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ORIGINAL RESEARCH

Lumbar Erector Spinae Plane Block for Total Hip Arthroplasty: A Comparison of 24-Hour Opioid Requirements

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Abstract

Aim: Lumbar Erector Spinae Plane Block for Total Hip Arthroplasty: A Comparison of 24-Hour Opioid Requirements.

Materials and Methods: Patients between the ages of 20 and 75 who elected to have a primary unilateral total hip arthroplasty performed under spinal anesthesia by one of the collaborating surgeon co-investigators. Initial eligibility determinations for participants were made by the lead investigator, while the research staff was responsible for making phone calls, recruiting individuals, enrolling them, and obtaining written permission.

Results: The main goal was unsuccessful in demonstrating that the combination of ESPB with spinal anesthesia is superior to spinal anesthesia alone on 24-hour postoperative opioid intake when compared to spinal anesthesia alone. In the ESPB group, the average daily use of opioids was 1088 mg, whereas in the control group, the average daily consumption was 1408 mg ($p = 0.11$). However, the control group had a considerably greater median opioid intake than the ESPB group in the first 8 hours postoperatively, 480 mg OME against 96 mg OME ($p = 0.02$). At 48 hours postoperative, there was no statistically significant difference in the amount of opioid intake between the two groups (1120 mg and 1420 mg OME in the ESPB group and the control group, respectively) ($p=0.47$).

Conclusion: We came to the conclusion that there is potential advantage of lumbar ESPB in lowering the amount of opioids needed in the first eight hours after hip arthroplasty but not beyond that. Our findings at the 24-hour mark are equivocal because of the limited size of the sample we used and the widespread dispersion of the opioid data.

Keywords: Lumbar Erector Spinae Plane Block, Total Hip Arthroplasty

Introduction

In the United States, around 500,000 hip arthroplasties are carried out every year [1]. This figure has been consistently rising over the last two decades, most likely as a result of improvements in life expectancy and, more crucially, the pandemic of obesity. Historically, this operation has been carried out when the patient was under the influence of general anesthetic. On the other hand, neuraxial and regional anesthesia are being applied in a greater number of cases to help with postoperative analgesia and to lessen the adverse effects of opioids. These adverse effects include sedation, nausea, and vomiting. Postoperative pain management has been shown to have a substantial influence on a number of patient outcomes including quicker ambulation, earlier commencement of physical therapy, improved

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functional recovery, and overall patient satisfaction [2]. In addition, effective treatment of pain may cut down on the length of time spent in the hospital as well as the likelihood of unfavorable outcomes such as deep vein thrombosis [2]. It is common practice to provide multimodal analgesia, which may include non-steroidal anti-inflammatory drugs (NSAIDS), acetaminophen, and opioids.

Blocking the femoral nerve, the obturator nerve, the nerve to the quadratus femoris, the superior gluteal nerve, and the sciatic nerve are the five nerves that are necessary to ensure complete analgesia during hip arthroplasty. It is a difficult process to anesthetize each of these nerves individually. The lumbar plexus (or psoas compartment) block, the femoral nerve block, the fascia iliaca compartment block, and the quadratus lumborum block are all examples of single-shot injections that offer appropriate coverage [3]. Even while some of these regional anesthetic procedures are effective in delivering appropriate postoperative pain management, they also have the potential to cause motor weakness in the quadriceps muscles, which in turn limits ambulation. This is a trade-off that patients are willing to make in exchange for the pain reduction they get. The erector spinae plane block, also known as the ESPB, is a relatively recent block that has been reported to be successful in giving analgesia to the hip without blocking the motor pathways of the quadriceps muscles.

In 2016, the literature published the first description of the ESPB block, which was then being utilized as a treatment for persistent neuropathic thoracic pain. Since then, there have been studies that have shown its effectiveness using a thoracic approach for the treatment of analgesia in breast surgery as well as rib fractures [4]. To this day, only a few of case studies have shown that an analgesic effect may be achieved with a lumbar approach for hip arthroplasty [5–7]. since of its location anatomically, there is a relatively minimal risk of problems with this block [5], and there is also no chance of mechanical nerve injury since there is no direct contact with any nerves [6]. These are two of the most significant advantages of this block.

