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RESEARCH ARTICLE

Effectiveness of lateral femoral cutaneous and femoral nerve block in managing postoperative pain for hemiarthroplasty patients

Kazi Mahzabin Arin | Shofina Sultana | Ayesha Sultana |
Mohammad Abdul Hannan | Chandra Shekhar Karmakar | AKM Akhtaruzzaman |

Department of Anaesthesia, Analgesia and Intensive Care Medicine, Bangabandhu Sheikh Mujib Medical University,

Abstract

Background: The fascia iliaca compartment block is commonly used for postoperative analgesia after hemiarthroplasty. However, the method often fails to adequately manage pain due to frequent sparing of the lateral femoral cutaneous nerve. This randomised controlled study was conducted to compare the efficacy of lateral femoral cutaneous and femoral nerve blocks compared to fascia iliaca compartment block for postoperative pain management following hemiarthroplasty.

Methods: Sixty patients were randomly assigned to either the fascia iliaca compartment (FIC) block group or the lateral femoral cutaneous nerve and femoral nerve (LFCN plus FN) block group. All patients received a subarachnoid block for surgery. Pain was assessed using a visual analogue scale (VAS) in the recovery room. When patients reported VAS score 3 or 4, the FIC and LFCN plus FN blocks were performed according to group allocation. VAS scores were reassessed 20 minutes after the blocks and recorded. Subsequently, the pain was assessed using VAS at two-hour intervals until the patients required rescue analgesia.

Results: The VAS scores differed significantly between the two groups. In the LFCN plus FN block group, 13.3% reported VAS 0, 30% reported VAS 1, and the rest reported VAS 2. In the FIC block group, 53.3% reported VAS 2, and 46.7% reported VAS 3. None reported VAS 0 in the FIC group. The average time to demand rescue analgesia was 4.9 (0.8) hours in the FIC group and 9.4 (1.5) hours in the LFCN plus FN group. Adjusted time based on age, sex, body mass index, and Anesthesiologists class for the FIC block group was 6.8 (0.9) hours, while the LFCN plus FN block group recorded 7.5 (0.8) hours (P=0.003).

Conclusion: Administering the LFCN and FN block separately but simultaneously provides better postoperative analgesia than the conventional FIC block following hemiarthroplasty.

Key message

Elderly patients undergoing hemiarthroplasty are particularly vulnerable to opioid side effects. Nerve blocks targeting the lateral femoral cutaneous and femoral nerves provide extended pain relief, reducing the need for rescue analgesics. Continuous nerve block techniques can eliminate opioids, resulting in faster recovery, fewer side effects, and lower healthcare costs.

Correspondence
Kazi Mahzabin Arin
kazimahzabinarin@bsmmu.edu.bd

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Introduction

Optimal postoperative pain management is imperative for facilitating a prompt recovery after surgery. Hemiarthroplasty is a surgical procedure commonly practised in orthopaedics, involving the replacement of one-half of the hip joint with a prosthesis. The significance of effective pain management following this surgery cannot be overstated. Inadequate pain control has been correlated with prolonged immobilisation, which in turn can lead to disruptions in the rehabilitation process and delays in regaining the ability to walk unaided. These setbacks may heighten the risk of thromboembolic complications, compromise functional recovery, and ultimately extend the patient's hospital stay [1]. Therefore, ensuring optimal pain management is crucial in promoting successful outcomes and minimising postoperative complications in hemiarthroplasty patients.

Hip fracture is a condition that predominantly affects older adults. Managing pain in these patients presents significant challenges due to the high prevalence of polypharmacy and consequential drug interactions within this population [2]. In addition, insufficient pain control can exacerbate comorbidities such as airway disease and cognitive impairment [3]. Hemiarthroplasty is performed under spinal anaesthesia. Surgical approaches may be anterior, lateral, or posterior. Most surgeons prefer the lateral approach due to its convenience and fewer complications. Following hemiarthroplasty, it is common practice to manage postoperative pain using opioid analgesics and adjuvants. However, it is essential to note that opioids have a range of adverse effects. These include nausea, vomiting, constipation, sedation, dizziness, life-threatening respiratory depression, withdrawal symptoms, hypotension, an increased risk of seizures, sweating, dysphoria, and euphoric mood. Additionally, opioids may lead to cardiovascular events, such as tachycardia, bradycardia, and palpitations. Cutaneous reactions may manifest as pruritus, urticaria, and rash [4]. Opioids also affect long-term outcomes and influence the entire lives of patients, like potentially developing opioid dependence or opioid-induced hyperalgesia [5].For these reasons, the use of opioids is reduced by peripheral nerve blocks, and opioids are reserved for rescue analgesia. Fascia iliaca compartment (FIC) block or femoral nerve block is commonly performed for postoperative pain management in hemiarthroplasty patients. However, the study shows that none of these can adequately manage postoperative pain after hemiarthroplasty.

