EGYPTIAN JOURNAL OF ANAESTHESIA
2024, VOL. 40, NO. 1, 325–333
https://doi.org/10.1080/11101849.2024.2355713



# A comparative study between postoperative analgesia of suprainguinal fascia iliaca compartment block (SIFI) and lumbar erector spinae plane block (ESPB) in hip arthroplasty

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**ABSTRACT**

**Background:** Suprainguinal fascia iliaca (SIFI) block offers efficient pain relief in total hip arthroplasty, although motor blockage is a common complication. Erector spinae plane block (ESPB) is a promising technique with less motor block; in research, we evaluate the efficacy of both blocks regarding analgesia and early mobilization.

**Patients and method:** Fifty-six patients who underwent total hip replacement following spinal anesthesia were divided to either treated with ultrasound guided suprainguinal fascia iliaca (SIFI) block or ultrasound guided ESPB at the end of surgery. The primary measure of interest was the pethidine consumed within a 24-hour period following the surgical procedure. Subordinate outcomes were: first rescue pethidine time, pain scores, and onset of ambulation. Post-operative vomiting, nausea, and other adverse events were recorded.

**Results:** Fifty-six patients were involved in the study. No significant statistical variances were found in pethidine consumed at 24 hours ($p = 0.122$) or pain scores and rescue analgesia timing ($p = 0.075$). ESPB provided an early onset of ambulation with a highly significant divergence ($p < 0.001$).

**Conclusion:** We concluded that ESPB has a similar analgesic, opioid sparing effect to SIFI block after total hip arthroplasty (THA) and provides early onset of ambulation.

**ARTICLE HISTORY**
Received 20 March 2024
Revised 24 April 2024
Accepted 8 May 2024

**KEYWORDS**
Suprainguinal fascia iliaca; erector spinae plane; hip arthroplasty

## 1. Introduction

Total hip arthroplasty (THA), a commonly utilized surgical intervention, is employed to address end-stage joint issues, which can lead to deformities, reduced quality of life, and physiological impairments. This procedure offers a dependable, effective, and cost-effective solution [1]. The frequency of dissatisfaction linked to THA is substantial, with about 20%, despite great outcomes [2].

Forero et al. (2016) first explained using erector spinae plane block (ESPB), an interfascial plane block guided by ultrasound utilized for thoracic neuropathic pain handeling. It was then documented for managing post-operative pain in hip surgery [3]. A subsequent publication of a case series revealed that lumbar ESPB effectively provided post-operative analgesia in hip and proximal femoral surgery. Computerized tomography imaging showed the dispersion of the local anesthetic (LA) to the lumbar plexus, producing a similar effect to lumbar plexus block [4].

Hebbard (2011) described the suprainguinal fascia iliaca (SIFI) block (ultrasound-guided), which developed upon previous anatomical findings to more effectively anesthetize the three nerves that were initially targeted: the obturator, femoral, and lateral femoral cutaneous [5]. Furthermore, it has been proven that this relatively easy block can result in opioid-sparing analgesia in hip surgeries [6].

In our facility, fascia iliaca block (FIB) is considered a common practice in patients undergoing THA with motor blockage as a common complication; ESPB demonstrates a capacity to spare motor function. So, we compared using ESPB in hip surgeries to SIFI block regarding post-operative analgesia and early mobilization.

## 2. Aim of work

Assess the relative efficacy of ultrasound-guided suprainguinal fascia iliaca (SIFI) block and ultrasound-guided ESPB for postoperative analgesia following hip replacement surgery. The major variables were ambulation, analgesic requirements, and pain reported by patients using the visual analog scale (VAS).

## 3. Patients and methods

Prospective, randomized comparative trial, The research ethics committee at the faculty of medicine, Ain Shams University, Cairo, Egypt (FMASU MD 143/

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2022), granted approval for the study. Additionally, the study was recorded on the Pan African Clinical Trial Registry, with the ID. PACTR202209850411320. This study was conducted in Ain Shams University Hospitals. From July 2022 to August 2023, 56 individuals, aged between 20 and 70 years, who were planned for elective total hip replacement under spinal anesthesia, willingly participated in the study after providing written informed consent. As per the American Society of Anesthesiologists (ASA) score, the patients were categorized as either Physical Status I, II or III. Individuals who decline participation or have an ASA Physical Status IV classification are not included in our study. Also, we excluded patients exhibiting infection at the injection site, bleeding disorders and coagulopathy, having multiple fractures, known allergies to local anesthetics, with previous neuropathy or myopathy, patients who received long-acting opioids preoperatively and refusal of spinal anesthesia, patients with significant cognitive dysfunction.

