ANESTHESIOLOGY

Anterior Quadratus Lumborum Block Does Not Provide Superior Pain Control after Hip Arthroscopy: A Double-blinded Randomized Controlled Trial

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ABSTRACT

Background: Hip arthroscopy is associated with moderate to severe postoperative pain. This prospective, randomized, double-blinded study investigates the clinically analgesic effect of anterior quadratus lumborum block with multimodal analgesia compared to multimodal analgesia alone. The authors hypothesized that an anterior quadratus lumborum block with multimodal analgesia would be superior for pain control.

Methods: Ninety-six adult patients undergoing ambulatory hip arthroscopy were enrolled. Patients were randomized to either a single-shot anterior quadratus lumborum block (30 ml bupivacaine 0.5% with 2 mg preservative-free dexamethasone) or no block. All patients received neuraxial anesthesia, IV sedation, and multimodal analgesia (IV acetaminophen and ketorolac). The primary outcome was numerical rating scale pain scores at rest and movement at 30 min and 1, 2, 3, and 24 h.

Results: Ninety-six patients were enrolled and included in the analysis. Anterior quadratus lumborum block with multimodal analgesia (overall treatment effect, marginal mean [standard error]: 4.4 [0.3]) was not superior to multimodal analgesia alone (overall treatment effect, marginal mean [standard error]: 3.7 [0.3]) in pain scores over the study period (treatment differences between no block and anterior quadratus lumborum block, 0.7 [95% CI, –0.1 to 1.5]; $P = 0.059$). Postanesthesia care unit antiemetic use, patient satisfaction, and opioid consumption for 0 to 24 h were not significantly different. There was no difference in quadriceps strength on the operative side between groups (differences in means, 1.9 [95% CI, –1.5 to 5.3]; $P = 0.268$).

Conclusions: Anterior quadratus lumborum block may not add to the benefits provided by multimodal analgesia alone after hip arthroscopy. Anterior quadratus lumborum block did not cause a motor deficit. The lack of treatment effect in this study demonstrates a surgical procedure without benefit from this novel block.

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EDITOR'S PERSPECTIVE

What We Already Know about This Topic

- Hip joint arthroscopy is a surgical procedure gaining in popularity, although the optimal postoperative analgesic strategy has not been determined
- Quadratus lumborum block can provide analgesia to the hip area, but it is unclear whether this block provides a significant clinical advantage over multimodal analgesia alone

What This Article Tells Us That Is New

- Anterior quadratus lumborum block along with acetaminophen and ketorolac did not improve postoperative analgesia in comparison to acetaminophen and ketorolac alone
- Likewise, secondary outcomes including opioid consumption and patient satisfaction were not improved in subjects receiving quadratus lumborum blocks

Hip arthroscopy is associated with moderate to severe pain.[1] The lumbar plexus block for postoperative analgesia was previously studied by YaDeau *et al.*, who found statistically significant reductions in postanesthesia care unit (PACU) resting pain, but no change in most secondary outcomes, including PACU analgesic usage, PACU pain with movement, and patient satisfaction.[2] Additionally, two inpatient falls without injury were attributed to quadriceps weakness.

The quadratus lumborum block is a well-studied block for supplemental analgesia after abdominal and pelvic surgery that has been lauded for its ease of performance, tolerability by patients, and absence of side effects such as hypotension, urinary retention, or the quadriceps weakness associated with lumbar plexus blockade—all of which promote early ambulation and discharge.[3] Additionally, the

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quadratus lumborum block type I (also known as lateral quadratus lumborum block) has been shown to have a clinical benefit as an alternative to lumbar plexus, fascia iliaca, or femoral nerve block in patients with hip fracture as a perioperative analgesic.[4] However, it has had mixed results for total hip arthroplasty.[5–7] Retrospective studies have shown mixed results when evaluating quadratus lumborum block as an analgesic block for hip arthroscopy.[8,9] However, there are no published prospective randomized controlled trials.

Depending on the approach (*e.g.*, anterior, lateral, posterior, or intramuscular), the quadratus lumborum block can result in local anesthetic spread generating analgesia ranging from T6 to L4.[10] With the anterior approach to the quadratus lumborum block, also known as quadratus lumborum block 3 or the anterior quadratus lumborum block, the local anesthetic is injected between the psoas muscle and the quadratus lumborum muscle. Given that branches of the lumbar plexus travel between the psoas major muscle and the quadratus lumborum, the anterior quadratus lumborum block appears to be the preferred approach to providing analgesia to both the lower extremities and the trunk as it consistently provides a spread of local anesthesia to the L1 to L3 nerve roots.[11] Hip innervation is primarily derived from the lumbar plexus (L1 to L4); therefore, it is crucial to ensure coverage of the lumbar nerve roots to optimize analgesia[12] while avoiding quadriceps weakness.