In this trial, we evaluated the hypothesis that patients receiving elective primary total hip arthroplasty would benefit more from postoperative pain management if they had a lumbar etector spinae plane block (ESPB) in addition to spinal anesthesia than they would from spinal anesthetic alone. The major purpose of this study was to compare the levels of postoperative opioid use at the 24-hour mark between the two groups. A comparison of opiate intake at 8 hours and 48 hours postoperatively was one of the secondary outcomes, as was a comparison of median pain ratings at 24 hours and 48 hours after surgery.

Materials and Methods

This trial was randomized, prospective, single-blind, and carried out at a single location. Before any of the patients were included in the trial, we made sure to get their written permission after providing them with enough information. The conduct of the trial was supervised by an independent data and safety monitoring board, which also conducted a blinded evaluation of the collected safety data.

Inclusion criteria

Patients between the ages of 20 and 75 who elected to have a primary unilateral total hip arthroplasty performed under spinal anesthesia. Initial eligibility determinations for participants were made by the lead investigator, while the research staff was responsible for making phone calls, recruiting individuals, enrolling them, and obtaining written permission.

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Exclusion criteria

Patient refusal, inability to understand and sign consent, allergy or hypersensitivity to any of the study medications, use of chronic opioids, use of chronic gabapentin/pregabalin, use of more than two anti-psychotic medications, contraindication to neuraxial anesthesia, thrombocytopenia (platelets 100,000/mCL), coagulopathy (INR>1.4 or insufficient time since stopping systemic anticoagulation), body mass index (BMI) ≥35 kg/ m2, anterior surgical approach, and patients with American Society of Anesthesiologists (ASA) IV or V classification.

Patients were randomly assigned to either the control group (no block) or the ESPB group using computer-generated randomization in a ratio of 1: 1. Patients in the ESPB group got a preoperative lumbar ESPB with 30 ml of 0.375% ropivacaine. Patients in the control group did not get an ESPB. The randomization schedule was established by a statistician who did not take part in the study of the data. The randomization envelopes were generated by a member of the research team who was not actively participating in the trial itself. On the day of the operation, the intraoperative anesthesiologist, the patients, and the regional anesthesiologist were all present when the envelopes containing the assignments were opened in front of them. This rendered all three groups unblinded. The sequentially numbered envelopes containing the assignments were given to the regional anesthesiologist, who then performed the block in accordance with the assignment. Blinding was performed on the research assistants who were in charge of enrolling participants and collecting data.

Methodology

All of the patients were pretreated with oral doses ranging from 50–100 mg of pregabalin and 975 mg of acetaminophen. Following premedication, patients in the ESPB group were given landmark guided lumbar ESPB at L3 transverse process on the ipsilateral surgery side under the guidance of the regional anesthesiologist. Intraoperatively, all patients received a spinal anesthetic consisting of 0.5% bupivacaine (2.4 ml–3 ml) + 15 mcg intrathecal fentanyl with moderate intravenous (IV) sedation (a maximum of 4 mg of midazolam) and 1 gm paracetamol given intravenously.

In the postanesthesia care unit (PACU), providers prescribed IV tramadol 100mg diluted, as-needed on the basis for severe pain (NRS>4). After being able to bend and extend the non-surgical knee, patients were released from the post-anesthesia care unit (PACU), as reported by the nurses in the recovery room. At the time of admission, multimodal analgesia was started for all patients by administering the following medications: IV paracetamol 1gm QID in all pts in both the groups , and rescue analgesic, 100 mg IV Tramadol TDS whenever the NRS>4.

Under conscious sedation, preoperative lumbar ESPB was conducted on the ipsilateral surgical side with 0–2 mg IV midazolam and 0–100 mcg IV fentanyl. This was done on the ipsilateral surgery side. Landmark guided ESPB was performed , at 3cm lateral to L3 spinous process after hitting the transverse processes and withdrawing the needle a little back. After negative aspiration for blood & CSF, thirty milliliters of ropivacaine with a concentration of 0.375% was given. The loss of temperature sensation in the posterolateral region of the hip 15 minutes after the insertion of the block was used to determine whether or not the block was successful. An skilled local anesthesiologist either carried out all of the block treatments herself or supervised those that were carried out.

