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Original Research Article

COMPARISON OF ANALGESIC EFFICACY OF USG GUIDED SUPRAINGUINAL APPROACH WITH INFRAINGUINAL APPROACH OF FASCIA ILIACA COMPARTMENT BLOCK IN PATIENTS POSTED FOR LOWER LIMB ORTHOPAEDIC SURGERY- A PROSPECTIVE RANDOMIZED DOUBLE BLINDED STUDY

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ABSTRACT

Background: Lower limb orthopedic surgeries are associated with significant postoperative pain. Effective analgesia is essential for early mobilization and reducing opioid-related side effects. The fascia iliaca compartment block (FICB) is commonly employed for perioperative analgesia. This study compares the analgesic efficacy of ultrasound-guided suprainguinal and infrainguinal approaches of Fascia Iiliaca Compartment Block in above knee surgeries.

Materials and Methods: In this prospective, randomized, double-blinded study, 50 patients scheduled for above-knee orthopedic procedures under spinal anesthesia were divided into two groups: Group S received USG-guided suprainguinal FICB, and Group I received infrainguinal FICB. Both groups received 40 ml of 0.2% ropivacaine. Postoperative parameters including duration of analgesia, pain scores (VAS), tramadol consumption, and incidence of postoperative nausea and vomiting (PONV) were recorded over 24 hours.

Results: The suprainguinal group showed significantly prolonged duration of analgesia (8.27 ± 0.58 hrs vs. 7.51 ± 0.50 hrs; $p<0.001$), lower VAS scores at multiple time points, and reduced 24-hour tramadol usage (38.0 ± 13.3 mg vs. 57.0 ± 13.6 mg; $p<0.001$) compared to the infrainguinal group. Incidence of PONV was also lower in the suprainguinal group.

Conclusion: Ultrasound-guided suprainguinal FICB offers superior postoperative analgesia, reduced opioid requirements, and fewer side effects compared to the infrainguinal approach. It is a more effective technique for managing postoperative pain in lower limb orthopedic surgeries.

Keywords: FICB, Pain, analgesics, PONV, Infra and supra inguinal.

INTRODUCTION

Regional anesthesia, especially nerve blocks performed under ultrasound guidance, has revolutionized the anesthetic management of orthopaedic lower limb surgery. Major lower limb fractures are often associated with severe perioperative pain, warranting early surgical intervention and fixation. Inadequately treated pain has been associated with postoperative delirium, delayed mobilization, prolonged hospitalization, and poor functional recovery, particularly in elderly patients.[1,2] Hence, effective pain control is essential for early rehabilitation and reduced hospital stay.

Ultrasound-guided nerve blocks have become an important anesthetic technique for lower limb surgical procedures and offer advantages over central neuraxial blockade, including greater hemodynamic stability and reduced incidence of neuraxial complications.[3] Acute postoperative pain management remains challenging and often requires a multimodal approach. Parenteral opioids, non-steroidal anti-inflammatory drugs (NSAIDs), epidural analgesia, and peripheral nerve blocks are commonly employed.[4] However, opioid administration is associated with nausea, vomiting, sedation, respiratory depression, and delirium, while NSAIDs may cause gastrointestinal, renal, and cardiovascular adverse effects, particularly in elderly patients.[5] Peripheral nerve blocks provide effective analgesia while minimizing systemic drug-related complications.[6]

The Fascia Iliaca Compartment Block (FICB) is a commonly used peripheral nerve block for perioperative analgesia in hip and proximal femur surgeries.[7] It involves injection of local anesthetic beneath the fascia iliaca to achieve blockade of the femoral nerve, lateral femoral cutaneous nerve, and obturator nerve.[8] Traditionally, FICB was performed using landmark-based and loss-of-resistance techniques as described by Dalens et al.[7] However, studies have demonstrated variable success rates with blind techniques because of inaccurate local anesthetic deposition.[9] The introduction of ultrasound guidance has improved the accuracy, success rate, and safety profile of FICB by allowing direct visualization of the fascia iliaca and spread of local anesthetic.[10,11]

Two approaches to FICB have been described: the conventional infrainguinal approach and the modified suprainguinal approach.[12] Anatomical studies have shown that the femoral nerve, obturator nerve, and lateral femoral cutaneous nerve lie in close proximity beneath the fascia iliaca proximal to the inguinal ligament and diverge distally as they descend into the thigh.[13] Therefore, injection above the inguinal ligament facilitates greater cephalad spread of local anesthetic and may result in more reliable blockade of all three nerves.[12,14] Cadaveric and clinical studies have demonstrated superior cranial spread and improved analgesic efficacy with the suprainguinal approach compared with the infrainguinal technique.[14,15] Consequently, the suprainguinal FICB has gained increasing popularity as an effective analgesic technique for lower limb orthopaedic surgeries.[16]

Hence, the present study was designed to compare the analgesic efficacy of ultrasound-guided suprainguinal and infrainguinal approaches of fascia iliaca compartment block in patients undergoing lower limb orthopaedic surgery.

