ISSN Print: 2664-7591
ISSN Online: 2664-7605
Impact Factor: RJIF 8-16
IJPCR 2025; 7(2): 129-135
www.pharmaceuticaljournal.in
Received: 05-07-2025
Accepted: 10-08-2025

Dr. Krishan Kumar Senapati
Post Graduate Trainee, Department Of Anesthesiology Peerless Hospital, Kolkata, India

Dr. Janmejoy Sengupta
Senior Consultant, Department of Anesthesiology, Peerless Hospital, Kolkata, India

Dr. Susmita Bhattacharya
Senior Consultant Department of Anesthesiology Peerless Hospital, Kolkata, India

Dr. Mohua Sengupta
Professor, Department of Pharmacology, Malda Medical College, Malda, West Bengal, India

Corresponding Author:
Dr. Mohua Sengupta
Professor, Department of Pharmacology, Malda Medical College, Malda, West Bengal, India

Comparison of ultrasound guided quadratus lumborum-3 block and lumbar erector spinae plane block for post operative analgesia in bipolar hemiarthroplasty: A prospective, randomized, double blinded study

Krishan Kumar Senapati, Janmejoy Sengupta, Susmita Bhattacharya and Mohua Sengupta

DOI: https://www.doi.org/10.33545/26647591.2025.v7.i2b.149

Abstract
Bipolar hemiarthroplasty (BHA) is a common surgical intervention for femoral neck fractures. Hip fractures can negatively affect a person's mobility, mental health and overall independence. Effective postoperative pain management is critical to ensure early mobilization and optimal recovery. Traditional techniques such as epidural analgesia and femoral nerve block often lead to undesirable side effects including hypotension and quadriceps weakness. Therefore, newer nerve blocks like Ultrasound-guided regional blocks like the quadratus lumborum-3 (QLB-3) and lumbar erector spinae plane (ESP) blocks have gained popularity to provide post- operative analgesia and offer promising alternatives with fewer motor side effects and stable hemodynamic.
Aims and Objective: To compare the effectiveness of ultrasound-guided quadratus lumborum-3(QLB-3) and lumbar erector spinae plane (ESP)blocks for postoperative analgesia in patients undergoing bipolar hemiarthroplasty (BHA).
Methods: In this prospective, randomized, double-blinded study, 80 patients aged between 25 to 75 yrs undergoing unilateral BHA under spinal anaesthesia were randomly assigned into two equal groups (n=40) to receive either a QLB-3 block or an ESP block using a standard dose of 2.0 to 2.5 ml of bupivacaine hydrochloride in dextrose was administered intrathecally for adequate surgical anaesthesia. The primary outcome was to compare post-operative analgesia between QLB-3 and ESP plane block using numeric rating scale score (NRS), score was assessed over a 24-hour postoperative period. Secondary outcomes included post-operative opioid consumption after bipolar hemiarthroplasty (BHP) and incidence of block related complications.
Results: The results of this study demonstrated that both groups were demographically and clinically comparable. NRS scores at 2 hours postoperatively were similar in both groups (QLB-3: 1.1±0.42; ESP: 1.125±0.404; p = 0.792). However, the QLB-3 group demonstrated significantly lower NRS scores at 6, 12, 18, and 24 hours (p<0.001). Fewer patients in the QLB-3 group required rescue analgesia at all time intervals, with the highest difference observed at 19-24 hours (ESP: 16 vs. QLB-3: 9). Regarding safety, both blocks were well tolerated, with no reported cases of hemodynamic instability. However, two patients (5%) in the ESP group experienced nausea and vomiting, likely due to the reduced need for opioid-based rescue analgesia.
Conclusion: The ultrasound-guided QL-3 block provides superior analgesia compared to the lumbar ESP block following bipolar hemiarthroplasty, as demonstrated by reduced opioid consumption, lower pain scores, and prolonged analgesic duration. These findings indicate that QLB-3 is more effective for prolonged pain relief and opioid sparing, making it a preferable regional anaesthesia technique for postoperative pain management in bipolar hemiarthroplasty patients.

