug abuse;

④ Coagulation abnormalities;

⑤ Conversion to open surgery.

The control group age ranged from 36 to 55 (46.15±1.68) years; body mass index (BMI) (22.16±0.75) kg/m². The observation group age ranged from 34 to 54 (45.15±1.59) years; BMI (22.25±0.78) kg/m². There were no statistically significant differences in general information between the two groups (P>0.05). This study was approved by the Medical Ethics Committee of the 910th Hospital (Ethics Approval Number: Hospital Medical Ethics [2025] No. 87).

1.2 Methods

Both groups underwent routine preparation after entering the operating room, received oxygen inhalation for 30 minutes before surgery, and were monitored for electrocardiogram, peripheral oxygen saturation, etc. Anesthesia induction was performed with 0.3-0.5 μg/kg sufentanil (National Drug Approval Number H20203650, Jiangsu Nhwa Pharmaceutical, 1 mL:50 μg) + 1.0-2.0 mg/kg propofol (National Drug Approval Number H20123138, Jiangsu Nhwa Pharmaceutical, 20 mL:0.2 g) + 0.8 mg/kg rocuronium bromide (National Drug Approval Number H20103235, North China Pharmaceutical, 5 mL:50 mg); muscle relaxants were discontinued at the end of surgery.

Postoperatively, both groups received QLB for analgesia, using ropivacaine hydrochloride (National Drug Approval Number H20183151, Ruiyang Pharmaceutical, 100 mg:10 mL) as the analgesic drug. The ultrasound probe was placed at the level of the anterior superior iliac spine, near the mid-axillary line to the posterior axillary line, and slid along the abdominal wall muscles dorsally. The quadratus lumborum muscle was visible at the tail of the muscle layer. Continuing to slide toward the posterior midline until the level of L_4, the quadratus lumborum muscle could be clearly visualized, and puncture was initiated.

The control group received an anterior approach to the quadratus lumborum. The patient was placed in the supine position. The needle tip was passed from behind the probe into the space between the quadratus lumborum and the psoas major muscle, and 20 mL of 0.2% ropivacaine was injected. Downward pressure on the quadratus lumborum muscle shown by ultrasound indicated accurate injection.

The observation group received a supra-anterior approach to the lateral arcuate ligament of the quadratus lumborum. Under ultrasound guidance, the probe was placed vertically on both costovertebral angles and parallel to the spine. The needle was inserted from the posterior and superior direction toward the inner and inferior side. When the nerve block needle penetrated the erector spinae muscle and quadratus lumborum muscle and reached the anterior layer of the quadratus lumborum, an obvious breakthrough sensation could be felt. At this point, the needle reached the injection target area above the diaphragm characterized by the "double-track sign," and 20 mL of 0.2% ropivacaine was injected. Downward pressure on the diaphragm shown by ultrasound visualization of the "double-track sign" indicated successful puncture and injection.

1.3 Observation Indicators

(1) Pain score: Visual Analogue Scale (VAS) [8] was used to assess patient pain levels at 2 hours (T1), 4 hours (T2), 12 hours (T3), and 24 hours (T4) postoperatively. The scale score ranged from 0 to 10 points (score proportional to pain intensity).

(2) Stress indicators: Serum angiotensin (Ang)-II and cortisol (Cor) levels were measured by radioimmunoassay.

(3) Microcirculation indicators: A microcirculation observer (Daowen Medical Technology) was used to detect the morphology score of capillary loops and the blood flow pattern score.

(4) Incidence of rescue analgesia and analgesia satisfaction: Postoperative analgesic drug use within 24 hours was recorded. Satisfaction level was classified as satisfied (does not affect daily activities, stable mood), average (reduced daily activities, stable mood), and dissatisfied (significantly limited activity, agitated mood).

(5) Adverse reactions: Bleeding, infection, dizziness, headache, etc.

1.4 Statistical Methods

Data analysis was performed using SPSS 19.0 software. Measurement data conforming to normal distribution were expressed as $\bar{x} \pm s$, and comparisons were made using *t*-tests and one-way analysis of variance. Comparisons at multiple time points were performed using repeated measures analysis of variance, and pairwise comparisons were performed using the LSD-t test. Count data were expressed as case(%), and comparisons were made using the chi-square test. Ranked data were compared using the rank sum test. P<0.05 was considered statistically significant.