Objectives

1. To compare the total duration of postoperative analgesia between ultrasound-guided suprainguinal and infrainguinal Fascia Iliaca Compartment Blocks.
2. To compare postoperative pain scores during the first 24 hours, total 24-hour tramadol consumption, time to first rescue analgesic requirement, and the incidence of postoperative nausea and vomiting between the two groups.

MATERIALS AND METHODS

This prospective, randomized, double-blind study was conducted in the Department of Anaesthesiology, Thanjavur Medical College and Hospital, Thanjavur, after obtaining approval from the Institutional Ethics Committee. Written informed consent was obtained from all participants after explaining the study protocol and educating them regarding the use of the Visual Analogue Scale (VAS) for pain assessment.

A total of 50 patients of either sex, aged between 18 and 60 years, belonging to the American Society of Anesthesiologists (ASA) physical status I and II, and scheduled for elective above-knee orthopaedic surgery under spinal anaesthesia were included in the study. Patients who refused participation, had infection at the injection site, hypersensitivity to local anaesthetics, coagulopathy, diabetic neuropathy, pre-existing neurological deficits of the lower limb, inability to comprehend the VAS score, or those receiving combined spinal-epidural anaesthesia were excluded from the study.

The sample size was calculated based on the study by Bansal et al., considering the duration of analgesia as the primary outcome measure. Using a mean duration of analgesia of 68.75 ± 51.2 hours in the suprainguinal group and 34.38 ± 30.1 hours in the infrainguinal group, with a confidence interval of 95% and a study power of 80%, the minimum sample size required was 22 patients in each group. After accounting for a 10% attrition rate, the sample size was increased to 25 patients per group, resulting in a total sample size of 50 patients.

The enrolled patients were randomly allocated into two equal groups using a closed-envelope randomization technique. Group S received ultrasound-guided suprainguinal fascia iliaca compartment block, while Group I received ultrasound-guided infrainguinal fascia iliaca compartment block. Both the patients and the investigator assessing postoperative outcomes were blinded to the group allocation.

In the operating room, standard monitoring including non-invasive blood pressure, electrocardiography, pulse rate, and peripheral oxygen saturation was instituted. Intravenous access was secured, and Ringer's lactate infusion was commenced. All patients received subarachnoid block under aseptic precautions with 2.5 mL of 0.5% hyperbaric bupivacaine and 25 µg fentanyl in the sitting position. Following confirmation of adequate sensory and motor blockade, patients were placed in the supine position, and the allocated fascia iliaca compartment block was performed under ultrasound guidance. For the suprainguinal approach, a high-frequency linear ultrasound probe (6–14 MHz) was used to identify the anterior superior iliac spine, iliacus muscle, and fascia iliaca. An in-plane needle technique was employed, and after confirmation of correct needle placement by hydrodissection, 40 mL of 0.2% ropivacaine was injected beneath the fascia iliaca. For the infrainguinal approach, the femoral artery, femoral nerve, iliopsoas muscle, and fascia iliaca were identified at the inguinal crease using ultrasound. Following confirmation of needle placement beneath the fascia iliaca using hydrodissection, 40 mL of 0.2% ropivacaine was administered incrementally. Correct spread of the local anaesthetic beneath the fascia iliaca was confirmed sonographically in both groups. Patients were monitored intraoperatively and postoperatively. Intravenous tramadol 50 mg was administered as rescue analgesia whenever required, up to a maximum dose of 150 mg during the first 24 postoperative hours. Postoperative nausea and vomiting were managed with intravenous ondansetron 4 mg as necessary.

The primary outcome measure was the duration of analgesia, defined as the time interval between administration of the fascia iliaca compartment block and the first request for rescue analgesia. Secondary outcome measures included postoperative pain scores assessed using the Visual Analogue Scale at 4, 6, 12, 18, and 24 hours after block administration, total tramadol consumption during the first 24 postoperative hours, and the incidence of postoperative nausea and vomiting.

Data were analyzed using appropriate statistical software. Continuous variables were expressed as mean ± standard deviation, while categorical variables were presented as frequencies and percentages. Intergroup comparisons of continuous variables were performed using the independent Student's t-test or Mann–Whitney U test, as appropriate. Categorical variables were compared using the Chi-square test or Fisher's exact test. A p-value of less than 0.05 was considered statistically significant.

RESULTS

The results of above study among 50 participants is given below.