The participants were assigned into 2 equal groups, each consisting of 28 individuals, utilizing computer-generated random number tables. S group patients were treated with ultrasound guided SIFI block at the end of surgery. Whereas E group patients were treated with ultrasound-guided single-shot ESPB at the end of surgery

## 4. Sample size

Through employing PASS 11 to calculate sample size, the power is set at 80%, alpha error at 5% and following the results of Nasser et al. (2021) [7] showed that the median of total doses of morphine used after hip arthroplasty among patients who took lumbar erector spinae plane block versus those who took suprainguinal fascia iliaca block was (6 (4,5,6,7,4) versus 8 (7,4,9,10) respectively); accordingly, a minimum sample size of 56 patients experiencing hip arthroplasty subdivided randomly into two groups (28 patients each) deemed adequate to accomplish study aim.

## 5. Anesthetic protocol

Prior to the surgery, all patients underwent a preoperative assessment and were asked to observe an 8-hour fasting period. When patients arrived at the operation theater, intravenous access was set up under complete aseptic condition. The patient received intravenous infusion of lactated Ringer solution at a rate of 10 ml/kg/hr. Additionally, sedation was administered through titration of midazolam in increments of 1 mg (20–50 mcg/kg) and fentanyl in doses of 50 micrograms (0.5 microgram/kg). throughout the procedure, the patient's vital signs-heart rate, electrocardiogram (ECG), non-invasive blood pressure and pulse oximetry (SPO2)-were checked every five minutes.

In both groups, Rescue dosages of intravenous fentanyl were administered if there was still pain during positioning for spinal anesthesia, increments of 50 microgram fentanyl (0.5 microgram/kg) with a maximum dose of 100 micrograms, and then both blocks were given after surgery.

Spinal anesthesia was given at sitting position under strict aseptic circumstances utilizing a 25-gauge Quincke needle through intervertebral space L3-L4 or L4-L5 with 3–3.5 ml of 0.5% heavy bupivacaine according to the patient's height and 25 microgram fentanyl.

Once the sensory block was confirmed (loss of sensory response to the pinprick test), the level of the sensory block (the highest dermatome where the sensory response was absent) was documented, and the surgeon was allowed to start.

After surgery regarding suprainguinal fascia iliaca block:

The technique employed for the suprainguinal fascia iliaca block closely resembled the approach explained by Hebbard (2011). The patient assumed a supine position with hip extended; following palpation of the anterior superior iliac spine, the ultrasound probe is positioned just below and towards the center of it. Typically, the probe is positioned over the inguinal ligament at a perpendicular angle, which is commonly preferred. In general, a high-frequency linear ultrasound probe is known for its efficiency. However, for patients with obesity, a lower-frequency curved probe can be a suitable alternative [5].

Using an in-plane technique, an echogenic B-bevel needle is introduced from the inferior portion of the ultrasound probe, slightly above the ligament, with a steeper angle. This approach improves the loss of tactile resistance experienced while crossing the fascia iliaca and traversing the iliacus muscle below [6]. Once the "pop" sensation is felt upon piercing the fascia iliaca, the needle can be partially withdrawn to reach the outer edge of the iliacus. Subsequently, an injection of 1–2 ml of saline or local anesthetic is administered to verify the diffusion between the fascia iliaca and the underlying iliacus muscle. With a good spread, the needle is introduced more into the local anesthetic, directing in a more upward direction to create separation between the iliacus muscle and the fascia iliaca above it (Figure 1).

## 6. Regarding the erector spinae plane block

The approach was very similar to that described by Tulgar and Senturk (2018).

