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Ultrasound-guided Anterior Quadratus Lumborum Block for Perioperative Analgesia in Allograft Orthotopic Liver Transplantation: 4 Case Reports

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Abstract Anesthesia management for patients undergoing liver transplantation is challenging due to significant hemodynamic fluctuations and potential intraoperative awareness risk. Quadratus lumborum (QL) block is often used for anesthesia and postoperative analgesia in the patient's abdominal surgery. In this case-series report, we present our experience with 4 patients in whom liver transplantation and early extubation were performed successfully under ultrasound-guided QL block. Four patients were scheduled for allograft orthotopic liver transplantation (AOLT), all of them were diagnosed with severe hepatitis B cirrhosis. After due deliberation and with the consent of patients and their family, a bilateral ultrasound-guided anterior QL block was performed with the patient in the lateral position. Fifteen to 20mL of 0.5% ropivacaine was injected at the front edge of the QL, bilaterally. Sensory loss to pinprick from T6 to L2 was achieved in all four patients 20 min after administration of blocks. The operation went smoothly for all the patients. All four patients experienced quiet recovery and early extubation, and none of them complained of discomfort in the surgical side in the first 12h after surgery. Here we present 4 cases of ultrasound-guided anterior QL block that may be an attractive option for anesthetic management of AOLT in clinical practice.

Keywords: *quadratus lumborum block, analgesia, allograft orthotopic liver transplantation*

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1. Introduction

Allograft orthotopic liver transplantation (AOLT) is an effective treatment for many end-stage liver diseases (ESLD), Patients with ESLD are often associated with severe hypoproteinemia, ascites, hepatopulmonary syndrome (HPS), hepatic encephalopathy, and coagulopathies [1]. The anesthesia management for AOLT is often challenging due to the high risk of bleeding, long operation time, and poor condition of the patient. Large incisions in the upper abdomen during liver transplantation often cause severe postoperative pain, and it is associated with a high incidence of postoperative complications [2]. Intravenous opioid analgesia is the most common method used for upper abdominal pain. However, an overdose of opioids may result in a range of adverse effects such as excessive sedation, respiratory depression, and deceleration of gastrointestinal motility [3,4], which are not conducive to the rapid recovery of patients. Since the QL block generates an analgesic effect by unilaterally blocking spinal nerves from T6–T9 to L1-L3, it can provide effective postoperative analgesia after many abdominal surgeries [5]. In this case-series report, we present our experience with the use of ultrasound-guided bilateral anterior QL block to provide surgical and postoperative anesthetic cover for liver transplantation in 4 patients. The reporting of these cases was approved by the Ethics Committee at The First Affiliated Hospital of Hunan Normal University, Hunan Normal University. Written informed consent was obtained from all 4 patients.

2. Case Descriptions

2.1. Case 1

A 64-year-old female (weight 44 kg, ASA status III) was scheduled for AOLT due to the recurrence of hepatocellular carcinoma and severe hepatitis B cirrhosis. She had undergone laparoscopic microwave ablation for hepatic clear cell carcinoma (grade III) three years ago. During a regular review in the outpatient clinic of our hospital, an MRI of the upper abdomen suggested new nodules in the left outer lobe of the liver, and the possibility of metastasis was considered. In this hospitalization, her diagnosis also included decompensated

hepatitis B cirrhosis, splenomegaly, and hypersplenism. Based on our successful experience with QL blocks in the previous patient, we decided to adopt the same technique for this patient. With the consent of the patient and her family, ultrasound-guided QL blocks were performed.

2.2. Case 2

A 50-year-old male (weight 60 kg, ASA status III) suffered from viral hepatitis B for 20 years, and was scheduled for AOLT. He was admitted to the hospital because of a 2-month history of abdominal cavity and jaundice. He was diagnosed with hepatitis b cirrhosis decompensated with hypoproteinemia, ascites, splenomegaly, and hypersplenism. Because of the decompensation of liver function and the need for intraoperative heparinization therapy, he was a high-risk case for epidural anesthesia. After careful discussion with multidisciplinary teams and due deliberation and with the consent of the patient and his family, the surgery was performed under a combination of ultrasound-guided QL Blocks and general anesthesia.

