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Research Article

A Retrospective Study on the Comparison between Lumbar Plexus Block and Quadratus Lumborum Block on the Postoperative Pain in Total Hip Replacement Patients

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Abstract

Introduction: Lumbar plexus block (LPB) is known to provide effective postoperative analgesia for hip surgeries. However, there were concerns of quadriceps weakness from the motor blockade that may affect early ambulation. Several recent studies showed the effectiveness of quadratus lumborum block (QLB) for postoperative analgesia after hip surgeries. We proposed that QLB type 1 was as effective as LPB for postoperative analgesia in total hip replacement patient and facilitate early ambulation and participation in physical therapy.

Materials and methods: Retrospective data were collected from 120 consecutive patients who underwent primary, unilateral total hip replacement by the same surgeon. They were assigned to either pre-operative ultrasound guided QLB type 1 or traditional LPB performed with nerve stimulator. Postoperative outcomes were assessed by opioid consumption (oral morphine equivalents), visual analog scale (VAS) score, time required to perform nerve blocks, time to achieve physical therapy goals, complications and length of hospital stay.

Results/Case report: After exclusion, we had 54 patients in each group (QLB vs LPB). We found similar outcomes in VAS scores at 0 h (2.69 ± 3.04 vs 3.56 ± 3.10), 12 h (4.44 ± 2.40 vs 4.56 ± 2.55) and 24 h (2.33 ± 2.50 vs 2.80 ± 2.29) after the surgery, total opioid consumption at 12 h (42.63 ± 25.04 mg vs 43.19 ± 23.29 mg) and 24 h (16.38 ± 19.09 mg vs 19.09 ± 16.46 mg) after surgery (all p-value > 0.05). Time to achieve physical therapy goals (22.24 ± 15.75 h vs 24.81 ± 15.57 h) and length of hospital stay (28.86 ± 15.67 h vs 34.04 ± 17.37 h) were comparable between QLB and LPB groups, p-value > 0.05. There were no complications reported from neither technique. Interestingly, significantly less time was required to perform QLB when compared to LPB (7.16 ± 3.32 min vs 14.2 ± 9.84 min, p-value < 0.01).

Discussion: Our study suggests non-inferior effectiveness of QLB type 1 in postoperative analgesia and preservation of motor function when compared to traditional LPB in the first 24 h following total hip arthroplasty. As it is easier to perform QLB (with ultrasound guidance only and no need for the use of nerve stimulator), QLB consumed less time to complete the procedure.

Keywords: Quadratus lumborum block, Lumbar plexus block, Postoperative hip pain, Total hip Arthroplasty.

Introduction

Lumbar plexus block (LPB) is well accepted technique for post-operative analgesia after hip surgery. However, the main drawback was significant incidence of quadriceps weakness, which interfered with early patient rehabilitation [1]. The other peripheral nerve blocks known for hip analgesia such as femoral nerve block [1] and fascia iliaca block were found to cause motor blockade and not as effective as LPB for postoperative hip analgesia [2,3]. In addition, LPB is considered as an advanced and deep block, performed mostly by experienced regional anesthesiologists. Its disadvantages include frequent failure, time consuming by non-experienced provider and using ultrasound guidance in a deep block as LPB can be challenging [4]. Given this, we aim to provide a simpler regional technique that provides adequate pain control and allows patient to participate in physical therapy for at least two sessions without significant muscular weakness, therefore facilitates patient discharge.

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In quadratus lumborum block (QLB), local anesthetics deposited posterior to abdominal wall muscles and beneath fascia transversalis was proved to spread between quadratus lumborum muscle and psoas major muscle in cadavers which is diffusible to lumbar plexus area [5]. Recent case reports and retrospective studies revealed QLB were able to achieve postoperative hip analgesia without indwelling catheter and not affect quadriceps motor blockade [6-8]. One retrospective study found immediate hip pain improvement and decreased opioid consumption postoperatively with QLB when compared with non-blocked group [8]. Another retrospective data demonstrated similar effectiveness of LPB and transmuscular QLB in providing analgesia for hip arthroplasty [9]. There are several types of QLB that has been described; QLB 1, 2, 3 or transmuscular QLB, and intramuscular QLB. QLB type 1 was first described by Blanco et al in 2007 and it targets anterolateral border of QL muscle, deep to the transversus abdominis aponeurosis [10]. QLB type 3 or transmuscular QLB described by Borglum et al, local anesthetics were injected between QL muscle and psoas muscle and theoretically spreaded to lumbar plexus [11]. A randomized controlled trial in 104 patients with femoral neck fractures by Parras et al also suggested superiority of QLB type 1 in hip analgesia over femoral nerve block [12]. However, the effectiveness of QLB type 1 in providing postoperative analgesia comparing to LPB is still questionable.