Keywords: Bipolar hemiarthroplasty (BHP), postoperative analgesia, quadratus lumborum-3 block (QLB-3), erector spinae plane block (ESP), regional anaesthesia

Introduction
Bipolar hemiarthroplasty is a commonly performed surgical procedure for managing hip fractures, particularly in the geriatric population. This procedure aims to restore function and alleviate pain, allowing patients to regain mobility and independence. However, despite its

benefits, it is associated with significant postoperative pain, which can impede recovery and prolong hospital stays if not managed effectively. Adequate pain control is crucial for early mobilization, functional rehabilitation, and overall improved patient outcomes. Traditionally, opioids have been the primary analgesic choice for postoperative pain management in hip surgeries. While effective in controlling pain, opioids are associated with numerous side effects, including sedation, nausea, vomiting, pruritus, dizziness, and urinary retention, all of which can negatively impact the patient's recovery and hospital course [1, 2]. These limitations necessitate the exploration of alternative pain management strategies that optimize analgesia while minimizing opioid-related complications.

Regional anaesthesia has emerged as a vital component of multimodal analgesia strategies, offering improved pain control with reduced opioid consumption. Epidural analgesia, despite being an effective pain management technique, has not demonstrated significant advantages in postoperative rehabilitation or functional recovery compared to opioid-based analgesia [3, 4]. Moreover, peripheral nerve blocks such as the lumbar plexus block and femoral nerve block have been widely used to provide effective postoperative analgesia in hip surgeries. However, a major drawback of these blocks is the associated motor blockade, which can hinder early mobilization and delay rehabilitation [5]. As a result, there has been growing interest in alternative regional anaesthesia techniques that provide sufficient analgesia without significant motor impairment.

In recent years, ultrasound-guided quadratus lumborum block (QLB-3) and lumbar erector spinae plane (ESP) block have gained prominence as promising regional anaesthesia techniques for postoperative analgesia in hip arthroplasties. These fascial plane blocks have been shown to provide effective analgesia while preserving motor function, facilitating early mobilization and rehabilitation [6]. QLB-3, a variant of the quadratus lumborum block, targets the thoracolumbar fascia and provides extensive somatic and visceral pain relief. Similarly, the lumbar ESP block, by targeting the dorsal rami of the spinal nerves, offers a simple and safe alternative to traditional nerve blocks with a lower risk of complications [7]. Given the increasing use of these techniques in clinical practice, further research comparing their efficacy and safety in hip surgeries is essential to optimize pain management strategies and improve patient outcomes.

The relevance of this study lies in its potential to enhance postoperative pain management strategies for patients undergoing bipolar hemiarthroplasty, a common procedure in the elderly population. Effective analgesia is crucial for early mobilization, functional recovery, and reducing postoperative complications, particularly in geriatric patients who are at higher risk of morbidity due to prolonged immobility. By comparing the efficacy and safety of these two blocks, this study aims to determine the optimal approach for postoperative analgesia in hip arthroplasties, potentially improving patient outcomes, reducing hospital stays, and minimizing opioid-related complications. The findings of this study could contribute to evidence-based pain management protocols, offering anaesthesiologists and orthopaedic surgeons a more effective and safer alternative for postoperative pain control in hip fracture surgeries [11, 12, 13].

Aims and Objectives

1. To compare post-operative analgesia between quadratus lumborum-3 and lumbar erector spinae plane block using numeric rating scale (NRS) score.
1. To compare post-operative opioid (pethidine) consumption after bipolar hemiarthroplasty providing ultrasound guided quadratus lumborum-3 and lumbar erector spinae plane block.

Materials and Methods

The study was conducted at Peerless Hospital and BK Roy Research Centre, Kolkata, and it was prospective, randomized, double-blinded study. It was designed to compare the efficacy of ultrasound-guided quadratus lumborum-3 (QLB-3) block and lumbar erector spinae plane (ESP) block for postoperative analgesia in patients undergoing bipolar hemiarthroplasty (BHA). A written informed consent was obtained from each participant before enrolment. The study was conducted between December 2024 and February 2025, over a period of 3 months. Patients scheduled for primary BHA under neuraxial anaesthesia, aged between 25 and 75 years, and classified as ASA I, II, or III were included, provided they met the inclusion criteria and voluntarily agreed to participate. Patients with a history of allergy to local anaesthetics, prior orthopaedic surgery on the same side, those on antiplatelet therapy, those with pre-existing peripheral neuropathy, or those unwilling to participate were excluded from the study.

To ensure methodological rigor, a double-blind approach was employed. The anaesthesiologist performing the block was not involved in postoperative data collection or analysis, minimizing bias in outcome assessment. Additionally, both the patients and the postoperative care observers remained blinded to the type of block administered, ensuring objective evaluation of pain relief and other analgesic outcomes. A predetermined sample size was calculated based on previous literature and statistical analysis to ensure adequate power for detecting clinically significant differences between the two techniques. This robust study design aimed to provide reliable evidence on the comparative efficacy and safety of QLB-3 and ESP blocks in optimizing postoperative pain management in hip arthroplasty patients.