In addition to the surgical pain caused by hip arthroscopy, intra-abdominal fluid extravasation is a well-established complication that can occur approximately 16% of the time and can be readily identified by point-of-care ultrasound.[13–15] Additionally, intra-abdominal fluid extravasation has been associated with increased pain scores in the postoperative period.[13–15] Given that intra-abdominal fluid extravasation can increase postoperative pain, it is worth investigating the incidence in the patient population when evaluating the clinically analgesic effect of specific pain interventions in the hip arthroscopy population.

The study objective was to investigate the impact of adding anterior quadratus lumborum block to a multimodal analgesia plan on pain scores over the first 24 h after surgery. We hypothesized that the addition of anterior quadratus lumborum block to multimodal analgesia would be associated with superior postoperative pain control, as well as a significant decrease in opioid use, postoperative nausea, and vomiting, and would not cause quadriceps weakness.

Materials and Methods

Ethics

This randomized double-blinded trial received institutional review board approval, was registered at ClinicalTrails.gov (NCT03432650; principal investigator: Stephen C. Haskins, M.D.; February 12, 2018), and adheres to Consolidated Standards of Reporting Trials guidelines. The trial was conducted in accordance with the original protocol. Although no changes to methods and definitions were made during this trial, the clinical trial registration was updated after the completion of a previous trial to correct an original oversight. The full trial protocol can be obtained upon request. Written informed consent was obtained from all participants before surgery.

Patient Recruitment

Patients 18 to 80 yr of age being treated with an ambulatory hip arthroscopy by a participating surgeon coinvestigator between June 2018 and December 2019 were eligible for this study. All patients were enrolled at a single site and were approached by the research study staff on the day of surgery. Exclusion criteria encompassed hepatic or renal insufficiency, age younger than 18 and older than 80 yr, allergy or intolerance to one of the study medications, chronic gabapentin/pregabalin use (regular use for longer than 3 months), chronic opioid use (daily opioids use for longer than 3 months), contraindication for spinal anesthesia, non-English speakers, and any arthroscopy procedures including lipogems, revisions, or repair of the gluteus medius. Study enrollment ceased when the target sample size was obtained.

Randomization and Blinding

Patients were randomized in a 1:1 ratio, *via* a computer-generated randomization schedule, to receive a single shot anterior quadratus lumborum block (30 ml 0.5% bupivacaine with 2 mg preservative-free dexamethasone) or no block. A statistician who was not involved in the analysis of the data prepared the randomization schedule. A research assistant provided an opaque card with the randomization written on it to the coinvestigator anesthesiologist on the day of surgery if a patient enrolled. The cards were prepared by research staff who had access to the randomization schedule but were not otherwise involved in the study. Upon patient arrival to the operating room, the investigator anesthesiologist assigned to the case opened a sequentially numbered sealed opaque envelope containing assignment. Coinvestigator anesthesiologists were unblinded and administered the block, but research assistants enrolling and collecting data were blinded. Patients were also blinded as the anterior quadratus lumborum block was performed under deep sedation.

Study Interventions

All patients received either a spinal (4 ml mepivacaine) or combined spinal–epidural anesthetic (5 ml of 2% lidocaine) with deep IV sedation (up to 5 mg of midazolam, IV fentanyl, and IV propofol infusion titrated to effect). Intraoperative antiemetics consisted of IV ondansetron (4 mg) and IV dexamethasone (4 mg). Intraoperative analgesics were IV fentanyl (maximum 100 mcg), IV acetaminophen (maximum

1,000 mg), and IV ketorolac (maximum 30 mg). Up to 2 mg of IV hydromorphone hydrochloride was given at the anesthesiologist's discretion at the end of the case.

Block Procedure

Anterior quadratus lumborum block was performed on the ipsilateral surgical side under deep IV sedation to ensure adequate patient blinding, but before performing neuraxial technique using an X-Porte ultrasound system (FujiFilm SonoSite, USA) with a curvilinear transducer (5–2 MHz, C60xp) and a 22-gauge, 4-in needle (Chiba) in the lateral decubitus position using a sterile technique. The patient was placed in the lateral decubitus position with the operative side facing up. The transducer was placed in the transverse position immediately cephalad to the iliac crest at the level of the posterior axillary line. The needle was inserted in-plane in a posterolateral to anteromedial fashion until the needle tip transversed the quadratus lumborum muscle and pierced the fascia between the quadratus lumborum and the psoas major muscle. Thirty milliliters of 0.5% bupivacaine with 2 mg preservative-free dexamethasone was injected with an endpoint of separation of the quadratus lumborum and psoas major muscles (fig. 1). Experienced regional anesthesiologists performed all block procedures.