The patient was positioned laterally. A high-frequency curved or linear probe, based upon the patient's BMI, was positioned in a longitudinal orientation, 2–3 cm away from the vertebral column. The erector spinae muscle, psoas muscle, and transverse

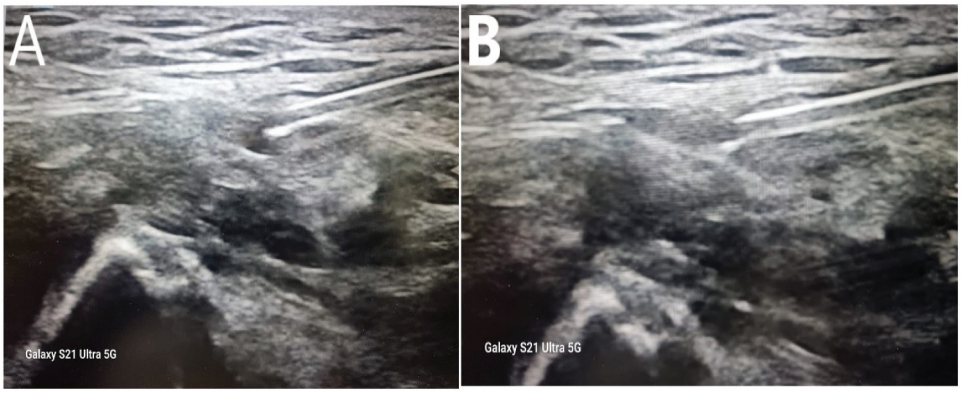


**Figure 1.** Ultrasound guided suprainguinal fascia iliaca block. Ultrasound scans: SIFI block pre-injection (A) and post-injection (B).

processes of the vertebrae at the L4 level were successfully identified. With an in-plane technique, the echogenic B-bevel needle was introduced in a direction from top to bottom, until it reached the point of touching the upper portion of the transverse process. Following withdrawal of the needle, the local anesthetic was administered posterior to the erector spinae muscle (Figure 2) [4].

Prior to commencing the nerve block sterilization of skin was done. For the block, a 22 Gauge echogenic needle measuring 4 inches in length was utilized.

In both groups, a cautious administration of 40 mL of (0.25% bupivacaine) was carried out, ensuring adherence to the individual patient's toxic dose limit of 2.5 mg/kg. Prior to injection, negative aspiration was performed to prevent accidental intravascular injection. Subsequently, the diffusion of the medication within tissue planes was monitored using ultrasound imaging.

The patients were closely observed for any adverse events, e.g., hematomas, bradycardia, hypotension, vomiting, nausea, reduced peripheral oxygen saturation and were managed accordingly.

If hypotension occurred (fall in blood pressure ˃20% of baseline reading), intravenous administration of ephedrine (0.1–0.3 mg/kg/dose) diluted in 10 ml of 0.9% normal saline was repeated based on the response of blood pressure.

- If bradycardia occurred (HR <50 bpm), especially when accompanied by hypotension or other indications for decreased perfusion, 0.5 mg of atropine was administered.
- To address decline in peripheral SpO2, supplemental oxygen was provided to maintain SpO2 exceeding 94%.
- If there is post-operative nausea and vomiting (PONV), a slow intravenous infusion of ondansetron (4 mg) diluted within 10 ml 0.9% normal saline was administered over a 10-minute period.
- In instance of spinal anesthesia failure, the patient received general anesthesia and was not involved in the study.
- Following surgery, the patient received 1 gm of Paracetamol at 6-hour intervals along with Ketolac 30 mg intravenously every 12 hours. The