As the name suggests, the FIC block is a fascial plane block. Following local anaesthetic administration, drugs must diffuse to reach the femoral nerve (FN) and lateral femoral cutaneous nerve (LFCN). These two nerves run behind the fascia iliaca and are located together in the fascia iliacus space [6]. FIC block often results in inadequate blockade of the LFCN [7]. Dolan J *et al.* showed the success rate of ultrasound-guided fascia FIC block is 87% [8]. For lateral approach hemiarthroplasty, a surgical incision is made in the lateral thigh. The LFCN of the thigh supplies this area. So, a significant amount of postoperative pain originates from this site. There is a substantial variation in sensory coverage among individuals because of the highly variable course of the LFCN and branches [9]. That's why the FIC block couldn't consistently block the lateral LFCN of the thigh. Blocking the LFCN and FN separately with real-time ultrasound guidance may offer better pain management after hemiarthroplasty. So, this randomised control trial was designed to compare the efficacy and time to demand rescue analgesia between FIC block versus individual femoral cutaneous nerve block and FN block following hemiarthroplasty surgery.

Methods

This was a randomised control trial approved by the Institutional Review Board (IRB) of Bangabandhu Sheikh Mujib Medical University (BSMMU) under protocol memo no. BSMMU/2023/6687, dated 6 May 2023. The study was conducted at the orthopaedic surgery operation theatre and postoperative ward of BSMMU. Sixty patients scheduled for hemiarthroplasty at BSMMU from May 2023 to May 2024 were recruited. The eligibility criteria included patients' age >50 years, body mass index <30 kg/m^2 and American Society of Anesthesiologists (ASA) physical status I to II. Exclusion criteria were bilateral surgery, revision hemiarthroplasty, uncooperative patient, inability to communicate, neurological deficits involving the lower extremities, significant psychiatric or mental disorders, history of drug allergies, clinically significant coagulopathy, infection at the injection site, allergy to local anaesthetics, diabetic or other neuropathies and inability to comprehend visual analogue score (VAS). Patients were randomly allocated into two groups using a computer-generated random number table method. Group information was sealed in an envelope, numbered, and used sequentially. Randomisation was conducted by one of the research team members in the pre-anaesthetic assessment room who was not involved in the block procedure and evaluation. Each group comprises thirty participants - one group received the ultrasound-guided FIC block (FIC block group), and another group received the ultrasound-guided individual LFCN and FN block (LFCN plus FN block group). Demographic and clinical data, including age, weight, height, BMI, and ASA physical status, were recorded for all patients.

Ethical consideration

The study's objectives, procedure, risks, and benefits were explained to the patients in an easily understandable local language. All participating subjects were assured that they had the full right to withdraw from the study at any time for any reason, and their refusal to participate or withdraw from the project would not hamper their treatment. They were also assured that all data would be kept confidential and not disclosed except for the study.

Intraoperative anaesthesia and analgesia management

A subarachnoid block was administered to all patients for surgical anaesthesia. The surgeon did hemiarthroplasty in the lateral approach. After the surgery, 1 gm of intravenous paracetamol and 5 mg of

intravenous dexamethasone were administered as part of multimodal analgesia, and the patient was transferred to the recovery room.

Visual analogue scale assessment

In the recovery room patients were asked to mark a point on a 10 cm line to record their VAS score. This line shows a range from "no pain" on the left (0 cm) to the "worst pain" on the right (10 cm). Measurements from the starting point (left end) of the scale to the patients' marks are recorded in centimetres and are interpreted as their pain [10]. The patient's pain was assessed at an interval of 15 minutes using a visual VAS. When the VAS score reached 3 or 4, according to group allocation, FIC block was administered in the control group; on the other hand, LFCN and FN block were administered in the study group using ultrasound guidance. Both procedures were done by the same anesthesiologist who has three years of experience in doing ultrasound-guided nerve blocks. Data was recorded by the three resident doctors trained before the study to assess the VAS. Data collectors were blinded regarding the group allocation.