Our study goal is to demonstrate that QLB type 1 would provide efficient analgesia for hip arthroplasty as effective as LPB. Our assumptions were that single shot QL blocks were able to provide similar pain scores and opioid consumptions for 24 hours postoperatively. We also hypothesized QLB facilitated physical therapy and discharge from the hospital without complications associated with quadriceps weakness.

Materials and Methods

Data were collected from patients who had surgery by the single surgeon at University of Pittsburgh Medical Center - Shadyside Hospital between September 2015 to July 2016. The patients were selected in a consecutive fashion by surgery date without any preselections. Patients received either continuous LPB or single shot QLB preoperatively for total hip arthroplasty. Inclusion criteria for the study was patients who underwent unilateral primary total hip replacement. Exclusion criteria was patients who underwent bilateral hip arthroplasty, hip revision, patients with ASA ≥ 4 and charts with incomplete data.

Nerve blocks were performed in a preoperative room by anesthesiologists from Acute Interventional Perioperative Pain Service (AIPPS). LPB was performed with anatomical landmark; the line between iliac crests that is perpendicular with the midline along lumbar spinous process were drawn. Five cm lateral to the midline was the insertion point for nerve stimulating 10-cm 18g B-Braun CONTIPLEX Tuohy needle, using with nerve stimulator (Stimuplex HNS12, B Braun) set up at 2 Hz, 0.1 msec, 1.5 mA current. Once the transverse process of L4 was contacted, the needle was redirected caudally until a quadriceps twitch obtained at the current between 0.3-0.5 mA. 0.1% ropivacaine 20 ml was then injected and nerve block catheter was inserted. The nerve block infusion with 0.0625% bupivacaine 5 ml/h was continued for 24-48 h or until patient was discharged. In QLB group, QL type 1 was performed under ultrasound guidance (curved array transducer 6-2 MHz, Sonosite Inc, Bothell, WA), in which the 8-cm 22g B-Braun Touhy needle is inserted anterior to QL muscle and spreading of local anesthetics around the QL muscle was confirmed under ultrasound. QLB was injected with 0.5% ropivacaine 30 ml mixed with dexmedetomidine 30 mcg, dexamethasone 4 mg and epinephrine 100 mcg. The patients from both groups were further received spinal or general anesthesia intraoperatively. Patients from both groups underwent minimally invasive total hip arthroplasty, anterior approach. Postoperative analgesia includes oral acetaminophen, oral ketamine, oral NSAIDs, gabapentin, oxycodone and intravenous hydroxymorphone as a rescue.

The following data were collected retrospectively from electronic medical records: age, gender, American Society of Anesthesiologists (ASA) classification, nerve block type, intraoperative anesthetic type, incidence of chronic opioid usage. The primary outcomes were postoperative pain scores (at 0, 12 and 24 hours after surgery end time, ± 3 hours) and opioid consumptions (at 12 and 24 hours after surgery end time, ± 3 hours). Secondary outcomes included time to perform nerve blocks (from procedure time out to the end of procedure, minutes), length of stay in post-anesthetic care unit (hours), duration to achieve physical therapy goal (from surgery end time to the time documented by physical therapists that patients were safe to be discharged, hours), length of stay in the hospital (hours) and nerve block-associated complications. Visual analog scale (VAS) score of 0 to 10 was used to assessed postoperative pain scores. All opioids consumptions were converted to oral morphine milligram equivalent (MME) according to the websites of Centers for Disease Control and Prevention (CDC) and Center for Medicare and Medicaid Services.

Statistical Analysis

We performed statistical analysis using Graphpad Prism 8.0 for Mac (Graphpad Software, San Diego, CA). All data were presented as mean and standard deviations. Age, gender, ASA classification, type of primary anesthesia and incidence of chronic opioids use between two groups were calculated by Mann-Whitney test. VAS pain score was also calculated using Mann-Whitney test, the other data using two-tailed unpaired Student t-test. A p-value ≤ 0.05 was considered statistically significant.