Sample Size

The study done by *Kavishwar PJ et al* [8] showed that taking this study as reference the sample size was calculated using the formula:

- $N = \{Z_{(1-\alpha/2)} + Z_{(1-\beta)}\} \times \{2\sigma^2\} / (\mu_1 - \mu_2)^2$
- $Z_{(1-\alpha/2)}$ - (the Value of the standard normal variate at 5% error) =1.96
- $Z_{(1-\beta)}$ - (Considering 90% power) =1.28
- SD = σ = 0.72 (as per reference)
- Mean NRS score at first 6 hours Group 1(μ_1) = 1.4
- Mean NRS score at first 6 hours Group 2(μ_2) = 0.9
- So
- $N = \{1.96 + 1.28\} \times \{2 \times 0.72^2\} / (1.4 - 0.9)^2$
- = 41.2
- ≈ 42

So in each group 42 subjects were considered

Considering 2 groups the final Sample size is (42+42) = 84
Total 4 patients refused to participate.
So final sample size was 80

Statistical Plan

Categorical variables were presented as the number and percentage of patients and were compared between the two groups using Pearson's Chi-Square test for Independence of Attributes or Fisher's Exact Test, depending on the appropriateness of the data. Continuous variables were expressed as mean ±standard deviation and analysed using an unpaired t-test if the data followed a normal distribution, while the Mann-Whitney U test was applied for non-normally distributed data. Statistical analysis was performed using SPSS software version 25. An alpha level of 5% was set, meaning that a p-value of less than 0.05 was considered statistically significant.

Tools and Techniques: In the operating room, all patients were attached to ASA standard monitors for continuous hemodynamic monitoring. Those who met the inclusion criteria received spinal anaesthesia at the L3-L4 level using either a 25G Quincke needle or a Whitacre pencil-point 25G needle. A standardized dose of 2.0-2.5 mL of bupivacaine hydrochloride in dextrose was administered intrathecally for adequate surgical anaesthesia. To minimize the risk of infection and postoperative nausea, all patients received a prophylactic intravenous dose of 1g ceftriaxone after anaphylaxis precautionary skin test (APST) and 4 mg ondansetron at the start of surgery. Additionally, to ensure baseline analgesia and optimize multimodal pain management, an ultrasound-guided femoral nerve block was performed using 20 mL of 0.375% ropivacaine with a high-frequency linear transducer (8-18 MHz). The femoral nerve block was provided uniformly across all patients to minimize the confounding effects of surgical site pain before evaluating the efficacy of the quadratus lumborum-3 (QLB-3) and lumbar erector spinae plane (ESP) blocks.

For the QLB-3 block, a low-frequency curvilinear transducer (2-5 MHz) was positioned in the axial plane over the patient's flank, just cranial to the iliac crest as shown in Fig 2. The target for injection was the fascial plane between the quadratus lumborum (QL) and psoas major muscles. Using an in-plane technique, a 20G, 100mm Stimuplex Ultra needle was advanced from the posterior end of the transducer into the inter fascial plane between the QL and psoas muscles under real-time ultrasound guidance. After confirming the needle placement with negative aspiration, 30 mL of 0.375% ropivacaine was injected in 5 mL increments, ensuring adequate spread of the local anaesthetic within the target fascial plane as shown in Fig 1. The efficacy of these blocks was evaluated using the Numeric Rating Scale (NRS) for pain at multiple postoperative time points 2, 6, 12, 18, and 24 hours. Additionally, secondary outcome measures included the incidence of complications such as nausea and vomiting, the time to first rescue analgesia, and hemodynamic instability requiring intervention. These parameters provided a comprehensive assessment of the analgesic effectiveness and safety profile of the two blocks in the context of postoperative pain management for bipolar hemiarthroplasty.