2 Results

2.1 Comparison of VAS scores between the two groups

The VAS scores of the two groups after surgery showed statistically significant differences in the interaction between groups, the effect of time, and the interaction between group and time (P<0.05). The VAS scores in the observation group were lower than those in the control group at each time point T1 to T4 (P<0.05); compared with T1 in the same group, the VAS scores at T2, T3, and T4 in both groups were higher; compared with T2 in the same group, the VAS scores at T3 and T4 were higher; compared with T3 in the same group, the VAS score at T4 was higher (P<0.05). See **Table 1**.

Tab.1 Comparison of VAS scores between the two groups at various time points after surgery (n=40, point, $\bar{x} \pm s$)

Group	T_1	T_2	T_3	T_4
Control group	1.65±0.34	2.35±0.49[a]	2.68±0.56[ab]	3.48±0.49[abc]
Observation group	0.15±0.58	0.58±0.49[a]	1.35±0.33[ab]	2.45±0.36[abc]
$F/P_{\text{between-group}}$ **value**	228.431/0.001			
F/P_{time} **value**	156.786/0.001			
$F/P_{\text{interaction}}$ **value**	5.210/0.002			

Note: Compared with T_1, [a]P<0.05;Compared with T_2, [b]P<0.05; Compared with T_3, [c]P<0.05.

2.2 Comparison of stress indicators between the two groups

The intergroup effect and time effect of postoperative Ang-II and Cor in the two groups were statistically significant (P<0.05), while the interaction effect was not statistically significant (P>0.05). The serum levels of Ang-II and Cor in the observation group were lower than those in the control group at each time point T1 to T4 (P<0.05). Compared with T1 in the same group, the levels of Ang-II and Cor at T2, T3, and T4 in both groups were higher; compared with T2 in the same group, the levels of Ang-II and Cor at T3 and T4 were higher; compared with T3 in the same group, the levels of Ang-II and Cor at T4 were higher (P<0.05). See **Table 2**.

2.3 Comparison of microcirculation indicators between the two groups

The intergroup effect and time effect of the capillary loop morphology score and blood flow pattern score after surgery in the two groups were significant (P<0.05), while the interaction effect was not statistically significant (P>0.05). Compared with the control group, the observation group had lower capillary loop morphology scores and blood flow pattern scores at each time point T1 to T4 (P<0.05). Compared with T1 in the same group, the capillary loop morphology scores and blood flow pattern scores at T2, T3, and T4 in both groups were higher; compared with T2 in the same group, the capillary loop morphology scores and blood flow pattern scores at T3 and T4 were higher; compared with T3 in the same group, the capillary loop morphology score and blood flow pattern score at T4 were higher (P<0.05). See **Table 3**.

2.4 Comparison of analgesic effect at 24-hours after surgery between the two groups

The incidence of rescue analgesia within 24-hours after surgery in the observation group was lower than that in the control group (P<0.05); the analgesic satisfaction in the observation group was higher than that in the control group (P<0.05). See **Table 4**.

2.5 Comparison of the incidence of adverse reactions between the two groups

The difference in the total incidence of adverse reactions between the two groups was not statistically significant (P>0.05). See **Table 5**.

Tab.2 Comparison of Ang-II and Cor between two groups at various time points after surgery (n=40, nmol/L, $\bar{x}\pm s$)

Group	Ang-II				Cor			
	T_1	T_2	T_3	T_4	T_1	T_2	T_3	T_4
Control group	220.49±16.81	212.95±15.59[a]	195.48±14.67[ab]	180.67±12.45[abc]	432.45±25.68	419.56±20.55[a]	396.58±19.59[ab]	375.89±18.65[abc]
Observation group	212.48±15.38	203.49±14.58[a]	183.86±12.76[ab]	170.45±11.05[abc]	420.56±24.59	407.89±19.54[a]	381.69±17.56[ab]	356.48±15.39[abc]
$F/P_{between-group}$ value	18.362/<0.001				24.611/<0.001			
F/P_{time} value	45.290/<0.001				58.730/<0.001			
$F/P_{interaction}$ value	1.878/0.135				2.152/0.098			

Note: Compared with T_1, [a]P<0.05;Compared with T_2, [b]P<0.05;Compared with T_3, [c]P<0.05.

Tab.3 Comparison of postoperative microcirculation indicators between two groups at various time points (n=40, point, $\bar{x}\pm s$)

Group	Loop morphology score				Blood flow state score			
	T_1	T_2	T_3	T_4	T_1	T_2	T_3	T_4
Control group	1.22±0.26	1.09±0.20[a]	0.98±0.18[ab]	0.74±0.11[abc]	1.30±0.25	1.19±0.21[a]	1.05±0.18[ab]	0.97±0.15[abc]
Observation group	1.10±0.21	0.98±0.15[a]	0.89±0.15[ab]	0.65±0.08[abc]	1.25±0.23	1.06±0.19[a]	0.90±0.16[ab]	0.74±0.13[abc]
$F/P_{between-group}$ value	12.753/<0.001				27.890/<0.001			
F/P_{time} value	38.422/<0.001				49.656/<0.001			
$F/P_{interaction}$ value	1.531/0.208				1.924/0.126			

Note: Compared with T_1, [a]P<0.05;Compared with T_2, [b]P<0.05;Compared with T_3, [c]P<0.05.