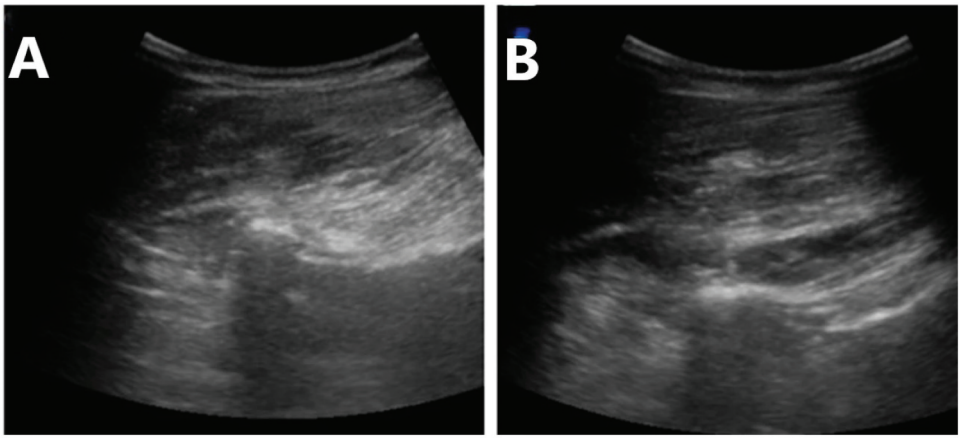


**Figure 2.** Ultrasound guided lumbar erector spinae plane block. Ultrasound scans: ESP block pre-injection (A) and post-injection (B).

duration of postoperative analgesia was measured from transfer to PACU (post-anesthetic care unit) (0 hr).

- Recorded data:

Blood pressure, heart rate, Visual analogue (VAS) score or any complications were observed in patients. Data was recorded at specific intervals; Every 15 mins in the first hour in PACU, then every 1 hour in the initial 6 hours after discharge from PACU, every 2 hours until 24 hours after surgery. Other recorded data included post operative pain, first request of analgesia, total pethidine consumption in 24 hours, onset of ambulation and side effects of the block were recorded for 48 hours.

- The measurement of post-operative pain was conducted utilizing the VAS. VAS exceeding 3 was addressed by giving Paracetamol (10–15 mg/kg) IV at 6-hour intervals and injection of Pethidine 25 mg intravenous as second rescue analgesia; a patient with VAS score of more than 5 after the first pethidine analgesia was received a third rescue dose (25 mg pethidine) if VAS score still more than 5 was considered failed block and was excluded from the study.

The main goal of the study was to evaluate and compare postoperative analgesia between both groups using total opioids consumption between the studied groups and the time of the 1st requested dose of opioid. Secondary objectives were VAS score, onset of ambulation, and complication of nerve block for the first 24 hrs post-operative of the study.

## 7. Statistical analysis

The process involved gathering data, applying codes to it, organizing it into tables, and subsequently analyzing it using the SPSS software package (IBM SPSS Statistics for Windows, Version 22.0. Armonk, NY: IBM Corp., 2013). Mean (standard deviation) or median (interquartile range) were used to present numerical variables, while frequency (%) was used to present categorical variables. The t-test or Mann–Whitney test, as appropriate, were employed to compare numerical variables, whereas the chi-square test was used to compare categorical variables. Using the log-rank test and Kaplan–Meier survival analysis, the time to first rescue analgesia was examined. A difference is deemed statistically significant if its p-value is less than 0.05.

## 8. Results

Seventy patients were assessed for eligibility, and 60 are enrolled Figure 3. Demographic data were compared