Point-of-care Ultrasound to Assess for Intra-abdominal Fluid Extravasation

To assess intra-abdominal fluid extravasation, the operating room anesthesiologist, trained in the focused assessment with sonography for trauma examination, evaluated the patient preoperatively to assess for fluid within the abdomen or pelvis. Postoperatively, the same anesthesiologist repeated the examination, and patients with new fluid in either compartment were diagnosed to have intra-abdominal fluid extravasation. The amount of fluid present was graded as "small," "moderate," or "large." To increase the ultrasound examination's sensitivity, the patients were placed in the Trendelenburg position while evaluating the perihepatic and perisplenic space and reverse Trendelenburg to evaluate the pelvic compartment. An anesthesiologist blinded to the case reviewed images independently. In points of disagreement, the images were reviewed by a third independent expert to reach a consensus.

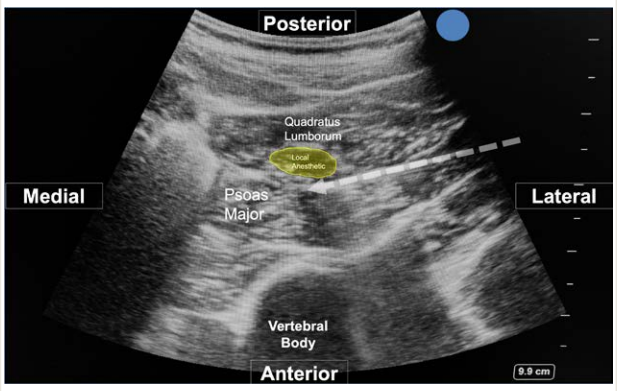

Fig. 1. Ultrasound image of anterior quadratus lumborum block. The *hashed arrow* indicates needle placement. The local anesthesia is injected anterior to the quadratus lumborum muscle with an endpoint demonstrating a fusiform separation of the local anesthesia in the fascial plane between the quadratus lumborum muscle and the psoas major muscle.

Quadriceps Strength Assessment

Before surgery and upon resolution of the neuraxial block in the PACU, a blinded research assistant independently assessed each patient for quadriceps weakness. The patient was placed supine with a cushion underneath the knee, resulting in a 45-degree angle at the knee. Quadriceps strength of both legs was assessed with a dynamometer placed on the anterior of the ankle, between the malleoli. Patients were instructed to extend their legs three times each, with a 30-s pause between each attempt. After each attempt, the strength was recorded, and patients rated their pain using a numerical rating scale. A blinded assessor determined analgesia in the L1 to L3 dermatomal distribution by touch and temperature discrimination using an alcohol swab.

Postoperative pain medications included oxycodone 5/10 mg with IV hydromorphone hydrochloride 0.5 mg every 5 min for breakthrough pain in the PACU. Patients were prescribed oxycodone/oxycodone with acetaminophen (unless contraindicated) and an oral nonsteroidal anti-inflammatory drug (naproxen or indomethacin).

Outcomes

The primary outcome, numerical rating scale pain scores at rest and movement, was assessed at 30 min and 1, 2, 3, and 24 h after PACU arrival. Secondary outcomes included the presence of intra-abdominal fluid extravasation after surgery, opioid use, the incidence of antiemetic use, the incidence of hospital admission, time to discharge from PACU, patient satisfaction with pain management, change in quadriceps strength, the incidence of urinary retention, and hypotension. Questionnaires were also administered assessing opioid-related symptoms and adverse effects using the opioid-related symptom distress scale during PACU stay, and on postoperative day 1.[16] The opioid-related symptom distress scale uses 4-point Likert scales to evaluate the frequency, severity, and bothersomeness of 12 symptoms. The composite score ranges from 0 to 4. The Quality of Recovery 40 was also administered in the PACU and on postoperative day 1. The Quality of Recovery 40 is a 40-item questionnaire that assesses five dimensions of recovery after surgery and anesthesia—comfort, emotions, physical independence,

patient support, and pain—and has a mean time to completion of 5 min.[17] The self-administered Leeds assessment of neuropathic symptoms and signs of pain scale was performed 6 months after surgery if the patient had persistent hip pain. A *post hoc* subgroup analysis of the intra-abdominal fluid extravasation groups (anterior quadratus lumborum block *vs*. control) was performed to assess pain scores at rest and movement in the first 24 h. This analysis was performed *post hoc* because the incidence of intra-abdominal fluid extravasation is low, and patients could not be prospectively randomized to either have or not have intra-abdominal fluid extravasation. However, given that intra-abdominal fluid extravasation is an independent indicator of postoperative pain, the analysis was performed *post hoc* to evaluate for a difference.