Tab.4 Comparison of analgesic effects between two groups 24-hours after surgery [n=40, case(%)]

Group	Analgesic remedy	Analgesic satisfaction		
		Satisfied	General	Dissatisfied
Control group	15(37.50)	14(35.00)	18(45.00)	8(20.00)
Observation group	5(12.50)	30(75.00)	7(17.50)	3(7.50)
χ^2/Z value	6.667	3.452		
P value	0.010	0.001		

Tab.5 Comparison of the incidence rates of adverse reactions between two groups [n=40, case(%)]

Group	Bleeding	Infection	Dizziness and headache	Total incidence (%)
Control group	5(12.50)	3(7.50)	2(5.00)	25.00
Observation group	1(2.50)	2(5.00)	1(2.50)	10.00
χ^2 value				3.117
P value				0.078

3 Discussion

Day surgery has developed rapidly and been applied both domestically and internationally, characterized by safety, painlessness, and comfort [9]. Hysteroscopic surgery, as one of the common gynecological day surgeries, has gained recognition from clinicians and patients in gynecological surgery. Although it has the advantage of a short duration, a series of operations during the procedure such as endometrial curettage, cervical dilation, and pressurized uterine distension can easily bring significant pain and discomfort to patients. Therefore, the requirements for anesthesia during the surgical procedure are extremely high, necessitating adequate sedation and analgesia for patients [10]. Currently, during the perioperative period, surgical and anesthetic operations

can induce strong stress responses, resulting in a series of neuroendocrine reactions, leading to massive secretion of glucocorticoids, suppressing the patient's immune function, and affecting the patient's subsequent recovery and quality of life [11-12]. Currently, ultrasound-guided nerve blocks combined with general anesthesia are commonly used in clinical practice to complete abdominal surgeries. Commonly used nerve blocks include QLB, transversus abdominis plane block, and posterior rectus sheath block [13]. Some studies have reported that QLB has clear analgesic effects, a wider block plane, and fewer postoperative complications. However, the mechanism of QLB is complex, and different approaches can affect the effect of nerve blockade [6,14]. Therefore, exploring the effects of different ultrasound-guided QLB approaches on the postoperative recovery of hysteroscopic patients is crucial.