For the lumbar ESP block, the ultrasound transducer was first placed in a parasagittal oblique interlaminar orientation to identify the laminae, followed by a lateral adjustment to visualize the transverse processes (TPs) as shown in Fig 4. The TPs were recognized as hyperechoic structures casting acoustic shadows separated by the psoas muscle. By sliding the transducer laterally beyond the TP tips until the shadows disappeared and then slowly moving back until they reappeared, the precise injection site was located. A block needle was inserted in-plane to the transducer, targeting the tip of the TP. Once the needle tip was correctly positioned, 30 mL of 0.375% ropivacaine was injected in 5 mL increments with intermittent aspiration, ensuring that the injectate spread into a hypoechoic pocket lifting the erector spinae muscle. This approach ensured diffusion of the local anaesthetic along the dorsal rami of spinal nerves, providing effective postoperative analgesia as shown in Fig 3.

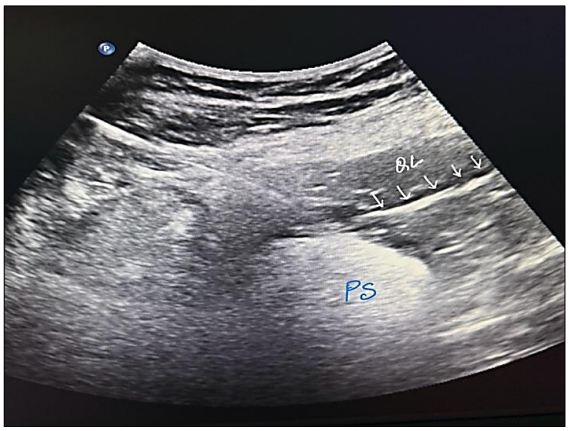

Fig 1: QL= Quadratus muscle PS= Psoas Major muscle Diagonal arrow= local anesthetic deposition

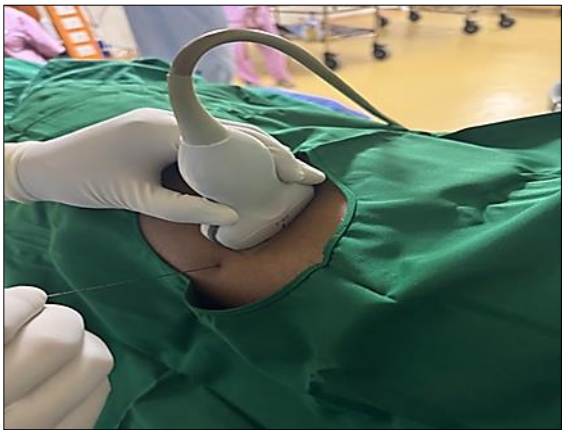

Fig 2: Transducer position and needle insertion

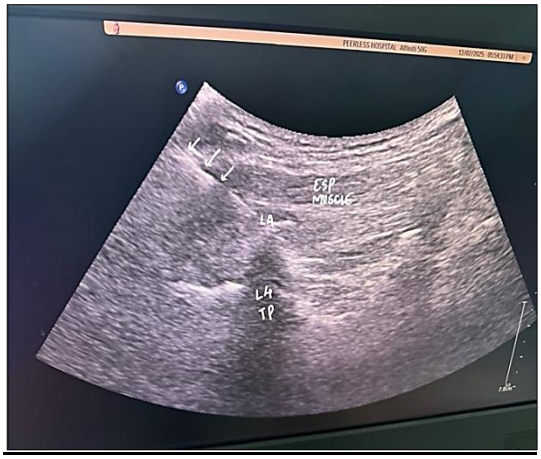

Fig 3: Diagonal arrow= stimpulex ultra needle ESP= Erector spinae plane muscle L4 TP= transverse process of lumbar 4 vertebra LA= local anesthetic deposition

Fig 4: Transducer position and needle insertion

Results

Table 1: Comparison of demographic data and side of Bipolar Hemiarthroplasty in Lumbar Erector Spinae Plane Group vs Quadratus Lumboram 3 Block Group

Charaterestics	Group	Lumbar Erector Spinae Plane Group	Quadratus Lumboram 3 Block Group
Age	-	63.22±6.27	63.65±5.34
Gender	Male	17	19
	Female	23	21
Distribution of ASA	Grade I	4	4
	Grade II	32	33
	Grade III	4	3
Side of Total Hip Replacement	Left	24	22
	Right	16	18

The demographic and clinical characteristics of the study population were comparable between the lumbar erector spinae plane (ESP) block group and the quadratus lumborum-3 (QLB-3) block group. The mean age of patients in the ESP group was 63.22±6.27 years, while in the QLB-3 group, it was 63.65±5.34 years, indicating no significant difference in age distribution between the two groups. This similarity ensured that age-related variations in pain perception and response to analgesic techniques were minimized, contributing to a more reliable comparison of the two regional blocks.