2.3. Case 3

A 62-year-old male (weight 68 kg, ASA status III) was scheduled for AOLT due to hepatocellular carcinoma. He had a history of hepatitis B for 11 years, liver cirrhosis for 7 years, and abdominal distension pain for 4 months. During this hospitalization, he was also diagnosed with severe cirrhosis, ascites, and hypoproteinemia. In agreement with him and his family, we performed QL blocks and general anesthesia for him.

2.4. Case 4

A 30-year-old male (weight 83 kg, ASA status III) presented with space-occupying lesions in the liver suggestive of hepatocellular carcinoma, and he was scheduled for AOLT. He had a background of viral hepatitis B for 15 years and was diagnosed with hepatitis B cirrhosis. He was on drug entecavir 0.5mg per day. With the agreement of the patient and his family, we chose ultrasound-guided QL Blocks combined with general anesthesia for him.

3. Ultrasound-guided Anterior QL Block

We present a case series of effective perioperative analgesia obtained by performing a bilateral single-shot anterior QL block in patients scheduled to undergo AOLT. Standard monitoring included electrocardiogram, invasive arterial blood pressure, pulse oximeter, BIS, and Vigileo. Followed by induction of general anesthesia, QL block was performed bilaterally in each position the side to be injected is turned upward. A 22-gauge, 120-mm needle (stimuplex® aB. Braun, Melsung, Germany) using the sonosite M-turbo (Bothell, WA, USA) ultrasound machine with a convex probe was used to perform the QL block. A low-frequency convex probe of 2 to 5MHz was selected and placed at the level of the L2 transverse level near the posterior axillary line to locate the “sham-rock sign” (Figure 1A) [6]. The point of injection of local anesthetic lies in the tissue plane between the quadratus lumborum and psoas muscles [7]. The needle was advanced through the QL until penetration in the muscular fascia. About 5mL of normal saline was injected under ultrasound guidance to separate the muscle space, and 0.4ml/kg of 0.5% ropivacaine was injected into the space after re-confirming the needle tip position (Figure 1B). The identical technique was repeated on the opposite side. Surgical procedures for all cases were successful. Postoperatively intravenous patient-controlled analgesia (PCA) with 2μg/kg sufentanil, oxycodone hydrochloride 0.2mg/kg, and 8mg ondansetron was applied. The setting parameters of the analgesia pump include:2 mL/h continuous infusion volume, 0.5ml bolus doses (15min blocking time), and the maximum infusion volume of 5mL/h.

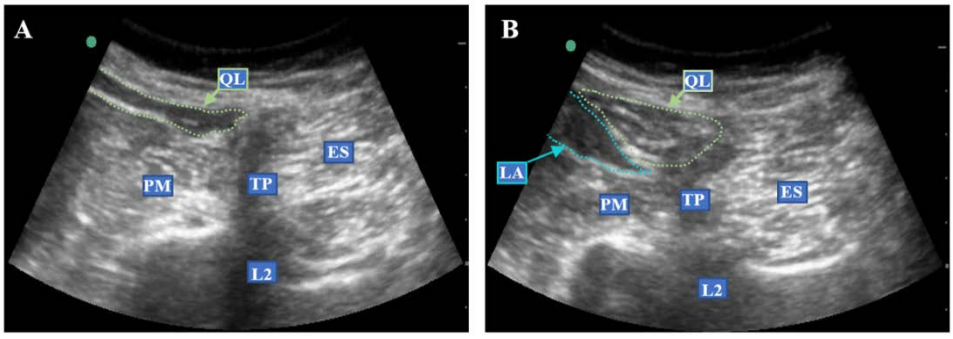

Figure 1. Ultrasound-guided anterior QL block. (A) Shamrock sign. (B) A local anesthetic was injected between the QL and the psoas major. QL, quadratus Lumborum; PM, psoas major; ES, erector spinae; TP, transverse process; LA, Local anesthetic

4. Results

Twenty minutes after the blocks, Sensory loss to pinprick from T7 to L2 was achieved in all four patients (Table 1). The duration of surgery was 480, 450, 425, and 445 minutes, respectively. Surgery for all patients was successful and extubation procedures for them all were done early, quietly, and smoothly, details of the procedures and parameters are summarized in Table 2. Propofol and opioids usage is shown in Table 3. Analgesics used in PCIA were 2μg/kg sufentanil, oxycodone hydrochloride 0.2mg/kg, and 8mg ondansetron diluted to a final volume of 100ml in normal saline. Parameters of the analgesic pump included 2 ml/h continuous infusion volume, 0.5ml bolus dose, 15min lockout time, and 5ml/h maximum infusion volume. In the first 12 hours in the ICU, none of the four patients reported static pain in the incision area, and the visual analog scale scores were all 0-2.