The study by Sonawane *et al.* [15] systematically integrated the fascial diffusion pathways and nerve coverage of QLB, clearly stating that QLB can achieve analgesic coverage of the thoracic, abdominal, and pelvic regions through the continuity of the thoracolumbar fascia system. The thoracolumbar fascia is closely related to the diffusion of local anesthetics in QLB, and it consists of an anterior layer, a middle layer, and a posterior layer [16]. The thoracolumbar fascia communicates with different potential anatomical spaces at different levels, so the key to the block plane of QLB lies in the thoracolumbar fascia [17]. Different approaches produce different analgesic effects. Both the supra-anterior approach to the lateral arcuate ligament of the quadratus lumborum and the anterior approach to the quadratus lumborum are suitable for abdominal surgery. The supra-anterior approach to the lateral arcuate ligament of the quadratus lumborum refers to using the lateral arcuate ligament of the diaphragm as the boundary and targeting the subfascia of the quadratus lumborum between the 6th rib and the transverse process of the 1st lumbar vertebra as the target area for blockade [18]. From a theoretical anatomical perspective, the supra-anterior approach to the lateral arcuate ligament of the quadratus lumborum has a wider block range and a more precise block effect. In contrast, the puncture area of the anterior approach to the quadratus lumborum is between the psoas major muscle and the quadratus lumborum muscle, i.e., the anterior layer of the thoracolumbar fascia, targeting the anterior layer of the thoracolumbar fascia between the 10th rib and the transverse process of the 4th lumbar vertebra, and its block effect is inferior to that of the supra-anterior approach to the lateral arcuate ligament of the quadratus lumborum [19]. The study by Liao Chunying et al. [20] affirmed the superiority of the supra-anterior approach to the lateral arcuate ligament of the quadratus lumborum in open radical hysterectomy for cervical cancer. In this study, the VAS scores, serum Ang-II and Cor levels, capillary loop morphology scores, and blood flow pattern scores in the observation group at T1, T2, T3, and T4 were all lower than those in the control group; the serum Ang-II and Cor levels in the observation group at T1, T2, T3, and T4 were lower than those in the control group; compared with the control group, the observation group had lower capillary loop morphology scores and blood flow pattern scores at all time points; compared with T1, the VAS scores, Ang-II and Cor levels, capillary loop morphology scores, and blood flow pattern scores in both groups at T2, T3, and T4 were higher; compared with T2, the VAS scores, Ang-II and Cor levels, capillary loop morphology scores, and blood flow pattern scores at T3 and T4 were higher; compared with T3, the VAS scores, Ang-II and Cor levels, capillary loop morphology scores, and blood flow pattern scores at T4 were higher. Compared with the control group, the observation group had a lower incidence of rescue analgesia within 24 hours postoperatively and higher analgesia satisfaction. The results of this study indicate that the supra-anterior approach to the lateral arcuate ligament of the quadratus lumborum has a faster onset, wider block plane, and better postoperative analgesic effect than the anterior approach to the quadratus lumborum. Analysis of the reasons: During ultrasound-guided anterior QLB, because the anterior layer of the thoracolumbar fascia may mix with the posterior renal fascia and the fascia of the quadratus lumborum muscle itself, it is difficult to distinguish under ultrasound, greatly reducing the success rate of the block. In contrast, the supra-anterior approach to the lateral arcuate ligament of the quadratus lumborum is a modified version of the subcostal anterior QLB. It allows the local anesthetic to be injected directly above the lateral arcuate ligament, so the anesthetic can directly enter the thoracic paravertebral space without needing to overcome the resistance of the arcuate ligament, with a block duration of up to 24 hours. The supra-anterior approach to the lateral arcuate ligament of the quadratus lumborum greatly improves the success rate of the block and provides better postoperative analgesic effects [14].

In summary, compared with the anterior approach to the quadratus lumborum, the application of the supra-anterior approach to the lateral arcuate ligament of the quadratus lumborum in hysteroscopic surgery can reduce postoperative stress responses in patients, optimize analgesic effects and microcirculation, and has higher safety.

Conflict of Interest None

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·临床麻醉专题·论著·

超声引导下不同入路腰方肌阻滞在宫腔镜手术中的应用

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摘要：目的　研究超声引导下不同入路腰方肌阻滞（QLB）对宫腔镜手术患者应激、微循环及术后镇痛效果的影响。**方法**　选择2020年9月至2023年9月于联勤保障部队第九一〇医院80例行宫腔镜手术患者为研究对象，采用随机数字表法分为对照组和观察组。两组均采用超声引导下QLB镇痛，对照组采用腰方肌前路进入（n=40），观察组采用腰方肌外侧弓状韧带上前侧路进入（n=40）。采用视觉模拟评分法（VAS）分别于术后2 h（T_1）、4 h（T_2）、12 h（T_3）、24 h（T_4）评估患者疼痛程度；比较两组患者应激指标[血管紧张素Ⅱ（Ang-Ⅱ）、皮质醇（Cor）]及微循环指标（甲襞微循环中的管襻形态积分、血液流态积分）的差异；记录两组术后24 h镇痛补救发生率、镇痛满意度及不良反应发生情况。**结果**　在VAS评分、应激指标及微循环指标上，组间效应与时间效应均有统计学意义（P<0.05），但应激指标、微循环指标的时间×组间交互作用无统计学意义（P>0.05）。观察组T_1~T_4各时间点VAS评分和血清Ang-Ⅱ、Cor水平以及管襻形态积分、血液流态积分均低于对照组（P<0.05）。观察组术后24 h镇痛补救发生率低于对照组（12.50% *vs* 37.50%，χ^2=6.667，P=0.010），镇痛满意度优于对照组（Z=3.452，P=0.001）。对照组和观察组不良反应发生率比较差异无统计学意义（25.00% *vs* 10.00%，χ^2=3.117，P=0.078）。**结论**　超声引导下腰方肌外侧弓状韧带上前侧QLB应用于宫腔镜手术患者，其对术后应激、微循环的改善及镇痛的效果优于前路QLB，且安全性高。