Table 1: Baseline Demographic and Clinical Characteristics of the Study Participants

Variable	Group S (n=25)	Group I (n=25)	p-value
Age (years), Mean ± SD	41.84 ± 13.25	47.40 ± 14.32	0.161
Gender, n (%)			1.000
Male	20 (80.0)	20 (80.0)	
Female	5 (20.0)	5 (20.0)	
ASA Physical Status, n (%)			0.569
ASA I	12 (48.0)	10 (40.0)	
ASA II	13 (52.0)	15 (60.0)	

The baseline demographic and clinical characteristics were comparable between the two groups. There was no statistically significant difference in age (p = 0.161), gender distribution (p = 1.000), or ASA physical status (p = 0.569) between Group S and Group I, indicating successful randomization and homogeneity of the study population.

Table 2: Comparison of Postoperative Outcomes Between Group S and Group I

Variable	Group S (n=25) Mean ± SD / n (%)	Group I (n=25) Mean ± SD / n (%)	p-value
Duration of analgesia (hours)	8.27 ± 0.58	7.51 ± 0.50	<0.001
24-hour tramadol consumption (mg)	72.00 ± 29.15	88.00 ± 21.76	0.030
Postoperative nausea and vomiting (PONV), n (%)	2 (8.0)	7 (28.0)	0.066

Patients in the suprainguinal group (Group S) experienced a significantly longer duration of analgesia, and lower 24-hour tramadol consumption compared with the infrainguinal group (Group I). Although the incidence of postoperative nausea and vomiting was lower in Group S, the difference did not reach statistical significance.

Table 3: VAS score comparison

VAS	Group S (n=25) Mean ± SD	Group I (n=25) Mean ± SD	p-value
VAS Score at 4 hours	0.00 ± 0.00	0.00 ± 0.00	–
VAS Score at 6 hours	1.68 ± 0.80	2.44 ± 0.76	0.001
VAS Score at 12 hours	2.00 ± 0.91	3.52 ± 0.71	<0.001
VAS Score at 18 hours	3.60 ± 0.70	4.44 ± 0.65	<0.001
VAS Score at 24 hours	4.52 ± 0.71	5.72 ± 0.54	<0.001

The mean pain score was significantly lower in suprainguinal group compared to Infrainguinal group at all times from 6hr to 24 hr after surgery.

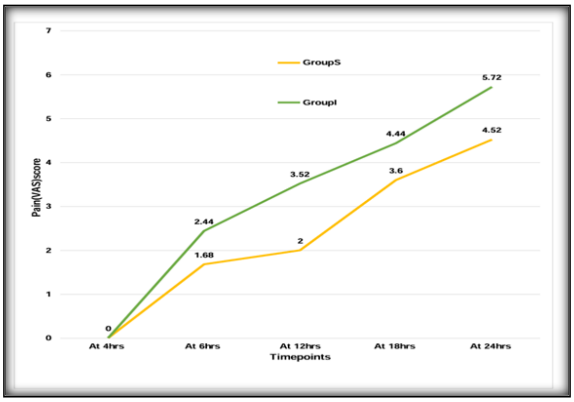

Figure 1: Mean pain score

DISCUSSION

Effective postoperative analgesia is a cornerstone of perioperative care in lower limb orthopaedic surgery. Inadequately controlled pain has been associated with delayed mobilization, prolonged hospitalization, increased opioid consumption, and adverse outcomes such as postoperative delirium, particularly in elderly patients.[1,2,5] Regional anaesthetic techniques have gained increasing popularity as part of multimodal analgesia strategies because they provide targeted pain relief while minimizing systemic opioid requirements.[3,4,6] The present prospective randomized double-blind study compared the analgesic efficacy of ultrasound-guided suprainguinal and infrainguinal fascia iliaca compartment block (FICB) in patients undergoing above-knee orthopaedic surgeries.

The demographic characteristics of the study population were comparable between the two groups. The mean age was 41.84 ± 13.25 years in Group S and 47.40 ± 14.32 years in Group I ($p = 0.161$). Both groups had an identical gender distribution with 80% males and 20% females, while ASA physical status was also comparable ($p = 0.569$). These findings indicate successful randomization and eliminate demographic factors as potential confounders. Similar baseline comparability was reported by Bansal et al. and Jubairiya et al., who observed no significant differences in age, sex, or ASA status between patients receiving suprainguinal and infrainguinal FICB.[14,15] The primary outcome of this study was the duration of postoperative analgesia. We observed that the mean duration of analgesia was significantly longer in the suprainguinal group (8.27 ± 0.58 hours) than in the infrainguinal group (7.51 ± 0.50 hours) ($p < 0.001$). This finding supports the hypothesis that the suprainguinal approach provides superior analgesic coverage because local anaesthetic is deposited proximal to the inguinal ligament, allowing more consistent spread toward the femoral, lateral femoral cutaneous, and obturator nerves. Hebbard et al. first described the suprainguinal technique and emphasized its ability to facilitate cephalad spread within the fascia iliaca compartment, thereby enhancing blockade of the lumbar plexus branches.[12] Anatomical studies by Bendtsen et al. further demonstrated that the fascia iliaca compartment extends cranially beyond the inguinal ligament, providing a pathway for proximal local anaesthetic spread.[13]

