

Quadratus lumborum block provides improved immediate postoperative analgesia and decreased opioid use compared with a multimodal pain regimen following hip arthroscopy

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ABSTRACT

The purpose of our study was to evaluate the effect on immediate patient outcomes following hip arthroscopy with use of a preoperative, single shot quadratus lumborum (QL) block. We retrospectively reviewed patients who underwent hip arthroscopy following a preoperative QL block. These patients were matched by age and gender to patients who had not received a block. Visual analogue scale (VAS) pain scores immediately postoperatively and at the time of discharge were recorded. Hourly and overall opioid intake in the postanesthesia care unit (PACU) was also recorded. Continuous data was analysed with paired *t*-test, with significance being defined as $P < 0.05$. Complications in the immediate postoperative period were recorded, as was time from admission to PACU to discharge. Fifty-six patients were included. Twenty-eight patients underwent QL block and 28 did not undergo a block. QL block patients required significantly less hydromorphone ($P = 0.010$) and oxycodone ($P = 0.001$) during their time in the PACU, and significantly fewer morphine equivalents overall and per hour in the PACU ($P < 0.001$). Despite receiving less opioid analgesia, QL block patients had significantly less pain immediately postoperatively ($P = 0.026$) and at the time of discharge ($P = 0.015$). The mean time to PACU discharge was 155 ± 49 min, and there was no difference in time to discharge between groups ($P = 0.295$). One patient in the QL block group experienced persistent flank numbness. Hip arthroscopy patients who received a preoperative QL block had less pain and a lower opioid requirement in PACU than those who did not receive a block.

LEVEL OF EVIDENCE: Level III (Retrospective matched cohort study).

INTRODUCTION

With improvements in surgical technique and instrumentation as well as understanding of hip pathology, arthroscopy has become increasingly prevalent for treating hip pain in younger patients. Despite less soft tissue dissection and morbidity compared to open surgery, postoperative pain remains a major cause of patient dissatisfaction in the immediate postoperative period after hip arthroscopy [1].

Adequate postoperative analgesia is important because improved patient comfort has been associated with increased patient satisfaction, earlier mobilization and decreased consumption of opioids. Because hip arthroscopy in North America is typically performed as an outpatient procedure, postoperative pain and appropriate opioid administration can be difficult to manage. Beyond

the problematic side effects of opioids that also lead to patient dissatisfaction, such as nausea, vomiting, constipation, urinary retention, altered sensorium, opioid use has been associated with worse clinical outcomes for multiple procedures in orthopaedic surgery, and increased early postoperative opioid use is associated with a longer duration of postoperative opioid use [2, 3]. Furthermore, patients undergoing hip surgery can be exposed to opioids for long periods of time and may be at high risk to experiencing opioid-related harm, particularly since up to 61% of patients who are chronic users of opioids preoperatively chronically use opioids postoperatively as well [4]. Opioid use has become a public health crisis [5–7], and it may well be that postsurgical use of opioid, particularly of greater dose and duration, is contributing to that crisis [3]. Thus, there is reason for effective opioid-sparing analgesia following surgery.

A relatively new concern comes from the increased use of patient satisfaction surveys and length of hospital stay as quality of care measures [8]. This underscores the need for efficient and effective postoperative pain control after hip arthroscopy. The use of a regional anesthesia technique such as femoral nerve block (FNB), fascia iliaca block, lumbar plexus block or lumbar paravertebral block has been suggested as a possible solution to posthip arthroscopy pain. However, following a recent randomized controlled trial where patients with FNB had an increased incidence of falls, the study authors discontinued using FNB for hip arthroscopy at their institution [9]. Given these results, there is a need for a safe and reliable, opioid-sparing and motor-sparing method of achieving postoperative analgesia following hip arthroscopy.

The quadratus lumborum (QL) block is a regional anesthesia technique originally described in 2007 to provide analgesia for abdominal surgery. Several years later it was found, somewhat surprisingly, that this block could also provide analgesia to the hip, and various reports have demonstrated efficacy in the setting of femoral neck fracture [10, 11] and hip arthroplasty [12–15]. Indeed the QL block has recently been shown to be superior to femoral block in providing analgesia after femoral neck fracture surgery [10]. More recently, this block has been suggested as a solution for postoperative pain control following hip arthroscopy [16]. However, to date, there is a paucity of evidence in the literature demonstrating the usefulness of QL block for analgesia following hip arthroscopy.