关键词：超声；腰方肌阻滞；宫腔镜；应激；微循环；术后镇痛
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Abstract: Objective　To investigate the effects of ultrasound-guided quadratus lumborum block (QLB) via different approaches on stress, microcirculation, and postoperative analgesia in patients undergoing hysteroscopic surgery. **Methods**　A total of 80 patients scheduled for hysteroscopic surgery at the 910th Hospital of the Joint Logistic Support Force from September 2020 to September 2023 were selected as the study subjects. They were randomly divided into a control group and an observation group using a random number table method. Both groups received ultrasound-guided QLB for analgesia. The control group underwent the anterior approach to the quadratus lumborum muscle (n=40), while the observation group underwent anterolateral approach to the lateral supra-arcuate ligament (n=40). The Visual Analog Scale (VAS) was used to assess pain levels at 2 hours (T_1), 4 hours (T_2), 12 hours (T_3), and 24 hours (T_4) postoperatively. Differences in stress indicators [angiotensin Ⅱ (Ang-Ⅱ), cortisol (Cor)] and microcirculation indicators (loop morphology score and blood flow state score in nailfold microcirculation) were compared between the two groups. The incidence of postoperative 24-hour analgesic rescue, analgesic satisfaction, and the occurrence of adverse reactions

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were recorded for both groups. **Results** Repeated measures analysis of variance showed that for VAS scores, stress indicators, and microcirculation indicators, the between-group effects and time effects were statistically significant ($P<0.05$), but the between-group × time interaction effects for stress and microcirculation indicators were not statistically significant ($P>0.05$). The VAS scores and serum levels of Ang-Ⅱ and Cor, as well as loop morphology and blood flow state scores at T_1 to T_4 in the observation group, were lower than those in the control group ($P<0.05$). The incidence of 24-hour postoperative analgesic rescue in the observation group was lower than that in the control group (12.50% *vs* 37.50%, $\chi^2=6.667$, $P=0.010$), and analgesic satisfaction was superior to the control group ($Z=3.452$, $P=0.001$). There was no statistically significant difference in the incidence of adverse reactions between the control group and observation group (25.00% *vs* 10.00%, $\chi^2=3.117$, $P=0.078$). **Conclusion** For patients undergoing hysteroscopic surgery, ultrasound-guided QLB at the lateral supra-arcuate ligament demonstrates superior effects on postoperative stress, microcirculation, and analgesia compared to the anterior approach QLB, with a high safety profile.

Keywords: Ultrasound; Quadratus lumborum block; Hysteroscopy; Stress; Microcirculation; Postoperative analgesia

宫腔镜手术是一种通过宫腔镜进入子宫腔内进行治疗的手术[1]。宫腔镜手术主要用于治疗子宫肌瘤、息肉肌瘤、子宫粘连分离、子宫纵膈切除等疾病，患者术后容易受气腹、创伤等影响，存在术后疼痛[2]。因此，有效的疼痛管理不仅能显著提高患者的术后舒适度，还能减少术后并发症的发生，加快患者康复[3]。腰方肌阻滞（quadratus lumborum block，QLB）是一种神经阻滞麻醉技术，常用于腰部和腹部手术的镇痛，旨在阻滞胸腰段脊神经的分支包括髂腹下神经和髂腹股沟神经等[4]。QLB在国内外已广泛应用于腹部和髋部手术，具有阻滞效果良好，阻滞范围广的特点，且QLB在降低恶心呕吐、缩短术后卧床时间等方面也具有积极作用[5]。有研究认为，由于穿刺入路不同，QLB在临床效果上也存在较大差异[6]。鉴于此，本研究将深入探讨超声引导下不同入路QLB对患者术后应激、微循环及镇痛效果的影响。

1 资料与方法

1.1 一般资料 本研究为前瞻性研究，纳入2020年9月至2023年9月于联勤保障部队第九一〇医院治疗的80例行宫腔镜手术患者作为研究对象，采用随机数字表法将受试者分为对照组和观察组。（1）纳入标准：①患者均符合手术治疗指标[7]；②患者及其家属对本研究知情同意；③精神状态正常。（2）排除标准：①合并精神疾病或认知功能障碍；②存在肝、肾功能异常；③存在药物滥用；④凝血异常；⑤中转开腹。对照组年龄36~55（46.15±1.68）岁；身体质量指数（body mass index，BMI）（22.16±0.75）kg/m^2。观察组年龄34~54（45.15±1.59）岁；BMI（22.25±0.78）kg/m^2。两组一般资料比较差异无统计学意义（$P>0.05$）。本研究经第九一〇医院医学伦理委员会批准（伦理批号：院医伦〔2025〕87号）。