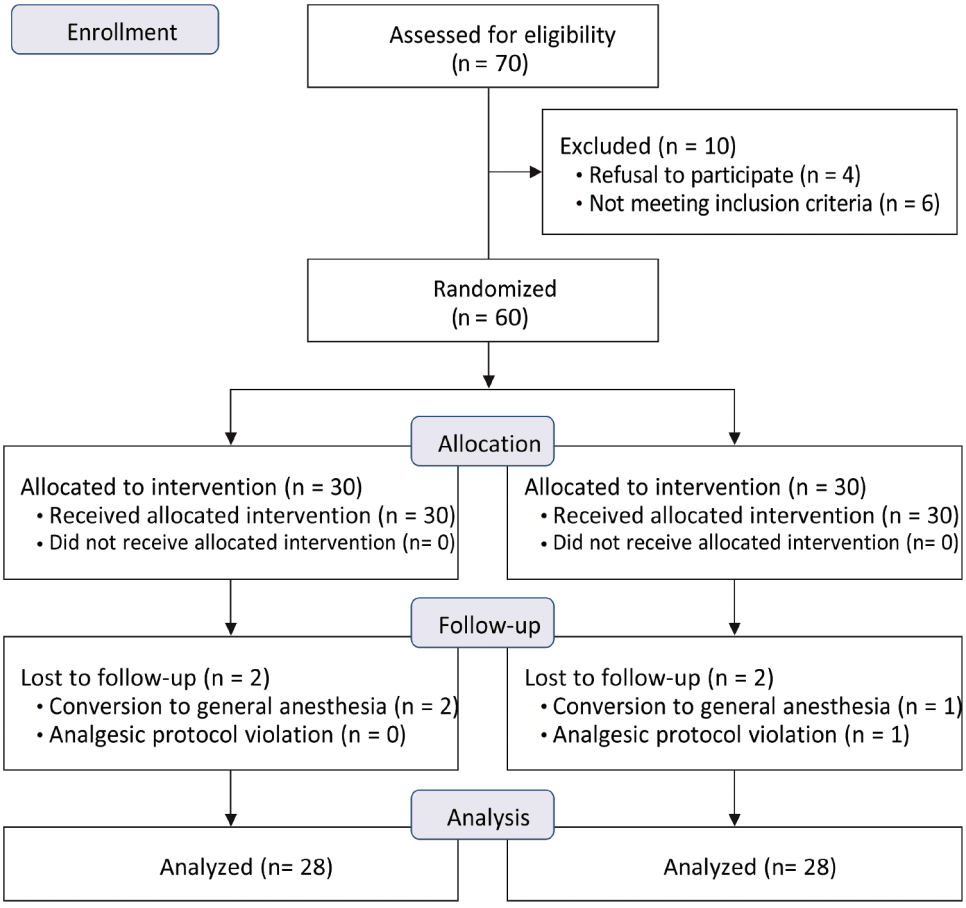


**Figure 3.** Flow chart of the studied cases.

between both groups, and there are no statistically significant variations in baseline characteristics between group S and group E, as indicated by Table 1. Regarding average patient age (60.89 ± 7.49 vs. 59.75 ± 6.386 years $p$ value = 0.542) for S group and E groups, respectively, or regarding males (13 vs. 12 patients) &females (15 vs. 16 patients) with p-value = 0.788 or regarding medical classification (ASA) (ASA I 6 vs. 12, ASA II 16 vs. 14 ASA III 6 vs. 2 with $p$ value = 0.044) and regarding to average duration of surgery (112.52 ± 17.919 vs 107.70 ± 183380 years $p$ value = 0.326) for group S and group E respectively.

Table 2 shows that there was no difference in VAS score in both groups within first 6 hours, after that group S showed insignificant higher values than group E at different time points till 24 hours between both groups, with a p-value ($p > 0.05$).

Table 3 and Figure 4 show that the timing to first rescue analgesia was earlier in group S compared to group E. However, both groups had no statistically meaningful distinction, with a p-value ($p > 0.05$). As for the total narcotic dose, no statistically meaningful distinction was found between either group, with a p-value ($p > 0.05$) (Figure 5). Group S showed a substantially longer onset of ambulation than group E, with a p-value ($p < 0.05$) (Figure 6).

Table 4 and Figure 7 show that the complications in Group E were 0 patients (0.0%) hematoma; 3 patients (10.7%) hypotension; one patient (3.6%) bradycardia and two patients (7.1%) PONV; as for the Group S it was two patients (7.1%) hematoma, one patient (3.6%) hypotension, 0 patients (0.0%) bradycardia and one patient (3.6%) PONV, but insignificant difference between both groups, with p-value ($p > 0.05$).

## 9. Discussion

In our randomized prospective comparative study, it was observed that group E exhibited a nearly identical analgesic effect to group S regarding VAS pain scores during rest, measured at 6, 12, 16, 20, and 24 hours postoperatively. However, no statistically significant variation was noticed between both groups. Also, the timing to first rescue analgesia was reduced in group S than in group E, but there is no statistically meaningful distinction between both groups. Also, group E had no statistically meaningful distinction regarding pethidine consumption with a p-value ($p > 0.05$) compared to group S. We also found that the onset of ambulation was with a p-value ($p < 0.05$) of much longer in Group S compared to Group E.