The total amount of opioids used at 24 hours following the patient's entrance in the PACU was the major end measure. This was recorded as oral morphine equivalents (OME). The total amount of opioids that were consumed both eight and forty-eight hours following surgery was one of the secondary outcomes. A numerical rating scale, often known as an NRS, was used to determine the levels of pain experienced. The nursing staff in the post-

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anesthesia care unit (PACU) and on the admitting floor were responsible for documenting the data that was gathered and included in the electronic medical record (EMR). Other outcomes that were evaluated were the duration of the patient's stay in the hospital, the occurrence of adverse events that were deemed to be connected to the block, and the existence of quadriceps weakness that was reported by the physical therapist on their first evaluation (within four hours of the patient's admission to the inpatient facility) as well as the provider of the Acute Pain Service.

Statistical Analysis

The Shapiro-Wilk test was used in order to investigate the degree to which the data followed a normal distribution. All of the patients' baseline and clinical characteristics were summed up as medians (interquartile ranges) for continuous variables, and the number of patients (percentage) was used to summarize categorical features. The Mann–Whitney–Wilcoxon test was used in order to conduct analysis on continuous data, whilst the chi-square test or Fisher's exact test was utilized in order to conduct analysis on categorical variables. The p-values that are reported are not modified, and thus do not take into account multiple comparisons. In all of the studies, we employed tests with two sides, and we considered a p-value of less than 0.05 to be significant. The intention-to-treat methodology was used throughout each of the studies that were carried out. The SPSS program, version 26.0 (provided by SPSS Inc. of Chicago, Illinois), was used to run the analyses on the data.

Results

Eligibility was determined for 120 individuals who had already planned elective total hip arthroplasty procedures. One hundred patients satisfied the requirements for eligibility; of these, fifty patients were randomly assigned to the control group and fifty patients were assigned to the ESPB group. The features of the patients at baseline were comparable between the two groups, as can be shown in Table 1.

Table 1: Baseline characteristics of study participants

	ESPB group (n = 50)	**Percentage**	**Control group (n = 50)**	**Percentage**	**p value**
Age	62.55±5.69		61.58±6.36		0.55
Sex					0.61
Male	20	40	21	42	
Female	30	60	29	58	
BMI	22.89±3.39		23.58±.89		0.11
Preoperative marijuana use	3 (4.8%)		2 (3.2%)		0.548
Medical history					
Diabetes mellitus	11	22	5	10	0.07
Osteoporosis	2	4	4	8	0.19
Sciatica	31	62	35	70	0.22
Herniated disc	2	4	2	4	0.44
Case time (minutes)	116.85±4.58		119.88±6.66		0.37
Length of stay (days)	2.5		3.5		0.19

The main goal was unsuccessful in demonstrating that the combination of ESPB with spinal anesthesia is superior to spinal anesthesia alone on 24-hour postoperative opioid intake when compared to spinal anesthesia alone. In the ESPB group, the average daily use of opioids was 1088 mg, whereas in the control group, the average daily consumption was 1408 mg (p =

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0.11). However, the control group had a considerably greater median opioid intake than the ESPB group in the first 8 hours postoperatively, 480 mg OME against 96 mg OME (p = 0.02) At 48 hours postoperative, there was no statistically significant difference in the amount of opioid intake between the two groups (1120 mg and 1472 mg OME in the ESPB group and the control group, respectively) (p = 0.47). In addition, there was no discernible difference in the levels of pain experienced by either of the two groups at either of the two time points. After 24 hours, the groups receiving ESPB had median pain levels of 2.5, whereas the control group had values of 3.5 (p = 0.25). After 48 hours, the ESPB group reported a median pain level of 3.5, whereas the control group reported a score of 4.0 (p = 0.19).

Table 2: Postoperative opioid consumption

	ESPB group	**Control group**	**p value**
Hours	OME in mg	OME in mg	
0-8	96	480	0.02
0-24	1088	1408	0.11
0-48	1120	1472	0.47

There was no significant difference in the incidence of adverse events, such as the need for perioperative blood transfusions, between the two groups. According to the record taken by the physical therapist, there was no evidence that the patient had quadriceps weakness or that they had fallen while they were a patient.