1.2 方法 两组均于入室后常规准备，术前吸氧30 min，监测心电图、外周血氧饱和度等。麻醉诱导为0.3~0.5 μg/kg舒芬太尼（国药准字H20203650，江苏恩华药业，1 mL∶50 μg）+1.0~2.0 mg/kg丙泊酚（国药准字H20123138，江苏恩华药业，20 mL∶0.2 g）+0.8 mg/kg罗库溴铵（国药准字H20103235，华北制药，5 mL∶50 mg）；术毕停用肌肉松弛药。术后两组均行QLB镇痛，采用盐酸罗哌卡因（国药准字H20183151，瑞阳制药，100 mg∶10 mL）为镇痛药物，手持超声探头置于髂前上棘水平、腋中线到腋后线附近，沿腹壁肌向背侧滑动探头，在肌层尾处可见腰方肌，继续向后正中线滑动，直至第4腰椎横突水平可清晰显示腰方肌开始进行穿刺。对照组采用腰方肌前路进入，患者取仰卧位，针尖从探头后方穿至腰方肌与腰大肌的间隙，注入0.2%罗哌卡因20 mL，当超声显示腰方肌下压提示注射准确。观察组采用腰方肌外侧弓状韧带上前侧路进入，在超声引导下将探头垂直放于两侧肋脊角并与脊柱平行，于后上方向内下方穿刺，神经阻滞针穿透竖脊肌、腰方肌并到达腰方肌前层时，可以感觉到明显的突破感，此时针抵达“双轨征”膈肌以上的注射靶区域，并注入0.2 %罗哌卡因20 mL，超声显示可见“双轨征”膈肌下压即为穿刺注射成功标志。

1.3 观察指标 （1）疼痛评分：采用视觉模拟评分法（Visual Analogue Scale，VAS）[8]分别于术后2 h（T_1）、4 h（T_2）、12 h（T_3）、24 h（T_4）评估患者疼痛程度，量表分数区间为0~10分（分数与疼痛程度呈正比）。（2）应激指标：采用放射免疫法检测血清血管紧张素（angiotensin，Ang）-Ⅱ、皮质醇（cortisol，Cor）水平。（3）微循环指标：采用微循环观察仪（道恩医疗科技）检测管襻形态积分、血液流态积分。（4）镇痛补救发生率及镇痛满意度：记录术后24 h镇痛药物使用情况，满意程度分为满意（不影响日常活动、情绪稳定）和一般

（日常活动量减少、情绪稳定）和不满意（活动量明显受限、情绪烦躁）。（5）不良反应：出血、感染、头晕头痛等。

1.4　统计学方法　数据分析用SPSS 19.0软件处理。符合正态分布的计量资料以$\bar{x}\pm s$表示，比较采用t检验及单因素方差分析，多时间点比较采用重复测量方差分析，两两比较采用LSD-t检验。计数资料以例（%）表示，比较采用χ^2检验，等级资料比较采用秩和检验。P<0.05为差异有统计学意义。

2　结　果

2.1　两组术后各时间点VAS评分比较　两组术后VAS评分，组间作用、时间作用及组间与时间的交互作用均有统计学意义（P<0.05）。观察组T_1~T_4各时间点VAS评分均低于对照组（P<0.05）；与同组T_1相比，两组T_2、T_3、T_4的VAS评分更高；与同组T_2相比，T_3、T_4的VAS评分更高；与同组T_3相比，T_4的VAS评分更高（P<0.05）。见表1。

2.2　两组术后各时间点应激指标比较　两组术后Ang-Ⅱ、Cor组间作用、时间作用有统计学意义（P<0.05），交互作用无统计学意义（P>0.05）。观察组T_1~T_4各时间点血清水平Ang-Ⅱ、Cor均低于对照组（P<0.05）。与同组T_1相比，两组T_2、T_3、T_4的Ang-Ⅱ、Cor水平更高；与同组T_2相比，T_3、T_4的Ang-Ⅱ、Cor水平更高；与同组T_3相比，T_4的Ang-Ⅱ、Cor水平更高（P<0.05）。见表2。

2.3　两组术后各时间点微循环指标比较　两组术后管襻形态积分、血液流态积分组间效应和时间效应均显著（P<0.05），交互作用无统计学意义（P>0.05）。相较于对照组，观察组T_1~T_4各时间点管襻形态积分、血液流态积分更低（P<0.05），与同组T_1相比，两组T_2、T_3、T_4管襻形态积分、血液流态积分更高；与同组T_2相比，T_3、T_4管襻形态积分、血液流态积分更高；与同组T_3相比，T_4管襻形态积分、血液流态积分更高（P<0.05）。见表3。