The anatomic target of the QL block, as originally described by Blanco and McDonnell, is at the anterolateral aspect of the QL muscle in the space between the QL fascia and the posterior endoabdominal fascia [10, 17]. Local

anesthetic injected in this area is believed to spread medially and as far cephalad as T6 and as caudad as L3 to block radicular roots as they exit the intervertebral foramina. An alternative hypothesis is that blockade occurs more laterally to the spine in this posterior fascial plane of injection effecting blockade of radicular nerves to the abdomen and nerves of the lumbar plexus once they have exited the psoas muscle [13].

The purpose of our study was to evaluate immediate patient outcomes following hip arthroscopy with a preoperative, single shot QL block. We hypothesized that patients who receive a single-shot of preoperative QL block will have significantly less postoperative pain in the postanesthesia care unit (PACU), will have shorter time until discharge, and will require fewer opioids than patients who do not receive QL block. Furthermore, we hypothesized that this block will lead to no immediate postoperative complications.

MATERIALS AND METHODS

Following approval from our center's institutional review board (IRB), we retrospectively reviewed a single surgeon's consecutive series of patients who underwent hip arthroscopy following a pre-operative, single shot QL regional block. This cohort was then matched by age and gender to a cohort of hip arthroscopy patients who underwent hip arthroscopy by the same surgeon, but did not undergo regional anesthesia, and were simply treated with a multimodal pain regimen without local anesthesia. Inclusion criteria for the intervention group was a patient who underwent hip arthroscopy following a QL regional block, and all indications for hip arthroscopy (femoroacetabular impingement, instability, snapping iliopsoas tendon, loose body removal) were included. Exclusion criteria for both groups were patients with open surgery, those who received another type of regional anesthesia and charts with incomplete data.

Following selection of patients, charts were retrospectively reviewed. Patient demographics, operative time and procedure type were recorded. The main outcomes recorded were pain, time to discharge and opioid consumption. Pain was evaluated by patient-reported visual analogue scale (VAS) from 1 to 10, and was noted immediately postoperatively, as well as at the time of discharge. Time to discharge was measured from when the patient left the operating suite until they were discharged home from the PACU. Opioid consumption was recorded both by the amount of each drug consumed (hydromorphone and extended-release oxycodone, in our institution), as well as by total morphine equivalents received in the postoperative care unit and morphine equivalents received per

hour in the postoperative care unit. Morphine equivalents which were calculated using the analgesic-specific conversion factor, as described by Von Korff *et al.* [18]. Criteria for discharge at our institution are as proposed by Aldrete and Marshall [19, 20], and require the patient to be in minimal to no pain with oral analgesics, have minimal nausea and vomiting, and medically stable, as well the presence of a responsible adult caretaker.

Quadratus lumborum block technique and anesthetic care

All QL blocks were conducted in the pre-operative holding area after intravenous access was established. Standard monitors were applied and a small sedating dose of midazolam and fentanyl administered. The patient was placed in the supine position and a rolled blanket was placed under the ischium, in order to elevate the operative hip. Following sterile preparation, draping and using standard aseptic technique a low-frequency curved array ultrasound probe covered by sterile plastic sleeve was placed horizontally at the umbilicus and moved laterally over the Triangle of Petit [21, 22]. A QL type I block according to Blanco and McDonnell [23] was performed using a 22-gauge, 8-cm Tuohy needle (B Braun Medical Inc., Bethlehem, PA, USA) attached to extension tubing. Needle positioning was confirmed as deep to the aponeurosis at the lateral termination of the transversus abdominis muscle using careful hydrodissection with normal saline (Figs 1 and 2). After negative aspiration, 20–30 ml of 0.5% ropivacaine + dexmedetomidine 20–30 mcg + dexamethasone 4 mg was injected and appropriate, posterior spread observed. The additives were both included to extend nerve block duration—both of which are well documented in the literature [24, 25]. Nerve blocks were intended only for postoperative analgesia and not for surgical anesthesia. All patients received general anesthesia with propofol induction and maintenance of anesthesia with sevoflurane. Intraoperative opioids were limited to a maximum of 100 mcg of fentanyl. Routine postoperative pain orders consisted of acetaminophen 1 gm IV, ketorolac 15 mg IV and hydromorphone 0.2 mg IV every 10 min for pain as needed and then oxycodone 5–10 mg PO depending on pain level when discharge was anticipated.