Table 1. Assessment of sensory block achieved

	20min after block		At the end of the operation	
	Sensory loss to pinprick	Sensory loss to ice	Sensory loss to pinprick	Sensory loss to ice
Case 1	T6-L2	T5-L2	T7-L1	T6-L1
Case 2	T7-L2	T6-L2	T7-L1	T6-T12
Case 3	T7-L2	T6-L1	T8-L1	T7-L1
Case 4	T7-L2	T5-L2	T7-L1	T6-L1

Table 2. Intraoperative conditions

	Blood pressure (mmHg)	Heart rate (bpm)	SpO_2 (%)	Duration of operation (min)	Blood loss (ml)	Time for recovery from anesthesia (min)
Case 1	110-160/63-85	65-93	97-100	480	1500	5
Case 2	105-163/58-89	71-103	93-100	450	2000	10
Case 3	95-150/55-80	82-105	97-100	425	2300	9
Case 4	90-130/56-79	64-100	95-100	445	1900	3

Table 3. Intraoperative usage of propofol and opioids

	Propofol dosage (mg/kg·h)	Remifentanil dosage (ug/kg·h)	Sufentanil dosage (ug/kg·h)
Case 1	2.8	5.1	0.18
Case 2	2.4	4.8	0.21
Case 3	2.2	4.6	0.16
Case 4	2.5	4.7	0.18

5. Discussion

All four patients in this case series were high-risk cases for general as well as neuraxial anesthesia. Under QL block, all of whom underwent liver transplantation successfully and received adequate analgesia, and recovered earlier. As a new trunk block technique, the QL block has been applied to postoperative analgesia of the upper abdomen, lower abdomen, and hip surgery, which has good postoperative analgesic effects and reduces the dosage of opioids [5]. However, its use to provide anesthetic cover for AOLT has not been documented. Compared with the conventional transverse abdominis plane (TAP) block, the QL block may have a wider block plane and a longer block time. The block plane of TAP can reach up to the T7 level, while the QL block can reach up to the T5 level [6]. Some studies have shown that in anterior QL block, local anesthetics can diffuse to the paravertebral space through the fascia, thus achieving the effect of a paravertebral block. However, compared with paravertebral block, QL block is less likely to cause local anesthetics to enter the subarachnoid or epidural space, resulting in respiratory and circulatory depression and other complications [7,8], so it is safer for clinical operation.

There are several approaches to the QL block. The choice of approach and block plane is also changed due to different analgesic requirements. QL block was named based on the anatomical position of the needle tip relative to the QL muscle (anterior QL block, lateral QL block, posterior QL block, and intramuscular QL block) [9]. The anterior approach is to pass the needle through the latissimus dorsi, erector ridge, and quadratus psoas, and then inject local anesthetics into the anterior side of the quadratus psoas. In lateral QL block, local anesthetics are injected at the junction of anterolateral QL and transverse abdominal fascia and was first successfully performed by Blanco [10] in 7 patients with abdominal wall shaping in 2007. The diffusion of anesthetics in the lateral QL block was similar to the posterior transversus abdominis plane block (TAPB), which could spread to the thoracic paravertebral space [11]. In the posterior QL block, the point of injection is located in the posterior side of the QL and the lateral margin of the erector spine, known as the lumbar fascia triangle [12]. Compared with other approaches, the injection place in the posterior QL block is more superficial, and the needle is separated from the peritoneum by QL, so the operation is safer, avoiding the risk of intraperitoneal injection and intestinal injury [13]. The intramuscular QL block is to inject anesthetics into the QL muscle. The probe tilts slightly to show the maximum cross-section of QL, in which a needle is inserted forward until it penetrates the fascia of QL and enters the muscle for injection. The operation of this approach is relatively simple and easy, but the mechanism is still unclear, which may be related to local anesthetic exudation to the thoracolumbar fascia (TLF) [14]. At present, there is no relevant research on whether the effects of these approaches are different. In this case series, we chose the anterior approach, in which local anesthetics were injected between the QL and the psoas major. This position was closer to the paravertebral space, and local anesthetics were more likely to spread into the paravertebral space to achieve paravertebral blockade with a better analgesic effect [15].