Statistical Analysis

The balance on demographics and surgical variables was compared by calculating standardized differences, where the difference in means or proportions was divided by the pooled SD. An imbalance was defined as a standardized difference with an absolute value greater than $1.96 \times (2/48)^{1/2} = 0.4$.[18] Continuous variables are summarized as mean ± SD or median with interquartile range. Categorical variables are summarized as counts and percentages. All analyses were performed on an intention-to-treat basis.

The primary outcomes, numerical rating scale pain score at rest and numerical rating scale pain score with movement at 30 min and 1, 2, 3, and 24 h after PACU arrival, were compared between the quadratus lumborum block and no block groups using regression based on a generalized estimating equations approach, with treatment group, time (30 min and 1, 2, 3, and 24 h after PACU arrival), and baseline numerical rating scale pain score as fixed effects, and participant as a random effect. An unstructured correlation model was used. The adjusted marginal means of pain scores aggregated across all time points were reported separately by group, with contrast for the difference in groups and 95% CI. *P* value is adjusted using Bonferroni adjustment for two primary outcomes. A *P* value less than 0.025 was considered significant for the primary outcome. As secondary outcomes, we added a time times treatment interaction term to the generalized estimating equations model to examine numerical rating scale difference at each observed time. For other secondary outcomes, continuous secondary outcomes measured at a single time point were analyzed using independent *t* tests or Wilcoxon rank sum tests. Categorical secondary outcomes measured at a single time point were compared between groups using chi-square and Fisher exact tests. Secondary outcomes measured at multiple time points per patient were analyzed using the generalized estimating equations method with time and treatment interactions. Effect sizes for continuous and binary secondary outcomes are presented as differences in means, and odds ratios, respectively, with corresponding 95% CI and unadjusted *P* values. A *P* value less than 0.05 in secondary outcomes should be interpreted as suggestive.

All statistical hypothesis tests were two-sided. Statistical analyses were performed with SAS Version 9.4 (SAS Institute, USA).

Previous literature found the mean ± SD for numerical rating scale pain at rest and with movement 24 h after surgery to be 3.3 ± 3.0 and 5.5 ± 3.0, respectively.[2] We determined that a sample size of 40 patients per group would provide 80% power at a two-sided alpha level of 0.025 to detect a 1.3-point difference in numerical rating scale pain score at rest or numerical rating scale pain score with movement 24 h after surgery between the anterior quadratus lumborum block and no anterior quadratus lumborum block groups.[19] We planned to enroll a total of 96 patients to account for attrition and protocol violations (20%).

Results

Ninety-six patients scheduled for a hip arthroscopy were randomized to receive either an anterior quadratus lumborum block or no block. All patients enrolled were included in the analysis (fig. 2). Baseline demographics, preoperative pain scores, and intraoperative variables between the two groups were similar (table 1).

For the primary outcome, quadratus lumborum block with multimodal analgesia was not superior to multimodal analgesia alone. There was no overall treatment difference in pain scores between the two groups over the study time. For secondary outcomes looking at numerical rating scale difference at each observed study time, the numerical rating scale at rest was only significantly lower in the anterior quadratus lumborum block group (3.3 ± 3.4) compared to the control group (4.4 ± 3.3; differences in means, 1.3 [95% CI, 0.2 to 2.4]; $P = 0.023$) at 30 min after PACU arrival. Of note, the correlation between delivery of intraoperative IV hydromorphone hydrochloride and numerical rating scale pain score at 30 min was weak (0.07 for numerical rating scale rest and 0.14 for numerical rating scale move). There was no significant difference between the anterior quadratus lumborum block *versus* no block groups for pain scores at rest or with movement at any other time point (table 2).

Intra-abdominal fluid extravasation was present in both groups, 18.8% in the anterior quadratus lumborum block group and 22.9% in the no block group. There was no difference in subgroup numerical rating scale pain scores for patients with intra-abdominal fluid extravasation (table 3).

Opioid consumption for 0 to 24 h, PACU antiemetic use, and PACU patient satisfaction were also not significantly different (table 4). There was no difference between the opioid-related symptom distress scale and the Quality of Recovery 40 scores in the PACU and postoperative day 1. Regarding the anterior quadratus lumborum block mitigating side effects of hypotension and urinary retention, there was no statistical difference between the anterior quadratus lumborum block group and the no block group.