Results

Data from 120 patients were collected from the electronic medical records, 12 patients were excluded for the following reasons; ASA 4, hip revision, bilateral hip replacement and incomplete data. A total of 108 patients were included, 54 patients underwent LPB and 54 patients underwent QLB following with unilateral primary total hip arthroplasty.

There was no difference between LPB and QLB groups regarding age (p = 0.19), gender (male or female, p = 0.33), ASA classification (1 or 2 or 3, p = 0.08), incidence of chronic opioid usage (p = 0.99) and type of primary anesthesia (spinal or general anesthesia, p = 0.51) (Table 1).

Patients with QLB had similar VAS pain scores when compared to LPB group at 0 (2.69 ± 3.04 vs 3.56 ± 3.10), 12 (4.44 ± 2.40 vs 4.56 ± 2.55) and 24 (2.33 ± 2.50 vs 2.80 ± 2.29) hours postoperatively (p = 0.08, 0.95 and 0.24, respectively) (Table 2). Postoperative opioid consumption of oral morphine equivalents was comparable between LPB and QLB at 12 (43.19 ± 23.39 mg

Table 1: Demographic data of patients. Values are presented as mean ± standard deviation or as absolute numbers or percentage. n number of patients. LPB lumbar plexus block. QLB quadratus lumborum block. ASA American Society of Anesthesiologist classification. GA general anesthesia.

	LPB (n = 54)	QLB (n = 54)	*p*-value
Age (years)	67.59 ± 11.21	64.94 ± 9.44	0.19
Gender Male/Female (n)	24/30	29/25	0.33
ASA 1/2/3 (n)	0/28/26	3/33/18	0.08
Spinal/GA (n)	51/3	50/4	0.99
Chronic opioids use	30%	24%	0.51

Table 2: Visual analog scale (VAS) scores for pain after surgery. Values are presented as mean ± standard deviation. LPB lumbar plexus block. QLB quadratus lumborum block.

	LPB (n = 54)	QLB (n = 54)	*p*-value
VAS 0 h	3.56 ± 3.10	2.69 ± 3.04	0.0817
VAS 12 h	4.56 ± 2.55	4.44 ± 2.40	0.9544
VAS 24 h	2.80 ± 2.29	2.33 ± 2.50	0.2475

Table 3: Opioid consumption (oral morphine equivalents) after surgery. Values are presented as mean ± standard deviation. LPB lumbar plexus block. QLB quadratus lumborum block. mg milligram.

Opioid consumption	LPB (n = 54)	QLB (n = 54)	*p*-value
12 h (mg)	43.19 ± 23.29	42.63 ± 25.04	0.910
24 h (mg)	19.09 ± 16.46	16.38 ± 19.09	0.431

Table 4: Duration of nerve block performed, PACU stay, physical therapy goal reached and hospital stay. Values are presented as mean ± standard deviation (min; minutes, h; hours). LPB lumbar plexus block. QLB quadratus lumborum block. PACU postanesthetic care unit. PT physical therapy.

	LPB (n = 54)	QLB (n = 54)	*p*-value
Nerve Block Procedure Time (min)	14 ± 9.84	7 ± 3.32	< 0.0001
PACU stay (h)	2.796 ± 1.10	2.844 ± 1.99	0.875
Time to PT goal (h)	24.81 ± 15.57	22.24 ± 15.75	0.395
Length of hospital tay (h)	34.11 ± 17.37	29.02 ± 15.67	0.112

vs 42.63 ± 25.04 mg) and 24 (19.09 ± 16.46 mg vs 16.38 ± 19.09 mg) hours (p = 0.91 and 0.43, respectively) (Table 3).

Time to achieve physical therapy goal, duration of PACU stay and length of hospital stay were also not statistically different between the two groups (p = 0.39, 0.87 and 0.11, respectively). However, time to perform nerve blocks were significantly less in QLB when compared to LPB (7 ± 3.32 vs 14 ± 9.84 min, p < 0.0001) (Table 4). There were no nerve block-related complications documented in both groups.

Discussion

Our study demonstrated that QLB type 1 were as effective as LPB for postoperative hip analgesia up to 24 h in total hip arthroplasty patients. VAS pain scores and total opioid consumption up to 24 h postoperatively are comparable in both groups, as well as the time to achieve physical therapy goal, time for PACU stay and hospital stay.