Statistics

Demographic data was compiled, and averages and standard deviations were noted for each particular group. Chi-square testing was used to detect differences between groups for categorical variables, while two-tailed paired *t*-test was used to detect differences between continuous

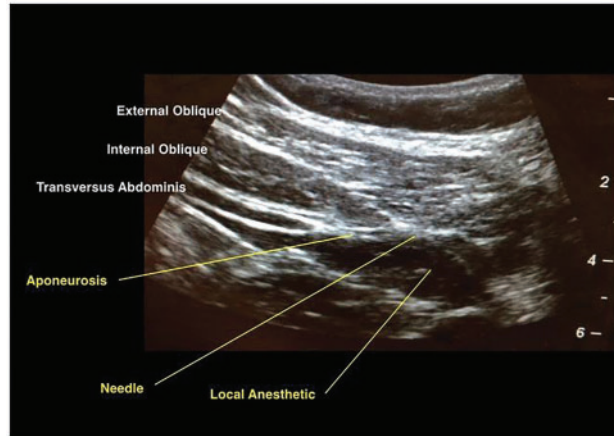


Fig. 1. Ultrasound image of block location, demonstrating the correct placement of QL block. Please note the location of the needle, in the space deep to the aponeurosis at the lateral termination of the transversus abdominis muscle after careful hydrodissection with normal saline.

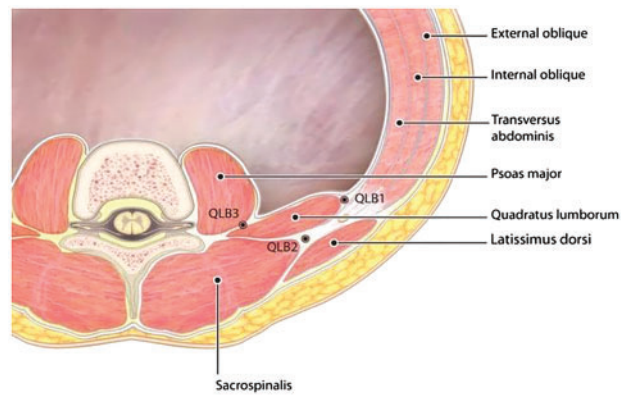


Fig. 2. Graphic illustration of the anatomy of three variations of quadratus lumborum blocks. Please note that our study utilized the QLB1 position. QLB, quadratus lumborum block.

variables. Statistical analysis was performed using Excel. Significance was set at $P = 0.05$.

RESULTS

A total of 59 patients were evaluated for inclusion in this study, but three were excluded for having incomplete data. Hence, for evaluation, a total of 56 patients were included in this study, with 28 patients having undergone QL block followed by hip arthroscopy and 28 age-matched hip arthroscopy patients who did not undergo a block. There was no significant difference between groups with regard to gender ($P = 0.164$), age ($P = 0.776$) or operative time ($P = 0.053$), although significantly more patients in the QL Block group did have a bony procedure ($P = 0.007$)

Table I. Patient demographics

	QL block	No block	Total	P-value
N	28	28	56	
Male	11	8	19	0.209
Female	17	20	37	
Age (years)	37	36	36	0.876
±	10.91	11.09	11.01	
Bony procedure	19	12	31	0.007*
Surgical time (minutes)	74	60	67	0.113
±	34	20	29	

Note: QL, quadratus lumborum. *, difference between groups reaches statistical significance at the $P=0.05$ level. Bony procedures indicate that a femoroplasty and/or acetabuloplasty were performed during arthroscopy.

(Table I). Procedures performed on each group can be noted in Table II; there was not a significant difference between groups based on procedure ($P=0.397$).