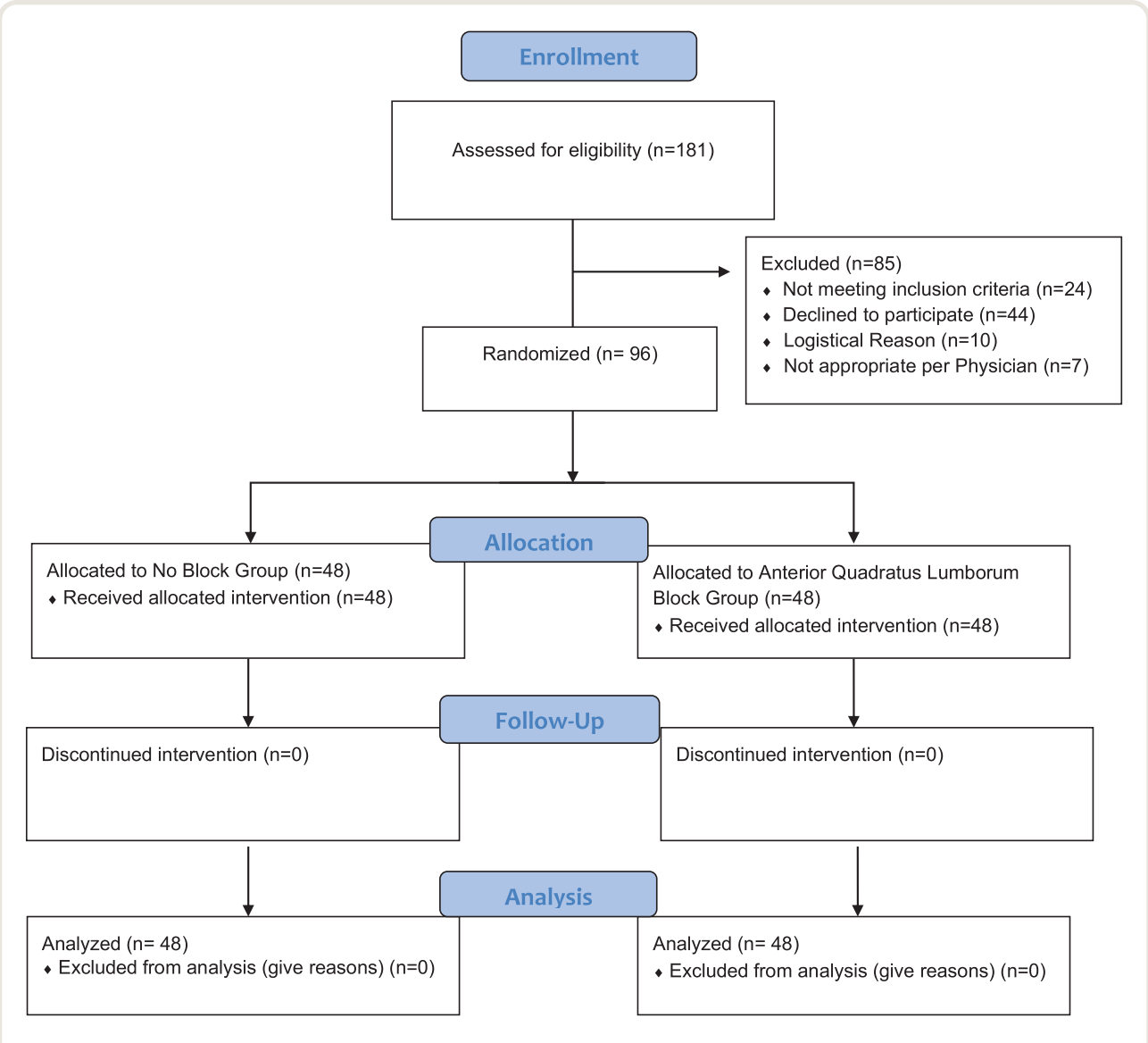

Fig. 2. Consolidated Standards of Reporting Trials patient flow diagram. Modified from Schulz KF, Altman DG, Moher D, for the CONSORT Group. CONSORT 2010 Statement: Updated guidelines for reporting parallel group randomised trials. BMJ 2010;340:c332.

There was no difference in the incidence of nausea and vomiting between the groups both in the PACU and on postoperative day 1 (table 4). There was no difference in the change of quadriceps strength on the operative side between groups (table 4; differences in means, 1.9 [95% CI, –1.5 to 5.3]; $P = 0.268$). At the 6-month follow-up, there was no difference in the self-administered Leeds assessment of neuropathic symptoms and signs of pain scale scores between the groups.