Fascia iliaca compartment block

The patient was placed supine, and the skin was disinfected. Then, the transducer was positioned to identify the femoral artery, the iliopsoas muscle, and the fascia iliaca. The transducer was moved laterally until the sartorius muscle was identified. Local skin infiltration was done with 1% lignocaine. Then the needle was inserted in-plane. As the needle pierces the fascia, a "pop" was felt. After negative aspiration, 1–2 mL of local anaesthetic was injected to confirm the proper injection plane between the fascia and the iliopsoas muscle 30 mL of 0.5% bupivacaine was injected [6].

Lateral femoral cutaneous nerve block

Block of the LFCN was performed with the patient in the supine position. At first, the anterior superior iliac spine (ASIS) was palpated, and the transducer was positioned at two cm inferior and medial to the ASIS parallel to the inguinal ligament. The tensor fasciae latae muscle (TFLM) and sartorius muscle (SaM) were then identified. The nerve appeared as a small hypoechoic oval structure with a hyperechoic rim between the TFLM and SaM in a short-axis view. After local skin infiltration with 1% lignocaine, a 10 cm block needle was inserted in-plane in a lateral-to-medial orientation through the subcutaneous tissue, and 5 mL of 0.5% bupivacaine was injected [6].

Femoral nerve block

With the patient supine, the skin over the femoral crease was disinfected, and the transducer was positioned to identify the femoral artery and nerve. Once the femoral nerve is identified, the skin weal of local anaesthetic is made 1 cm away from the lateral edge of the transducer. The needle is inserted in-plane in a lateral-to-medial orientation and advanced toward the femoral nerve. Once the needle tip was adjacent, after careful aspiration 1–2 mL of local anaesthetic was injected to confirm the proper needle placement. After confirmation, 15 mL of 0.5% bupivacaine was injected [6].

Outcome variables

After twenty minutes of performing the block, the VAS score was assessed and recorded in both groups. This was the primary outcome variable. In addition, patients' motor function was evaluated using the Bromage scale for any weakness. Subsequently, the VAS was assessed at a two-hour interval until patients demanded rescue analgesia. The VAS score at the time of requesting rescue analgesia and the total duration from 20 minutes after the block placement to rescue analgesia were recorded. These were the secondary outcomes. Twenty-five micrograms of fentanyl were then promptly administered as rescue analgesia.

Statistical analysis

Data analysis was performed using the Statistical Package for Social Sciences version 26.0 for Windows. The categorical variables (age group, sex, ASA class and time to demand rescue analgesia) are presented as number percentages, while numerical variables (e.g. BMI) are expressed as mean and standard deviation. The comparison was performed using the Chi-square test for categorical variables and the unpaired *t* test mean for continuous variables. Time to rescue analgesia was subjected to a linear regression procedure to obtain the adjusted values for variation in age, sex, BMI and ASA class. A *P* value of less than 0.05 was considered statistically significant.

Results

A total of sixty patients were analysed in the study. Thirty patients were in the control group (FIC block group) and thirty patients in the study group (LFCN plus FN block group). Most patients in both groups were female and elderly (over 60 years) [11]. The (standard deviation) BMI was 26.1 (2.5) for patients receiving the fascia iliaca block and 25.1 (3.6) for those receiving the LFCN plus FN block (Table 1). In the FIC block group, 40% of patients were ASA class 1, whereas 60% were ASA class 2. Whether in the LFCN plus FN block group, 70% were in ASA class 1, and 30% were in ASA class 2 .

After the block was given in the recovery room, 13.3% of patients in the LFCN plus FN block group reported a VAS score of 0, 30% reported a VAS score of 1, and the rest reported a VAS score of 2. On the other hand, in the FIC block group, 53.3% reported a VAS

Table 1 Distribution of the participants according to demographic and clinical variables

Variables	Study group (n=30)	Control group (n=30)	*P*
Age years, mean (SD[a])	64.3 (11.4)	65.6 (16.4)	0.13
<60	7 (23.3)	9 (30.0)	0.56
≥60	23 (76.7)	21 (70.0)	
Sex			
Male	11(37.0)	8 (27.0)	0.21
Female	19 (63.0)	22 (77.0)	
Body mass index, mean (SD[a])	25.1(3.6)	26.1(2.5)	0.24
ASA[b] class			
ASA class 1	21 (70.0)	12 (40.0)	0.02
ASA class 2	9 (30.0)	18 (60.0)	

[a]SD indicates standard deviation; [b]American Society of Anesthesiologists; Values are number (%) unless indicated otherwise

Table 2 Distribution of the participants according to the visual analogue scale (VAS) score after 20 minutes of block in the study and control group