Patients who received a QL block had significantly less pain immediately postoperatively ($P=0.026$), as well as at the time of discharge ($P=0.015$), compared with the group who did not receive a block (Table III). Additionally, patients who received the QL block received significantly less hydromorphone ($P=0.010$) and oxycodone ($P=0.001$) than those who did not receive a block during their time in the PACU. Furthermore, patients with the QL block received significantly fewer morphine equivalents overall in the PACU ($P<0.001$), as well as per hour ($P<0.001$), compared with the no block group (Table IV). The mean time to discharge from the PACU was 155 ± 49 min, and there was no difference in time to discharge between patients who received a block versus those who did not ($P=0.295$). We found one complication, as one patient in the QL block group did complain of persistent flank numbness during their initial postoperative follow up examination.

DISCUSSION

The results of this matched cohort study comparing patients who received a QL single shot block preoperatively versus patients who did not receive a block for postoperative analgesia demonstrated that QL patients experienced significantly less pain immediately following hip arthroscopy, as well as at the time of discharge from the postoperative care unit. Furthermore, patients who had a QL block

Table II. Procedures performed during hip arthroscopy in each group

	QL block	No block	Total
Synovectomy	19	22	41
Labral debridement	22	18	40
Labral repair	2	4	6
CAM osteoplasty	17	10	27
Acetabular osteoplasty	5	3	8
Iliopsoas lengthening	15	19	34
Loose body removal	2	3	5
Chondroplasty	0	6	6
Capsulotomy	1	2	3
Capsular plication	1	1	2
Microfracture	0	2	2

Table III. Postoperative pain

	QL block	No block	P-value
Immediate postop pain	4.161	6.393	0.026*
±	3.210	3.395	
Pain at discharge	2.571	4.179	0.015*
±	2.290	2.135	

Note: Table demonstrating postoperative pain, as measured by VAS from 0 to 10. *, difference between groups reaches statistical significance at the $P=0.05$ level. Bold signifies statistical significance at the $P=0.05$ level.

Table IV. Postoperative opioid consumption in the PACU

	QL block	No block	P-value
Total morphine equivalents	6.528	14.018	<0.001*
±	7.612	7.383	
Morphine Eq/Hr	2.55	5.790	<0.001*
±	3.0842	2.882	

Note: Opioid use measured in total morphine equivalents. Eq/Hr, morphine equivalents received per hour in the PACU. *, difference between groups reaches statistical significance at the $P=0.05$ level. Bold signifies statistical significance at the $P=0.05$ level.

preoperatively required significantly fewer opioids, but the block did not significantly alter the time until discharge from the postoperative care unit.

The significantly lower postoperative pain and lower opioid requirements of patients who undergo a QL block is similar to results noted in patients with other types of regional anesthesia. FNBs have been shown to be effective in reducing postoperative pain and opioid use as well [9, 26, 27]. Dold *et al.* noted that patients who had a preoperative FNB had significantly less pain only at the 60-min postoperative time-point, and those who received the FNB also received significantly fewer opioid in the postoperative care unit [26]. Xing *et al.* performed a randomized trial comparing FNB with general anesthesia only, and found significantly lower pain in the PACU in the group who had regional block, and noted that the FNB group had significantly less oral morphine consumption at 48 h as well [9]. Multiple authors have also noted that patients who received a lumbar plexus block (LPB) preoperatively experienced significantly lower pain at rest than those who had pain treated only with a multimodal regimen without regional block [28, 29]. Though comparisons of these blocks with QL blocks in hip surgery are few, Parras and Blanco [9] recently found the QL block provided analgesia superior to femoral block after surgery for femoral neck fracture.

Regional anesthesia has been used to successfully control pain following hip surgery in general and for hip arthroscopy in particular. However, given that innervation of the hip is complex, multiple techniques have been developed to try to best provide safe analgesia to this area. Anatomic evaluation of this region has shown innervation that varies based on the position within the capsule. The anteromedial innervation is mainly provided by the obturator nerve and branches thereof, the anterior hip is innervated by the femoral nerve, the posterior is mainly innervated by the sciatic nerve and branches, while the posteromedial aspect of the hip joint also receives branches from the nerve to the quadratus femoris [30]. Although paravertebral blocks of L1–L2 have been noted to have positive outcomes in the context of hip arthroscopy [31, 32], QL blocks have the theoretical advantage of more thoroughly covering the complex innervation of the hip.