Discussion

This prospective double-blinded randomized controlled trial assessed the clinically analgesic effect of anterior quadratus lumborum block with multimodal analgesia compared to multimodal analgesia alone in hip arthroscopy. The only benefit in the anterior quadratus lumborum block intervention was at the 30-min point after PACU arrival. However, while statistically significant, a 1.1 difference in pain score may not represent a clinically meaningful difference. There was no difference found in secondary outcomes regarding opioid use, nausea/vomiting, antiemetic use, the incidence of hospital admission, time to discharge from PACU, patient satisfaction with pain management, change in quadriceps strength, or incidence of urinary retention and hypotension. In sum, these findings suggest that anterior quadratus lumborum block, in addition to multimodal analgesia, may have limited value in the setting of hip arthroscopy.

Table 1. Patient Characteristics, Short Form-8 Health Questionnaire, and Intraoperative Characteristics

	No Block Group (n = 48)	Anterior Quadratus Lumborum Block Group (n = 48)	Standardized Difference*
Patient characteristics			
Age (yr), mean ± SD	36 ± 13	36 ± 12	–0.055
Sex (male/female), n	22/26	24/24	0.080
Body mass index, mean ± SD	26 ± 5.7	24.9 ± 3.8	–0.216
American Society of Anesthesiologists Physical Status (I/II), n	20/28	18/30	–0.085
Preoperative measures			
Short Form-8 Health Questionnaire, mean ± SD	16 ± 4	17 ± 6	0.133
Intraoperative measures			
Length of surgery (min), mean ± SD	95 ± 33	95 ± 23	–0.006
Length of anesthesia (min), mean ± SD	168 ± 34	171 ± 30	0.080

*An imbalance was defined as a standardized difference with absolute value greater than 0.4.

This study demonstrated that the anterior quadratus lumborum block did not cause a significant motor deficit despite previous reports suggesting up to 90% of quadriceps weakness after the anterior quadratus lumborum block.[20] A retrospective study by Ueshima and Hiroshi reported that 65 out of 81 patients receiving anterior quadratus lumborum block experienced quadriceps weakness after performing bilateral anterior quadratus lumborum block with a total of 40 cc of 0.375% levobupivacaine.[20] Quadriceps weakness caused by blockade of the lumbar plexus can impede early mobilization and physical therapy and cause falls, all of which delay PACU discharge.[2] Despite the anterior quadratus lumborum block's proximity to the lumbar plexus, the local anesthetic is injected posterior to the psoas major muscle. In contrast, the lumbar plexus is encased within the psoas major muscle. The cadaveric study by Dam *et al.*

Table 2. Numerical Rating Scale Pain Scores at Rest and with Movement

	n	No Block Group	n	Anterior Quadratus Lumborum Block Group	Treatment Differences between No Block and Anterior Quadratus Lumborum Block, 95% CI	*P* Value
Numerical rating scale pain at rest						
Model effect*						
Overall treatment effect, marginal mean (SEM)	48	4.4 (0.3)	48	3.7 (0.3)	0.7 (–0.1 to 1.5)	0.059
Time	48		48			0.028
Baseline numerical rating scale, mean ± SD	48	2.9 ± 2.1	48	3.5 ± 2.4		0.059
Time × treatment interaction†						0.812
30 min after PACU arrival, mean ± SD	48	4.4 ± 3.3	48	3.3 ± 3.4	1.3 (0.2 to 2.4)	0.023
1 h after PACU arrival, mean ± SD	48	4.6 ± 3.7	48	3.7 ± 3.2	1 (–0.1 to 2.1)	0.072
2 h after PACU arrival, mean ± SD	46	4.6 ± 2.4	48	4.1 ± 2.1	0.6 (–0.5 to 1.7)	0.284
3 h after PACU arrival, mean ± SD	46	4.6 ± 2.2	48	4.1 ± 2.3	0.6 (–0.5 to 1.7)	0.319
24 h after PACU arrival, mean ± SD	46	3.8 ± 2.1	46	3.3 ± 2.5	0.5 (–0.6 to 1.6)	0.363
Numerical rating scale pain with movement						
Model effect*						
Overall treatment effect, marginal mean (SEM)	48	5.0 (0.4)	48	4.7 (0.3)	0.4 (–0.6 to 1.3)	0.544
Time	48		48			0.004
Baseline numerical rating scale, mean ± SD	48	5.6 ± 2	48	5.6 ± 2.4		0.389
Time × treatment interaction†						0.861
30 min after PACU arrival, mean ± SD	24	4.7 ± 3.6	13	4.5 ± 4	0.7 (–0.9 to 2.3)	0.37
1 h after PACU arrival, mean ± SD	35	5.2 ± 2.9	28	4.1 ± 3.2	0.9 (–0.3 to 2.1)	0.154
2 h after PACU arrival, mean ± SD	45	4.8 ± 2.5	44	4.5 ± 2.3	0.2 (–0.8 to 1.3)	0.656
3 h after PACU arrival, mean ± SD	45	4.8 ± 2.4	48	4.6 ± 2.3	0.2 (–0.9 to 1.3)	0.68
24 h after PACU arrival, mean ± SD	46	5.7 ± 2.3	46	5.7 ± 2.6	0 (–1.1 to 1.1)	0.99

Numerical rating scale score: 0, no pain; 10, worst pain imaginable.