Regarding gender distribution, the ESP block group consisted of 17 males and 23 females, while the QLB-3 block group included 19 males and 21 females. The relatively balanced gender distribution in both groups reduced potential gender-related biases in pain assessment and postoperative recovery outcomes. Additionally, ASA grading, which is an indicator of the patient's preoperative health status, was similar across both groups. In the ESP block group, four patients were classified as ASA Grade I, 32 as Grade II, and four as Grade III. Similarly, in the QLB-3 block group, four patients were ASA Grade I, 33 were Grade II, and three were Grade III. The comparable ASA grading between groups ensured that the study results were not influenced by differences in baseline health conditions or comorbidities.

The laterality of the hip surgery was also distributed evenly between the two groups, minimizing any potential impact of surgical site variation on postoperative pain outcomes. In the ESP block group, 24 patients underwent left-sided Bipolar Hemiarthroplasty, while 16 had right-sided bipolar hemiarthroplasty. Conversely, in the QLB-3 group, 22 patients had left-sided procedures, and 18 had right-sided bipolar hemiarthroplasty. Since laterality can sometimes influence postoperative pain perception due to anatomical and neurophysiological factors, the balanced distribution of left- and right-sided surgeries between the two groups strengthened the validity of the comparative analysis.

Table 2: Comparison of NRS scores for pain between the two groups (n=80)

	Lumbar Erector Spinae Plane Group (Mean ±SD) N=40	Quadratus Lumboram 3 Block Group (Mean ±SD) N=40	P value (Paired T test)
Time Interval			
2 hours	1.125±0.404	1.1±0.42	0.792
6hours	2.55±0.552	1.275±0.716	<0.001
12 hours	3.85±0.535	2.625±0.74	<0.001
18 hours	4.98±0.6197	3.7±0.65	<0.001
24 hours	5.875±0.404	4.775± 0.62	<0.001

The comparison of postoperative pain intensity between the two groups was assessed using the Numeric Rating Scale (NRS) at multiple time intervals: 2, 6, 12, 18, and 24 hours. At the 2-hour mark, the mean NRS scores were similar between the lumbar erector spinae plane (ESP) block group (1.125±0.404) and the quadratus lumborum-3 (QLB-3) block group (1.1±0.42), with a p-value of 0.792, indicating no statistically significant difference in pain perception at this early postoperative stage. This suggests that both blocks provided comparable initial analgesia, likely due to the residual effects of spinal anaesthesia.

However, as the postoperative period progressed, significant differences in pain scores emerged. At 6 hours, the ESP group had a higher mean NRS score (2.55±0.552) compared to the QLB-3 group (1.275±0.716), with a statistically significant p-value of <0.001. This trend continued at 12 hours (ESP: 3.85±0.535 vs. QLB-3: 2.625±0.74, $p<0.001$), 18 hours (ESP: 4.98±0.6197 vs. QLB-3: 3.7±0.65, $p<0.001$), and 24 hours (ESP: 5.875±0.404 vs. QLB-3: 4.775±0.62, $p<0.001$). These results suggest that the QLB-3 block provided superior and prolonged analgesia compared to the ESP block, particularly after the initial few hours postoperatively.

The significant differences in NRS scores at later time highlight the potential advantages of QLB-3 over ESP block for sustained postoperative pain relief in hip arthroplasty patients. The superior efficacy of QLB-3 may be attributed to its anatomical target, which facilitates a more extensive spread of local anaesthetic within the thoracolumbar fascia, affecting both somatic and visceral pain pathways. In contrast, the ESP block primarily influences the dorsal rami of spinal nerves, which may provide less effective analgesia for deep surgical pain over time. These findings suggest that QLB-3 could be a preferred regional anaesthesia technique for optimizing pain management and reducing the need for opioid-based rescue analgesia in the postoperative period.