QLB was also proposed that it may spread to paravertebral space and lumbar plexus which may result in its analgesic effect. However, data from cadaveric study and healthy volunteer demonstrated conflicting results of QLB spreading. Caroline et al. found QLB type 1 spreading into either transversus abdominis plane or deep back muscles [13], whereas Yang et al found injectate of QLB anterior to QL muscles deposited mainly at T12 subcostal nerve, iliohypogastric and ilioinguinal nerves, and middle thoracolumbar fascia [14]. Adhikary et al found spreading of transmuscular QLB or QLB type 3 into lumbar paravertebral space and lumbar plexus [5] but Dam et al and Yang et al were unable to show similar results [14,15]. Recent study on five healthy volunteers demonstrated T10-T12 paravertebral spreading from QLB type 2 and resulted in lateral and lower abdomen analgesia [16]. Although it is not clear how QLB elicits postoperative hip analgesia, it seems to have similar clinical effect as LPB as shown in our study and a study by Adhikary et al [9].

Although transmuscular QLB has more proximity to the lumbar plexus and maybe more reliable for postoperative hip analgesia similar to LPB, but it requires needle piercing through QL muscle with higher risk of bleeding and pain from the procedure. With possibly better spreading to lumbar plexus, transmuscular QLB may also result in higher incidence of muscle weakness. Recent retrospective data by Adhikary et al., following score matching of total 60 patients showed similar hospital stays in both transmuscular QLB and LPB following hip arthroplasty [9]. QLB performed in our institution during the time of study were strictly QLB type 1 and theoretically believed to have less quadriceps weakness from less lumbar plexus spreading. However, our data, in consistent with Adhikary et al., resulted in similar duration to achieve physical therapy goal and safe to be discharged as LPB. It indirectly reflected that QLB type 1, transmuscular QLB and LPB resulted in similar amount of muscle weakness. There was one case report of patient who underwent gynecological procedure with QLB and subsequently had significant quadriceps weakness for 18 hours [17]. Therefore, fall precautions should be exercised in both LPB and QLB groups.

In comparison to LPB, we found that QLB consumed significantly less time to perform and allowed more patient's comfort during the procedure without leg twitching, hence less pre-procedure sedatives possibly required. In addition, QLB are relatively more superficial block and easier to perform by non-experienced anesthesiologists when compared to LPB. Although our study did not show nerve block-related complications from both techniques, LPB was previously reported of inadvertent intravascular injection of local anesthetics and psoas hematoma due to rich network of blood vessels in psoas major muscle [18-20]. QLB was recently found to cause spontaneously resolved postoperative hematoma on postoperative day 5 and day 8 in two pediatric cases [21], but complications in adults are yet to be determined. Single shot LPB might not be desirable because of the concerns of quadriceps weakness with the administration of high volume of local anesthetics, it is rather given as continuous low-dose infusion. With the cost of nerve block infusion pump, medications and increased nursing workload, continuous LPB block may cause higher expense compared to single shot QLB. As QLB was as effective as LPB, we propose that QLB is more desirable than LPB for postoperative hip analgesia, especially in the setting of fast turnover cases, healthcare cost reductions and for anesthesiologists who fear from doing advanced deep block.

Our study was limited by the nature of retrospective study that the accuracy of values obtained from the electronic charts and selection bias might not be ideal. Time for PACU stay, physical therapy goal and hospital stay might be confounded with pain, postoperative nausea and vomiting, patient's comorbidities, surgical-related complications, and possibly social and personal reasons. Study that directly measure quadriceps strength would elaborate more information on muscle weakness. However, with matching background data in both groups, we assume these confounding factors were balanced between both groups. Also, surgical techniques were unbiased between groups as they were performed by the same surgeon. Different methods of nerve block used, continuous nerve block for LPB vs single shot nerve block for QLB, and different local anesthetics given were possibly not a perfect comparison of these two techniques. Instead, we aimed to compare standard procedure of each technique in terms of analgesia effectiveness and hospital discharge facilitation.

In conclusion, our retrospective study demonstrated similar effectiveness in postoperative hip analgesia in primary, unilateral total hip arthroplasty in patients who received either LPB or QLB. We also found that QLB required significantly less time to perform nerve block. In the future, we expect to have randomized, controlled-trial study addressing these two techniques as well as among QLB type 1, 2 and 3. The optimal dose of local anesthetics and the necessities of additives should also be evaluated.

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