*A generalized estimating equations model was run to compare numerical rating scale score differences between groups, with treatment group, time (30 min, 1 h, 2 h, 3 h, and 24 h after PACU arrival), and baseline numerical rating scale score as fixed effects and participant as a clustering variable. †A generalized estimating equations model was run to compare numerical rating scale score differences between groups, with treatment group, time (30 min, 1 h, 2 h, 3 h, and 24 h after PACU arrival), treatment group × time interaction, and baseline numerical rating scale score as fixed effects and participant as a clustering variable.

PACU, postanesthesia care unit.

Table 3. Presence of Intra-abdominal Fluid Extravasation and Subgroup Numerical Rating Scale Score

	N	No Block Group (n = 48)	N	Anterior Quadratus Lumborum Group (n = 48)	*P* Value
Presence of intra-abdominal fluid extravasation postoperatively					
Yes, n (%)	48	11 (23)	48	9 (19)	0.615
Subgroup numerical rating scale pain score with intra-abdominal fluid extravasation, mean ± SD*					
Pain at rest					
Baseline	11	2.5 ± 2.2	9	3.1 ± 2.9	
30 min after PACU arrival	11	5.6 ± 3.3	9	5.3 ± 3.7	0.834
1 h after PACU arrival	11	6 ± 2.4	9	5.3 ± 3.2	0.616
2 h after PACU arrival	10	5.9 ± 2	9	5.1 ± 2.8	0.519
3 h after PACU arrival	10	6.1 ± 2.1	9	4.9 ± 2.5	0.373
24 h after PACU arrival	11	4.1 ± 2.4	9	3 ± 1.3	0.395
Pain with movement					
Baseline	11	4.4 ± 2.5	9	4.7 ± 2.6	
30 min after PACU arrival	4	6.3 ± 4.3	4	7.8 ± 2.6	0.104
1 h after PACU arrival	10	6.6 ± 2.7	5	6 ± 3.3	0.954
2 h after PACU arrival	10	6.3 ± 2.4	8	5.5 ± 1.8	0.516
3 h after PACU arrival	10	6.8 ± 2.3	9	5.3 ± 1.7	0.180
24 h after PACU arrival	11	6.5 ± 2.8	9	5 ± 3	0.254

Numerical rating scale score: 0, no pain; 10, worst pain imaginable.

*A generalized estimating equations model was run to compare numerical rating scale score differences between groups, with treatment group, time (30 min, 1 h, 2 h, 3 h, and 24 h after PACU arrival), treatment group × time interaction, and baseline numerical rating scale score as fixed effects and participant as a clustering variable.

PACU, postanesthesia care unit.

Table 4. Secondary Outcomes

	N	No Block Group (n = 48)	n	Anterior Quadratus Lumborum Block Group (n = 48)	*P* Value
Opioid consumption in 24 h, mg oral morphine equivalent median [quartile 1, quartile 3]	45	68 [45, 75]	44	75 [41, 90]	0.311
Quality of Recovery 40, mean ± SD					
PACU	46	108 ± 7	46	105 ± 7	0.087
Postoperative day 1	45	106 ± 7	45	105 ± 7	0.735
Opioid-related Symptom Distress Scale Score, median [quartile 1, quartile 3]					
PACU	31	1 [0, 4]	30	1 [0, 3]	0.929
Postoperative day 1	27	5 [1, 6]	27	3 [1, 9]	0.986
Antiemetic use, n (%)	48	12 (25)	48	18 (37.5)	0.186
Change in quadriceps strength on operative side (kg), mean ± SD	30	–3.5 ± 2.4	27	–4.4 ± 3.3	0.268
Side effects, n (%)					
Incidence of hypotension	48	19 (40)	48	16 (33)	0.424
Incidence of urinary retention	48	0 (0)	48	1 (2)	> 0.999
Incidence of nausea					
PACU	45	7 (156)	48	12 (25)	0.296
Postoperative day 1	45	19 (42)	45	21 (47)	0.280
Incidence of vomiting					
PACU	45	1 (2)	48	0 (0)	0.489
Postoperative day 1	45	3 (7)	45	2 (4)	> 0.999
Incidence of hospital admission, n (%)	48	9 (19)	48	11 (23)	0.802
Hospital length of stay (h), median [quartile 1, quartile 3]	48	4.2 [3.5, 6.2]	48	4.6 [3.9, 7.5]	0.098
Patient satisfaction, mean ± SD					
PACU	45	9 ± 2	47	8 ± 2	0.149
Postoperative day 1	45	9 ± 2	45	8 ± 2	0.230
Self-administered Leeds Assessment of Neuropathic Symptoms and Signs at 6 mo, mean ± SD	13	9 ± 2	18	8 ± 1	0.319