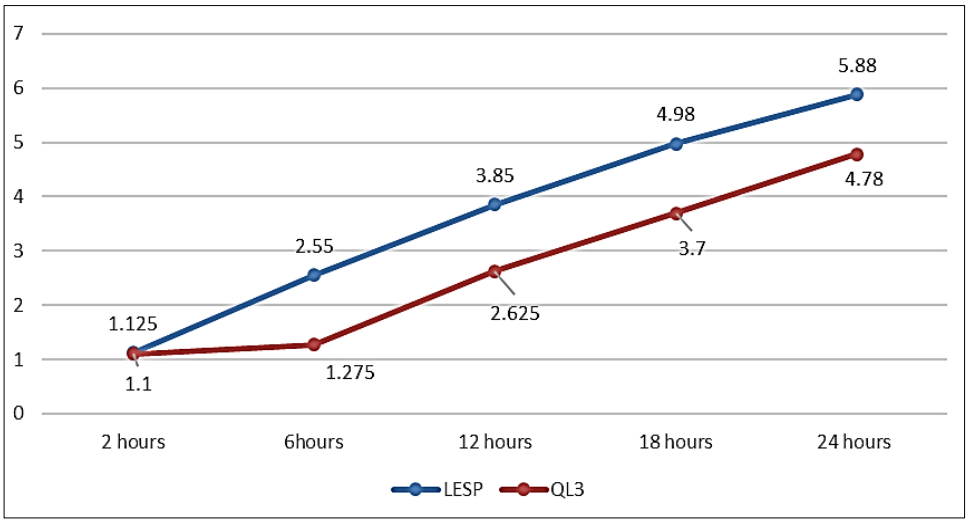

Fig 5: Comparison of NRS scores for pain between the two groups (n=80)

Table 3: Comparison of number of patients receiving rescue analgesia in both the groups

Time of request of rescue analgesia	Lumbar Erector Spinae Plane Group	Quadratus Lumboram 3 Block Group
0-6 hours	4	2
7-12 hours	9	4
13-18 hours	11	7
19-24 hours	16	9

The requirement for rescue analgesia was compared between the lumbar erector spinae plane (ESP) block group and the quadratus lumborum-3 (QLB-3) block group at different postoperative time intervals. In the initial 0-6 hours, only a small number of patients in both groups required additional analgesia, with four patients in the ESP group and two patients in the QLB-3 group requesting rescue pain relief. This suggests that both blocks provided adequate analgesia during the immediate postoperative period, likely due to the residual effects of spinal anaesthesia and the initial efficacy of the regional blocks.

As the postoperative period progressed, a greater number of patients in the ESP group required rescue analgesia compared to the QLB-3 group. Between 7-12 hours, nine patients in the ESP group requested additional analgesia, while only four patients in the QLB-3 group required it. This trend continued in the 13 to18-hour period, with 11 patients in the ESP group versus seven in the QLB-3 group needing supplementary pain relief.

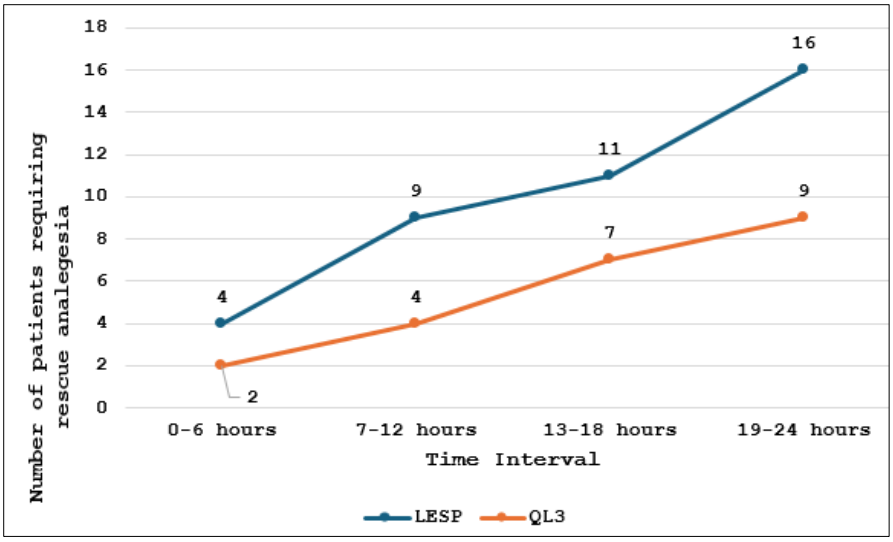

Fig 6: Comparison of number of patients receiving rescue analgesia in both the groups

Table 4: Comparison of complication of patient in both the groups

Complication	Lumbar Erector Spinae Plane Group Number (%)	Quadratus Lumboram 3 Block Group Number (%)
Nil	38(95)	40(100)
Vomiting/ Nausea	2(5)	0(0)
Vital Instability	0(0)	0(0)

The incidence of complications was analysed in both groups to assess the safety profile of the lumbar erector spinae plane (ESP) block and quadratus lumborum-3 (QLB-3) block. Majority of patients in both groups did not experience any complications. In the ESP block group, 38 out of 40 patients (95%) had an uneventful postoperative course, while all 40 patients (100%) in the QLB-3 group reported no complications. The absence of complications in the QLB-3 group suggests that this technique may have a slightly better safety profile compared to the ESP block.