Discussion

In this prospective randomized controlled trial, the addition of lumbar ESPB to spinal anesthesia did not reduce opioid consumption within the first 24 hours (p=0.11) or after 48 hours (p=0.47) postoperatively in patients undergoing elective primary total hip arthroplasty when compared to spinal anesthesia alone in these patients. The study was conducted on patients who had undergone spinal anesthesia alone. However, there was a statistically significant benefit observed with reduced opioid consumption in the first 8 hours postoperatively (p=0.02). At either 24 or 48 hours, there was no discernible and statistically significant difference in the pain ratings between the two groups. The findings of our research indicate that there was a linear trend toward a reduction in the amount of opioids utilized by the ESPB group. In point of fact, the patients in the control group used roughly 24 percent more opioids in the first twenty-four hours, which lends credence to the idea that there is probably a subgroup of patients who might benefit from using this regional anaesthetic approach. Additionally, the greater variation in opioid usage statistics points to a heterogeneity in opioid use that has not been well accounted for. However, the absolute difference in opioid usage at 8 hours and 24 hours is something that should be investigated further.

This is one of the very few randomized controlled studies that has been done to investigate the use of lumbar erector spinae plane blockade (ESPB) for analgesia in total hip arthroplasty. Our findings, in terms of their effectiveness, are in line with previous case reports and observational studies of ESPB used in hip procedures, only one of which is particularly related to complete hip arthroplasties [5–9]. The most similar study was performed by Ahiskalioglu et al., who demonstrated that deposition of 40 ml of a local anesthetic mixture (20 ml 0.5% bupivacaine, 10 ml lidocaine 2%, and 10 ml normal saline) between the erector spinae and L4 transverse process for both hemiarthroplasties and intramedullary femur nailing resulted in adequate analgesia with a median time of 8 hours [8]. Despite the use of a different local anesthetic, these results are consistent with our own, which showed a reduced necessity for opioid painkillers in the first eight hours after surgery.

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In order to provide postoperative analgesia for hip arthroplasty patients, the femoral nerve, the obturator nerve, the nerve to the quadratus femoris, the superior gluteal nerve, and the sciatic nerve are all blocked. The erector spinae plane block (ESPB), the lumbar plexus block, the psoas compartment block, the fascia iliaca compartment block, the quadratus lumborum block, and the femoral nerve block are all examples of blocks that may offer appropriate analgesia to the hip [3]. The lumbar plexus block is effective, although it is technically challenging to administer. Because the needle is inserted into the deep muscles, it also has a somewhat high risk of causing systemic toxicity [10]. Despite these risks, the lumbar plexus block is recommended. The femoral nerve block is a straightforward procedure that is often performed to provide analgesia for patients who have fractured their hip. However, a good femoral nerve block leads to quadriceps muscle weakening [11], which makes it less appropriate for patients getting hip arthroplasty since early ambulation and physical therapy are typically encouraged just hours into the postoperative period. This is because early ambulation and physical therapy are sometimes recommended only hours after surgery. A weakening in the quadriceps is a recognized side effect of the femoral nerve block, and the same is true for the fascia iliaca block if it is performed using an infrainguinal technique [3]. However, the fascia iliaca block is similarly reasonably simple to administer. When performed correctly, the quadratus lumborum block may effectively produce a sensory block between T6 and L3 without inducing motor weakness [3, 12–15]. This is in contrast to the situation that can arise when a local anesthetic is injected anteriorly, which can cause the patient to experience a loss of motor function. When compared to the other blocks that were discussed before, the ESPB seems to be the sole block that can deliver analgesia without causing a proven motor blockage in the quadriceps muscles.

It is hypothesized that the ESPB is effective because a significant amount of local anesthetic was distributed throughout the body. The aforementioned study that was carried out by Ahiskaligolu et al. with the assistance of magnetic resonance imaging demonstrated the spread of the local anesthetic mixture with the contrast between the T12 and L5 transverse processes and the erector spinae muscle, as well as between the multifidus muscle and the iliocostal muscle at the L2–L4 levels [8]. Additionally, the contrast was seen anterior to the transverse process, where it expanded to the paravertebral foraminal, and (partially) epidural areas. It was also seen in the region where the lumbar nerves enter the psoas muscle. On the other hand, cadaveric investigations of the lumbar erector spinae plane block have indicated minimal craniocaudal dissemination as well as little to no diffusion of the local anesthetic into the paravertebral region and ventral rami [16, 17].

Conclusion

We came to the conclusion that there is potential advantage of lumbar ESPB in lowering the amount of opioids needed in the first eight hours after hip arthroplasty but not beyond that. Our findings at the 24-hour mark are equivocal because of the limited size of the sample we used and the widespread dispersion of the opioid data. As a result, a bigger cohort randomized trial is required in order to determine the needs for opioids once possible confounders have been adjusted for.

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