PACU, postanesthesia care unit.

demonstrated that out of 10 anterior quadratus lumborum block injections, no dye surrounded the lumbar plexus block, suggesting that the lumbar plexus is not affected.[21] Changes in quadriceps strength were common in both of our groups, likely due to pain or surgical swelling limiting quadricep firing. Without a control group, it is possible that other retrospective reports misinterpreted standard surgery-related postoperative weakness as the direct result of the anterior quadratus lumborum block. Finally, although our study was not powered to assess this outcome, the addition of anterior quadratus lumborum block to multimodal analgesia did not provide superior pain control for patients with intra-abdominal fluid extravasation.

Contrary to the retrospective study by McCrum *et al.*,[8] our analysis suggests that for hip arthroscopy, the addition of anterior quadratus lumborum block to multimodal analgesia is not superior to multimodal analgesia alone for postoperative pain control, reducing opioid or antiemetic consumption, and patient satisfaction. Similar to the study by Brixel *et al.* evaluating posterior quadratus lumborum block for elective total hip arthroplasty, we also found that this block is not a good clinically analgesic option.[7] These findings are meaningful as the anterior quadratus lumborum block is relatively new. There are many hypotheses regarding the surgical procedures that might benefit from the performance of this block. However, the lack of treatment effect with performing anterior quadratus lumborum block for hip arthroscopy in addition to multimodal analgesia helps to identify the surgical procedures that do not benefit clinically from these novel blocks, particularly given that many of these blocks are deep, challenging to perform, and associated with potential complications. Additionally, the publication of prospective randomized studies with a lack of treatment effect ensures increased accuracy of future meta-analyses investigating the block's clinical analgesic effect.

The limitations of this study include the single-institutional nature, which limits external validity. We did not control for the type of hip arthroscopy performed. A sham block was not performed; however, we felt a sham block was not appropriate. The quadratus lumborum block is deep, and we did not want to risk potential violation of the peritoneum or kidney without the benefit of the postoperative analgesia. Further, we excluded patients with chronic pain or opioid dependence, who may have benefitted from additional analgesia from a regional technique.

There may be an analgesic role for the quadratus lumborum block as a rescue block for patients in severe postoperative pain. The quadratus lumborum block is performed far from the surgical site and is motor sparing; therefore, it can be performed easily without removing the surgical dressing. Also, the postprocedural analgesia might decrease the need for hospital admission for pain control while simultaneously enabling ambulation, unlike the lumbar plexus block. Additionally, patients with a history of chronic pain or high opioid dependence may benefit, no matter how marginally, from any supplemental analgesic to decrease the need for high-dose opioids postoperatively. However, despite these potential indications, our findings conclude that it does not seem prudent to routinely perform the anterior quadratus lumborum block on patients undergoing hip arthroscopy if multimodal analgesia is provided in the perioperative setting.

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Competing Interests

Dr. Memtsoudis declares a financial relationship with Teikoku (San Jose, California), Sandoz (Princeton, New Jersey), HATH (Bedford Hills, New York), Parvizi Surgical Innovation (Philadelphia, Pennsylvania), Centauros Healthcare Analytics (Scottsdale, Arizona), and SGM Consulting LLC (Holmdel, New Jersey). Dr. Kelly declares a financial relationship with Arthrex (Naples, Florida), Smith & Nephew (Watford, United Kingdom), and Organicell (Miami, Florida). Dr. Ranawat declares a financial relationship with Enhatch (Hoboken, New Jersey) and Conformis (Billerica, Massachusetts); serves as a consultant for Stryker (Kalamazoo, Michigan), Smith & Nephew (London, United Kingdom), Anika (Bedford, Massachusetts), Bodycad (Quebec, Quebec, Canada), Xiros (Leeds, United Kingdom), NewClip (Haute-Goulaine, France), Ranfac (Avon, Massachusetts), and Marrow Cellulation (Avon, Massachusetts); and is on the speakers' bureau for Pfizer (New York, New York). The other authors declare no competing interests.

Reproducible Science

Full protocol available at: haskinss@hss.edu. Raw data available at: haskinss@hss.edu.

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