2.4　两组术后24 h镇痛效果比较　观察组术后24 h镇痛补救发生率低于对照组（P<0.05）；观察组镇痛满意度高于对照组（P<0.05）。见表4。

2.5　两组不良反应发生率比较　两组不良反应总发生率比较差异无统计学意义（P>0.05）。见表5。

表1　两组术后各时间点VAS评分比较　（n=40，分，$\bar{x}\pm s$）

Tab.1　Comparison of VAS scores between the two groups at various time points after surgery　（n=40, point, $\bar{x}\pm s$）

组别	T_1	T_2	T_3	T_4
对照组	1.65±0.34	2.35±0.49^{a}	2.68±0.56^{ab}	3.48±0.49^{abc}
观察组	0.15±0.58^{d}	0.58±0.49^{ad}	1.35±0.33^{abd}	2.45±0.36^{abcd}
$F_{组间}/P_{组间}$值	228.431/0.001			
$F_{时间}/P_{时间}$值	156.786/0.001			
$F_{交互}/P_{交互}$值	5.210/0.002			

注：与T_1相比，^{a}P<0.05；与T_2相比，^{b}P<0.05；与T_3相比，^{c}P<0.05；与同时点对照组相比，^{d}P<0.05。

表2　两组术后各时间点应激指标比较　（n=40，$\bar{x}\pm s$）

Tab.2　Comparison of stress indicators between two groups at various time points after surgery　（n=40, $\bar{x}\pm s$）

组别	Ang-Ⅱ（pg/mL）				Cor（nmol/L）			
	T_1	T_2	T_3	T_4	T_1	T_2	T_3	T_4
对照组	220.49±16.81	212.95±15.59^{a}	195.48±14.67^{ab}	180.67±12.45^{abc}	432.45±25.68	419.56±20.55^{a}	396.58±19.59^{ab}	375.89±18.65^{abc}
观察组	212.48±15.38^{d}	203.49±14.58^{ad}	183.86±12.76^{abd}	170.45±11.05^{abcd}	420.56±24.59^{d}	407.89±19.54^{ad}	381.69±17.56^{abd}	356.48±15.39^{abcd}
$F_{组间}/P_{组间}$值	18.362/<0.001				24.611/<0.001			
$F_{时间}/P_{时间}$值	45.290/<0.001				58.730/<0.001			
$F_{交互}/P_{交互}$值	1.878/0.135				2.152/0.098			

注：与T_1相比，^{a}P<0.05；与T_2相比，^{b}P<0.05；与T_3相比，^{c}P<0.05；与同时点对照组相比，^{d}P<0.05。

表3　两组各时间点术后微循环指标比较　（n=40，分，$\bar{x}\pm s$）

Tab.3　Comparison of postoperative microcirculation indicators between two groups at various time points　（n=40, point, $\bar{x}\pm s$）

组别	管襻形态积分				血液流态积分			
	T_1	T_2	T_3	T_4	T_1	T_2	T_3	T_4
对照组	1.22±0.26	1.09±0.20^{a}	0.98±0.18^{ab}	0.74±0.11^{abc}	1.30±0.25	1.19±0.21^{a}	1.05±0.18^{ab}	0.97±0.15^{abc}
观察组	1.10±0.21^{d}	0.98±0.15^{ad}	0.89±0.15^{abd}	0.65±0.08^{abcd}	1.25±0.23^{d}	1.06±0.19^{ad}	0.90±0.16^{abd}	0.74±0.13^{abcd}
$F_{组间}/P_{组间}$值	12.753/<0.001				27.890/<0.001			
$F_{时间}/P_{时间}$值	38.422/<0.001				49.656/<0.001			
$F_{交互}/P_{交互}$值	1.531/0.208				1.924/0.126			

注：与T_1相比，^{a}P<0.05；与T_2相比，^{b}P<0.05；与T_3相比，^{c}P<0.05；与同时点对照组相比，^{d}P<0.05。

表4　两组术后24 h镇痛效果比较　[*n*=40, 例(%)]

Tab.4　Comparison of analgesic effects between two groups 24 hour postoperatively　[*n*=40, case(%)]

组别	镇痛补救	镇痛满意度		
		满意	一般	不满意
对照组	15(37.50)	14(35.00)	18(45.00)	8(20.00)
观察组	5(12.50)	30(75.00)	7(17.50)	3(7.50)
χ^2/Z值	6.667		3.452	
P值	0.010		0.001	

表5　两组不良反应发生率比较　[*n*=40, 例(%)]

Tab.5　Comparison of the incidence rates of adverse reactions between two groups　[*n*=40, case(%)]