In liver transplantation, an arc-shaped incision usually begins with the xiphoid process and runs along the costal margin to the right anterior axillary line [16]. Due to large surgical incisions and prolonged intraoperative traction of the intercostal nerve, postoperative pain in these patients is very severe. Generally, remifentanil is selected as the main analgesic during the operation because of its short duration of action and no obvious effect on liver function. PCIA is often used to eliminate postoperative pain, but the required dose of analgesic drugs is usually large. Since patients are often associated with different degrees of liver dysfunction, the adverse effects of opioids are obvious. In the study of Shaaban M [17] and his team, the analgesic effect of QL block as a remedial measure is very useful due to the severe respiratory depression caused by postoperative opioid drugs. On the one hand, it can

significantly reduce the dosage of opioids in patients and reduce the burden on the liver after the operation. On the other hand, it can also reduce the occurrence of adverse reactions such as nausea, vomiting, and respiratory depression.

In this case series, in order to adequately block the pain transmission of the surgical incision, we chose to perform anterior QL block at L2 transverse processes. We found that the hemodynamic fluctuations during skin incisions were less significant after the blocks. In addition, intraoperative consumption of sufentanil, remifentanil, and propofol was relatively low. And patients took less time to recover from anesthesia. These results were consistent with the findings in the study of Kukreja. et al. [14], suggesting that general anesthesia combined with anterior QL block could inhibit the intraoperative stress response in AOLT surgery, reduce the required dose of agents, and promote the rapid recovery of patients.

Some limitations need to be acknowledged. Ropivacaine is a local anesthetic commonly used in nerve block, which has the characteristics of long analgesic effect, low toxicity, less adverse reactions in the circulatory system and central nervous system. The effect of the QL block is largely dependent on the effect of a paravertebral block when the drug is diffused into the paravertebral space, so the volume of local anesthetics is a key factor in this process. In this study, 0.33% ropivacaine 0.4 mL/kg was applied per side, the concentration and dose were within the safe range, and the blocking time could last at least 24 hours. However, when bilateral blocks are needed, the concentration of local anesthetics should be adjusted appropriately on the premise of not reducing the drug volume to avoid local anesthetic poisoning. Unfortunately, no consensus has been reached on the volume and concentration of local anesthetics in the QL block, and further study is needed. Whatsmore, the small sample size may lead to a certain deviation of the results.

In conclusion, the combination of bilateral anterior quadratus lumborum blocks and general anesthesia may provide reliable surgical analgesia and satisfied postoperative pain control for allograft orthotopic liver transplantation surgery.

Abbreviations

QL: Quadratus lumborum; ESLD: End-stage liver diseases; HPS: Hepatopulmonary syndrome; T6, T7, T9, T12: Sixth thoracic vertebra, Seventh thoracic vertebra, Ninth thoracic vertebra, Twelfth thoracic vertebra; L1, L2, L3: First lumbar vertebra, Second lumbar vertebra, Third lumbar vertebra; ASA: America Society of Anesthesiologist; EEG: electroencephalogram; BIS: bispectral index of EEG; PCIA: Patient-controlled intravenous analgesia; ICU: Intensive care unit; AOLT: Allograft orthotopic liver transplantation; TAPB: Transversus abdominis plane block; TLF: Thoracolumbar fascia

Availability of Data and Materials

The datasets of the current study are available from the corresponding author on reasonable request.

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Authors Contributions

Yongping Liu and Siyou Tan contributed equally to this study. Siyou Tan performed the peripheral nerve blocks and was a major contributor in writing the manuscript. Yongping Liu analyzed and interpreted the patient data regarding the vital sign and sensory block levels. Lai Wei raised the initial idea and supervised all the perioperative management and patient care. Wenyan Chen recorded and collected all information during and after the surgeries and follow-up. All authors read and approved the final manuscript.

Ethics Approach and Consent to Participate

Written informed consent was obtained from the patient. The consent form will be provided upon request.

Consent for Publication

All patients consented to the educational publication of this case report and any accompanying images and written informed consent were obtained from the patients.

Competing Interests

The authors declare that they have no competing interests.

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