Our findings are consistent with those of Vermeylen et al., who demonstrated superior cranial spread of injectate with the suprainguinal approach compared with conventional infrainguinal techniques.[14] Similarly, Desmet et al. reported that suprainguinal FICB significantly improved postoperative analgesia after total hip arthroplasty and reduced opioid requirements compared with standard analgesic regimens.[15] A recent systematic review and meta-analysis by Zheng et al. concluded that suprainguinal FICB was associated with longer-lasting analgesia and superior pain control in patients undergoing hip and femur surgeries.[16]

Postoperative pain scores were significantly lower in the suprainguinal group at all assessed time points after 6 hours. At 6, 12, 18, and 24 hours, the mean VAS scores in Group S were 1.68, 2.00, 3.60, and 4.52, respectively, compared with 2.44, 3.52, 4.44, and 5.72 in Group I ($p < 0.05$ for all comparisons). These findings suggest that the suprainguinal approach provides more effective and sustained postoperative analgesia. Dolan et al. demonstrated that ultrasound guidance improves the accuracy and efficacy of FICB by ensuring appropriate deposition of local anaesthetic beneath the fascia iliaca.[8] Swenson et al. further showed that effective spread beneath the fascia iliaca is crucial for achieving adequate blockade of the target nerves.[10] The superior analgesic profile observed in our study is likely due to improved obturator nerve blockade with the suprainguinal approach, which contributes significantly to hip and proximal femoral innervation.

The opioid-sparing effect of the suprainguinal technique was reflected in the significantly lower 24-hour tramadol consumption observed in Group S (72 ± 29.15 mg) compared with Group I (88 ± 21.76 mg) ($p = 0.03$). Reduction in postoperative opioid requirement is clinically important because opioid-related adverse effects may hinder recovery and patient satisfaction. Morrison et al. reported that increased opioid consumption after hip fracture surgery was associated with a greater risk of postoperative complications, including delirium.[1] Similarly, Herr and Titler highlighted the importance of minimizing opioid use in orthopaedic patients through effective regional analgesic techniques.[2] Our findings are consistent with those of Desmet et al., who reported significantly lower postoperative morphine consumption among patients receiving suprainguinal FICB.[15] Zheng et al. also concluded that suprainguinal FICB reduces opioid consumption compared with infrainguinal techniques and conventional analgesic strategies.[16]

The incidence of postoperative nausea and vomiting (PONV) was lower in Group S (8%) than in Group I

(28%), although the difference did not reach statistical significance (p = 0.066). The reduced occurrence of PONV in the suprainguinal group may be attributed to decreased tramadol consumption. Chou et al. emphasized that opioid-sparing regional analgesic techniques reduce the incidence of opioid-related adverse effects, including nausea and vomiting.[4] Likewise, Chelly et al. demonstrated that peripheral nerve blocks not only improve analgesia but also reduce opioid-associated side effects and facilitate enhanced postoperative recovery.[6] Recent evidence continues to support the role of suprainguinal FICB in lower limb orthopaedic surgery. Madabushi et al,[17] reported superior postoperative analgesia and lower rescue analgesic requirements with suprainguinal FICB in hip fracture patients. Wang et al,[18] demonstrated improved early mobilization and patient comfort with the suprainguinal approach. Kumar et al,[19] observed significantly lower postoperative pain scores and opioid consumption in patients receiving suprainguinal FICB compared with infrainguinal FICB. Furthermore, a recent meta-analysis by Chen et al,[20] confirmed that suprainguinal FICB provides better analgesic efficacy, prolonged duration of pain relief, and reduced opioid requirements following hip and femur surgeries. The above findings demonstrate that ultrasound-guided suprainguinal fascia iliaca compartment block offers significant advantages over the infrainguinal approach.

CONCLUSION

Overall, the findings of the present study demonstrate that ultrasound-guided suprainguinal fascia iliaca compartment block offers significant advantages over the infrainguinal approach. It provides longer duration of analgesia, lower postoperative pain scores, reduced opioid consumption, and a lower incidence of postoperative nausea and vomiting. These benefits can be attributed to more reliable blockade of the lumbar plexus branches resulting from proximal spread of local anaesthetic. Therefore, the suprainguinal approach may be considered a preferred technique for postoperative analgesia in patients undergoing above-knee orthopaedic surgeries.

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