组别	出血	感染	头晕头痛	总发生率(%)
对照组	5(12.50)	3(7.50)	2(5.00)	25.00
观察组	1(2.50)	2(5.00)	1(2.50)	10.00
χ^2值				3.117
P值				0.078

3　讨　论

日间手术在国内外迅速发展并应用,其具有安全性、无痛性、舒适性等特点[9]。宫腔镜手术作为妇科常见的日间手术之一,在妇科手术中受到临床医生与患者的认可,虽具有时间短的优点,但在操作过程中的内膜诊刮、扩宫、加压膨宫等一系列操作容易给患者带来明显的疼痛不适,因此在手术过程中对麻醉要求极高,需要给予患者充分的镇静与镇痛[10]。目前,在围手术期间,手术、麻醉等操作会引起强烈的应激反应,从而产生一系列神经内分泌反应,导致糖皮质激素大量分泌,抑制患者的免疫功能,影响患者后续的康复和生活质量[11-12]。目前,临床上常采用超声引导下神经阻滞复合全身麻醉来完成腹部手术,常用的神经阻滞有QLB、腹横肌平面阻滞和腹直肌后鞘神经阻滞[13]。有研究报道,QLB镇痛效果明确,阻滞平面更广,术后并发症更少,但QLB机制复杂,不同入路方式会影响神经阻滞效果[6,14]。因此,探讨超声引导下QLB不同入路方式对宫腔镜患者术后康复至关重要。

Sonawane等[15]的研究系统整合了QLB的筋膜扩散通路和神经覆盖范围,明确指出QLB可通过胸腰筋膜系统的连续性,实现胸、腹、盆部区域的镇痛覆盖。胸腰筋膜在QLB中与局部麻醉药的扩散密切相关,其由前层、中层、后层组成[16]。胸腰筋膜在不同层面与不同潜在的解剖间隙相通,所以QLB的阻滞平面关键在于胸腰筋膜[17]。不同的入路方式会出现不同的镇痛效果,外侧弓状韧带上前侧QLB与前路QLB都适用于腹部手术,外侧弓状韧带上前侧QLB是指以膈肌的外侧弓状韧带为界限,以第6肋与第1腰椎横突之间的腰方肌下筋膜为阻滞目标区域[18]。从理论解剖角度来说,外侧弓状韧带上前侧QLB阻滞范围更广,阻滞效果更确切,而前路QLB穿刺区域是在腰大肌和腰方肌之间,也就是胸腰筋膜前层,以第10肋与第4腰椎横突之间的胸腰筋膜前层为阻滞目标区域,其阻滞效果不及外侧弓状韧带上前侧QLB[19]。廖春英等[20]的研究肯定了外侧弓状韧带上前侧QLB在开腹宫颈癌根治术的优越性。本研究中,观察组在T_1、T_2、T_3、T_4各时间点的VAS评分、血清Ang-Ⅱ、Cor水平、管襻形态积分、血液流态积分均低于对照组;观察组在T_1、T_2、T_3、T_4时间点的血清Ang-Ⅱ、Cor水平低于对照组;较对照组,观察组各时间点的管襻形态积分、血液流态积分更低;与T_1相比,两组T_2、T_3、T_4的VAS评分、Ang-Ⅱ、Cor水平、管襻形态积分、血液流态积分更高;与T_2相比,T_3、T_4的VAS评分、Ang-Ⅱ、Cor水平、管襻形态积分、血液流态积分更高;与T_3相比,T_4的VAS评分、Ang-Ⅱ、Cor水平、管襻形态、血液流态积分较高。较对照组,观察组术后24 h镇痛补救发生率更低,且镇痛满意度更高。本研究结果表明外侧弓状韧带上前侧QLB比前路QLB起效更快,阻滞平面更广,术后的镇痛效果更好。分析原因:超声引导下行前路QLB时,由于胸腰前层可能与肾后筋膜及腰方肌自身筋膜混合,超声下较难分辨,会大大降低阻滞的成功率,而外侧弓状韧带上前侧QLB是肋源下前路QLB的改良版,其可以直接将麻醉药直接注射在外侧弓状韧带以上,麻醉药不需要克服弓状韧带的阻力便能够直接进入胸椎旁间隙,阻滞时长可长达24 h,外侧弓状韧带上前侧QLB使阻滞成功率大大提高,术后镇痛效果更好[14]。

综上所述,相较于腰方肌前路QLB,在宫腔镜手术中应用腰方肌外侧弓状韧带外前路QLB可减轻患者的术后应激反应,优化镇痛效果及微循环,且安全性较高。

利益冲突　无

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(上接第379页)

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