Variables	Study group (n=30)	Control group (n=30)	*P*
VAS, number (%)			
0	4 (13.3)	0 (-)	0.001
1	9 (30.0)	0 (-)	
2	17 (56.7)	16 (53.3)	
3	0 (-)	14 (46.7)	
Time to rescue analgesia			
Crude mean (SD)[a]	9.4 (1.5)	4.9 (0.8)	0.001
Adjusted[b] mean (SD)[a]	7.5 (0.8)	6.8 (0.9)	0.003

[a]SD indicates standard deviation; [b]Time to rescue analgesia was adjusted according to age, sex, body mass index, and American Society of Anesthesiologist class

score of 2, and 46.7% of patients reported a VAS score of 3. The *P* for these comparisons was 0.001, indicating a significant difference in VAS scores between the two groups following blocks . The average time to demand rescue analgesia in the FIC block group was 4.9 (0.8) hours, and in the LFCN plus FN block group was 9.4 (1.5) hours (*P*=0.001) (Table 2). The adjusted time to demand rescue analgesia for the FIC block group was 6.8 (0.9) hours, and in the LFCN plus FN block group was 7.5 (0.8) hours (*P*=0.003). There was no motor weakness after the block in any group.

Discussion

Our study found that the time to patients' demand for rescue analgesia is longer in the case of individual lateral femoral cutaneous nerve and femoral nerve block. A study done by Wojciech Gola *et al.* showed that patients in the FIC block group needed the first rescue opioid dose an average of 4.5 (1.0) hour after the surgery. Our study results match this finding [12].

Due to anatomical variations of the LFCN, the FIC block often remains inadequate for postoperative analgesia. A study done by Shariat *et al.* reported no significant difference in postoperative pain score and 24-hour opioid consumption between FIC versus placebo in total hip arthroplasty [13]. In their study, only two patients out of sixteen had successful blocks for both femoral and lateral femoral cutaneous nerve following FIC, and the overall success rates of femoral nerve and LFCN block were 38% and 31%, respectively.

Helayel PE *et al.* reported that the adequate volumes of local anaesthetics in the FIC block capable of producing a block in 99% of cases were 37.3 mL [14]. A human cadaver pilot study done by Vermeylen K *et al.* in 2018 suggests that the volume of 40 mL is the effective volume to reach the femoral and lateral femoral cutaneous nerve [15]. Using 40 ml of local anaesthetic Bang S. *et al.* showed with and showed a significant opioid-sparing effect in the first 24 hours of hemiarthroplasty [16]. Though their study didn't report any case of local anaesthetic systemic toxicity (LAST), this large volume may cause systemic toxicity. LAST is a rare but life-threatening complication of fascia iliaca compartment blocks. Most instances of toxicity are related to inadvertent intravascular administration of local anaesthetics. Following systemic absorption, bupivacaine binds avidly to voltage-gated sodium channels of cardiac muscle, leading to conduction abnormalities, contractile dysfunction, and ventricular arrhythmias [17]. Therefore, by increasing the volume of local anaesthetics, adequate analgesia can be ensured at the risk of local anaesthetic systemic toxicity.

On the contrary, we showed that only 20 ml volume is sufficient for applying separate LFCN and FN blocks with the benefit of prolonged analgesia following hemiarthroplasty.

Most of the patients who came for hemiarthroplasty were elderly people. These groups of patients remain at risk for postoperative cognitive dysfunction [18]. Opioids are associated with increased cognitive dysfunction. As the FIC block group demanded rescue analgesia early in comparison to the study group, they may require more opioids for subsequent pain control in comparison to our study group.

Our study had some limitations. We could not show the actual number of patients screened for eligibility criteria. Another limitation is resource constraints, and we could not use a continuous catheter technique for FN and LFCN blocks. However, we believe that implementing the continuous catheter technique could potentially result in opioid sparing for postoperative pain management, leading to early recovery, decreased hospital stays, and overall cost following hemiarthroplasty.

Conclusion

Separate blocks for the LFCN and FN have been found to offer more effective postoperative pain relief than the FIC block in patients undergoing hemiarthroplasty.

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Author contributions

Conception or design of the work; or the acquisition, analysis, or interpretation of data for the work: KMA, SS. *Drafting the work or reviewing it critically for important intellectual content:* KMA, SS, MAH, AS, CSK, AKM . *Final approval of the version to be published:* KMA, SS, MAH, AS, CSK, AKM. *Accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved:* AKMA.

Conflict of interest

We do not have any conflict of interest.

Data availability statement

We confirm that the data supporting the findings of the study will be shared upon reasonable request.

Supplementary file

None

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