In the ESP block group, two patients (5%) experienced postoperative nausea and vomiting (PONV), while no such cases were reported in the QLB-3 group. The higher incidence of Post operative nausea, vomiting in the ESP group could be attributed to increased postoperative opioid consumption due to higher pain scores and earlier requests for rescue analgesia. Opioids are a well-known cause of nausea and vomiting in postoperative patients, and the reduced analgesic efficacy of the ESP block compared to QLB-3 may have contributed to this difference.

Discussion

Effective postoperative pain management is essential for optimizing recovery after bipolar hemiarthroplasty, particularly in the elderly population. This study compared the analgesic efficacy of the ultrasound-guided quadratus lumborum-3 (QLB-3) block and the lumbar erector spinae plane (ESP) block, demonstrating that QLB-3 provided superior and longer-lasting pain relief. The significant difference in Numeric Rating Scale (NRS) scores at 6, 12, 18, and 24 hours postoperatively suggests that QLB-3 offers a more prolonged analgesic effect compared to the ESP block. These findings are consistent with previous studies that have highlighted the extensive spread of local anaesthetic in the thoracolumbar fascia following QLB-3, leading to blockade of both somatic and visceral pain pathways, which is particularly beneficial for hip surgeries [6]. In contrast, the ESP block primarily acts on the dorsal rami of spinal nerves, which may limit its effectiveness for deep-seated pain from hip arthroplasty [7].

The requirement for rescue analgesia was significantly lower in the QLB-3 group, further supporting its efficacy in prolonged postoperative pain control. Similar trends have been reported in previous trials, where QLB-3 reduced opioid consumption and delayed the need for additional analgesia compared to ESP and femoral nerve blocks [9]. The reduced opioid requirement in the QLB-3 group may explain the lower incidence of nausea and vomiting, as opioid-related adverse effects are a common concern in postoperative pain management. Moreover, neither group reported cases of hemodynamic instability, reinforcing the safety profile of both regional blocks. This aligns with findings from *Liu QR et al* [10], who observed stable hemodynamic parameters with QLB-3 in hip surgeries, The findings of this study could contribute to evidence-based pain management protocols, offering anaesthesiologists and orthopaedic surgeons a more effective and safer alternative for postoperative pain control in hip fracture surgeries. [11],[12],[13]

Various other research works further supported its feasibility as an effective analgesic option without significant sympathetic blockade. [14],[15],[16]

Our results suggest that QLB-3 may be the preferred regional anaesthesia technique for hip arthroplasty, given its prolonged pain relief and reduced need for rescue analgesia. However, while this study provides valuable insights, further large-scale randomized controlled trials are needed to confirm these findings and explore the optimal dosing and volume of local anaesthetic for each block. Nevertheless, our study adds to the growing body of

evidence supporting QLB-3 as a promising alternative for effective postoperative pain management in hip arthroplasty patients.

Conclusion

This study demonstrated that the quadratus lumborum-3 (QLB-3) block is a more effective regional anaesthesia technique than the lumbar erector spinae plane (ESP) block for postoperative pain management in bipolar hemiarthroplasty. Patients who received QLB-3 experienced significantly lower pain scores, a delayed need for rescue analgesia, and fewer opioid-related side effects such as nausea and vomiting. Both blocks were safe, with no instances of hemodynamic instability, reinforcing their feasibility in clinical practice. Given its prolonged analgesic effect and opioid-sparing benefits, QLB-3 may be a preferred option for optimizing postoperative pain control and enhancing recovery in hip arthroplasty patients. However, further large-scale studies are needed to validate these findings and refine best practices for regional anaesthesia in orthopaedic surgeries.

Acknowledgement

The authors would like to thank all the members of Department of Anaesthesia, Peerless Hospital, for their constant support to carry out this study.

Funding: None

Conflict of interests: None declared.

Ethical approval: Approved by Institutional Ethics committee, Peerless Hospital, Kolkata.