As the popularity of this block is increasing, there have been several subtypes of QL blocks described in the literature. The QL1 block, as per the original description, places local anesthetic at the anterolateral aspect of the QL muscle [10, 17]. The QL2 block positions the local anesthetic at the posterolateral aspect of the QL, and the QL3 block is described as a transmuscular block with needle penetration of the QL muscle to deposit the local anesthetic between the QL and the psoas muscle [17, 33]. Carline *et al.* studied the spread of injectate during QL blocks. They demonstrated that regardless of the technique of QL block, these blocks consistently spread to L1–L3 nerve

roots, as well as within the psoas major and quadratus lumborum muscles [34, 35]. MRI investigations have shown that posterior QL blocks, or QL2 blocks, more reliably result in spread of anesthetic to the paravertebral space [36].

Falls are a concern following any type of procedure that may decrease strength or coordination of the postoperative patient. They are of particular concern following hip arthroscopy, where osteoplasty of the femoral neck in particular may leave patients at risk of fracture. Merz *et al.* note that 0.07% of patients who undergo arthroscopic femoroplasty experience femoral neck fracture, and this occurs in the immediate postoperative period, at a mean of 40 days postoperatively [37]. A recent systematic review suggests that up to 0.1% of hip arthroscopy patients may sustain a hip fracture postoperatively, and even minor trauma was noted to be a significant risk factor for this devastating complication [38]. Xing *et al.* conducted a randomized trial using FNB, and concluded that the block was inadvisable due to the alarmingly high rate of falls postoperatively—22% of patients within 24 h of surgery, due to the inhibitory effect of the block on the quadriceps [9]. Likewise, lumbar plexus blocks also leave patients at risk for postoperative falls due to the risk of both hip flexor weakness (intra-psoas injection) and quadriceps weakness (femoral nerve blockade). QL blocks may have a significant advantage (admittedly poorly documented) over other blocks used for hip surgery in that they appear to be motor sparing. Our anecdotal experience over several years and many thousands of QL blocks for both abdominal and hip surgeries, both inpatients and ambulatory patients, is that QL blocks seem to largely avoid motor consequence either of hip flexors or quadriceps. The explanation for this apparent motor sparing may rest in QL blocks having limited penetration into the psoas, limited extension to L3 and L4 roots, and limited, motor sparing, blockade of the formed femoral nerve after its exit from the psoas. One would expect, therefore, that this would decrease the risk of falls postoperatively [13]. Going forward this is a question that should be addressed with formal study.

LIMITATIONS

This study has several limitations. This was a retrospective design. As a result, there was some variability in the QL blocks with respect to dose of the local anesthetic and the additives used to prolong the block. Further, it is possible that some of the analgesic benefit of the QL blocks derived from a systemic effect of the additives rather than from the block. Also related to the retrospective nature of our study, patient selection into the block or the no block groups could have potentially been influenced by selection bias.

While this is certainly a potential limitation of the study, it is also important to note that there were no significant differences noted between group in age, gender or procedure performed. Postsurgically, staff were not blinded to the treatment that the patients had preoperatively which could have influenced analgesic administration in the PACU. Also, related to the retrospective nature of the study, outcomes such as patient satisfaction or postdischarge pain and opioid use was not recorded so that these important outcome measures could not be addressed. This lack of data beyond what was recorded in the hospital certainly limits the effect of this retrospective study. Finally, we did not analyse medical comorbidities which may potentially influence postoperative pain control as it is beyond the scope of this investigation. Nevertheless, this study has demonstrated the benefit of a preoperative QL block in postoperative pain control following hip arthroscopy. Using our results, an *a priori* power analysis can be performed and a prospective randomized control trial comparing preoperative QL block to standard general anesthesia would be appropriate.

CONCLUSION

Hip arthroscopy patients who received a preoperative QL block had less pain and a lower opioid requirement in PACU than those who did not receive a block. These outcome improvements notwithstanding, there was no significant difference between groups in time to discharge.

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CONFLICT OF INTEREST STATEMENT

None declared.

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