References

1. Gan TJ, Habib AS, Miller TE, White W, Apfelbaum JL. Incidence, patient satisfaction, and perceptions of post-surgical pain: results from a US national survey. Curr Med Res Opin. 2014;30(1):149-160.
2. Shafi S, Collinsworth AW, Copeland LA, Ogola GO, Qiu T, Kouznetsova M, *et al.* Association of opioid-related adverse drug events with clinical and cost outcomes among surgical patients in a large integrated health care delivery system. JAMA Surg. 2018 Aug 1;153(8):757-763. doi:10.1001/jamasurg.2018.1039. PMID: 29799927; PMCID: PMC6142954.
3. Choi JV, Cheung RM, Mozel MR, Merchant RN, Lee SM. Perioperative outcomes after preoperative epidural analgesia in patients with hip fracture undergoing surgical repair: a systematic review. Pain Med. 2022;23(2):234-245. doi:10.1093/pm/pnab176.
4. Rubin MA, Stark NF, Hårsmar SJC, Møller AM. Pre-operative epidural analgesia in hip fracture patients - a systematic review and meta-analysis. Acta Anaesthesiol Scand. 2021;65(5):578-589. doi:10.1111/aas.13760.
5. Guay J, Johnson RL, Kopp S. Nerve blocks or no nerve blocks for pain control after elective hip replacement (arthroplasty) surgery in adults. Cochrane Database Syst Rev. 2017 Oct 31;10(10):CD011608. doi:10.1002/14651858.CD011608.pub2. PMID: 29087547; PMCID: PMC6485776.
6. Blanco R, Ansari T, Riad W, Shetty N. Quadratus lumborum block versus transversus abdominis plane block for postoperative pain after cesarean delivery: a randomized controlled trial [published correction appears in Reg Anesth Pain Med. 2018;43:111]. Reg Anesth Pain Med. 2016;41(6):757-762. doi:10.1097/AAP.0000000000000495.
7. Chin KJ, Adhikary S, Sarwani N, Forero M. The analgesic efficacy of pre-operative bilateral erector spinae plane (ESP) blocks in patients having ventral hernia repair. Anaesth. 2017;72(4):452-460. https://doi.org/10.1111/anae.13814.
8. Kavishwar PJ, Satapathy AR, Kumar BS, Balavenkatasubramanian J. Section: Anaesthesiology. Int J Acad Med Pharm. 2024;6(4):584-591.
9. Elsharkawy H, El-Boghdadly K, Kolli S, *et al.* Injectate spread following anterior sub-costal and posterior approaches to the quadratus lumborum block: a comparative cadaveric study. Eur J Anaesthesiol. 2017;34(9):587-595. doi:10.1097/EJA.0000000000000680.
10. Liu QR, Dai YC, Xie J, Li X, Sun XB, Sun J. Ultrasound-guided quadratus lumborum block enhances the quality of recovery after gastrointestinal surgery: a randomized controlled trial. Pain Res Manag. 2022 Apr 30;2022:8994297. doi:10.1155/2022/8994297. PMID: 35535242; PMCID: PMC9078840.
11. Vishal U, Retter S, Kehoe E, McKeen DM. Quadratus lumborum block for postoperative analgesia: a systematic review and meta-analysis. Can J Anaesth. 2020 Nov 1;67(11):1557-1575.
12. Ma J, Bi Y, Zhang Y, Zhu Y, Wu Y, Ye Y, *et al.* Erector spinae plane block for postoperative analgesia in spine surgery: a systematic review and meta-analysis. Eur Spine J. 2021 Nov;30(11):3137-3149.
13. Sun Q, Zhang C, Liu S, Lv H, Liu W, Pan Z, Song Z. Efficacy of erector spinae plane block for postoperative analgesia in lumbar surgery: a systematic review and meta-analysis. BMC Anesthesiol. 2023 Feb 16;23(1):54.
14. Tulgar S, Ermis MN, Ozer Z. Combination of lumbar erector spinae plane block and transmuscular quadratus lumborum block for surgical anaesthesia in hemiarthroplasty for femoral neck fracture. Indian J Anaesth. 2018 Oct 1;62(10):802-805.
15. Ahiskalioglu A, Tulgar S, Celik M, Ozer Z, Alici HA, Aydin ME. Lumbar erector spinae plane block as a main anesthetic method for hip surgery in high-risk elderly patients: initial experience with a magnetic resonance imaging. Eurasian J Med. 2020 Feb;52(1):16-19.
16. Chan A, Ng TK, Tang BY. Single-shot lumbar erector spinae plane block in total hip replacement: a randomized clinical trial. Anesth Analg. 2022 Oct 1;135(4):829-836.