This study found that group E (ESP group) had almost similar analgesic effect with group S (SIFI group) regarding VAS pain scores. The duration for the administration of initial rescue analgesia per hour was shorter in the group S than group E. Consistent with the study of Flaviano et al. (2023), no statistically meaningful distinction was observed between both groups [8]. No statistically meaningful distinction in pain scores were observed at any point in time. Also,

**Table 1.** Comparison of two groups based on their baseline characteristics.

| Baseline characteristics | Group E ($n = 28$) | Group S ($n = 28$) | p-value |
|---|---|---|---|
| Age (years) | 59.75 ± 6.386 | 60.89 ± 7.490 | 0.542 |
| Sex | | | |
| Female | 16 (57.1%) | 15 (53.6%) | 0.788 |
| Male | 12 (42.9%) | 13 (46.4%) | |
| BMI (kg/m2) | 27.07 ± 3.495 | 27.14 ± 4.403 | 0.947 |
| Duration of surgery (mins) | 107.70 ± 18.380 | 112.52 ± 17.919 | 0.326 |
| ASA classification | | | |
| 1 | 12 (42.9%) | 6 (21.4%) | 0.044* |
| 2 | 14 (50.0%) | 16 (57.1%) | |
| 3 | 2 (7.1%) | 6 (21.4%) | |

*Using: t-Independent Sample t-test for Mean±SD; .*
*x2: Chi-square test for Number (%) or Fisher's exact test, when appropriate*
*p-value >0.05 is insignificant; *p-value <0.05 is significant; **p-value <0.001 is highly significant.*

**Table 2.** Postoperative pain perception (VAS-10) within the examined groups.

| | Group E ($n = 28$) | Group S ($n = 28$) | p-value |
|---|---|---|---|
| VAS 1 (15 mins in PACU) | 0 (0–0) | 0 (0–0) | 1.000 |
| VAS 2 (30 mins in PACU) | 0 (0–0) | 0 (0–0) | 1.000 |
| VAS 3 (45 mins in PACU) | 0 (0–1) | 0 (0–1) | 1.000 |
| VAS 4 (60 mins in PACU) | 0 (0–0) | 0 (0–0) | 1.000 |
| VAS 5 (after 2 hours at ward) | 1 (0–1) | 1 (0–1) | 1.000 |
| VAS 6 (after 3 hours at ward) | 1 (0–2) | 1 (0–2) | 1.000 |
| VAS 7 (after 4 hours at ward) | 1.5 [1,2] | 1.5 [1,2] | 1.000 |
| VAS 8 (after 5 hours at ward) | 2 [2] | 2 [2] | 1.000 |
| VAS 9 (after 6 hours at ward) | 2 [2] | 2 [2] | 0.571 |
| VAS 10 (after 8 hours at ward) | 3 [2,3] | 3 [2,3] | 1.000 |
| VAS 11 (after 12 hours at ward) | 3 [3] | 3 [3,4] | 0.971 |
| VAS 12 (after 16 hours at ward) | 3 [3,4] | 3 [3,4] | 0.525 |
| VAS 13 (after 20 hours at ward) | 3.5 [3,4] | 4.5 [3–5] | 0.062 |
| VAS 14 (after 24 hours at ward) | 3.5 [3–5] | 3 [3,4] | 0.404 |

*Using: U=Mann–Whitney test for non-parametric data "Median and Interquartile range (IQR)".*
*p-value >0.05 is insignificant.*

**Table 3.** Total narcotic dose in milligrams and timing to first rescue analgesia & ambulation per hour within the examined groups.

| | Group | N | Mean | Std. Deviation | p-value |
|---|---|---|---|---|---|
| Time of first rescue dose of pethidine (per hours) | Group E | 28 | 12.78 | 3.19 | 0.075 |
| | Group S | 28 | 11.31 | 2.87 | |
| Total Opioids consumed in the first 24 hours in mg | Group E | 28 | 53.94 | 11.50 | 0.122 |
| | Group S | 28 | 58.92 | 12.20 | |
| Onset of ambulation in hours | Group E | 28 | 17.14* | 1.627* | <0.001* |
| | Group S | 28 | 25.29* | 5.689* | |

^Independent t-test. *Significant. Effect size: Value of group S relative to group E. SE: Standard error. CI: Confidence interval.

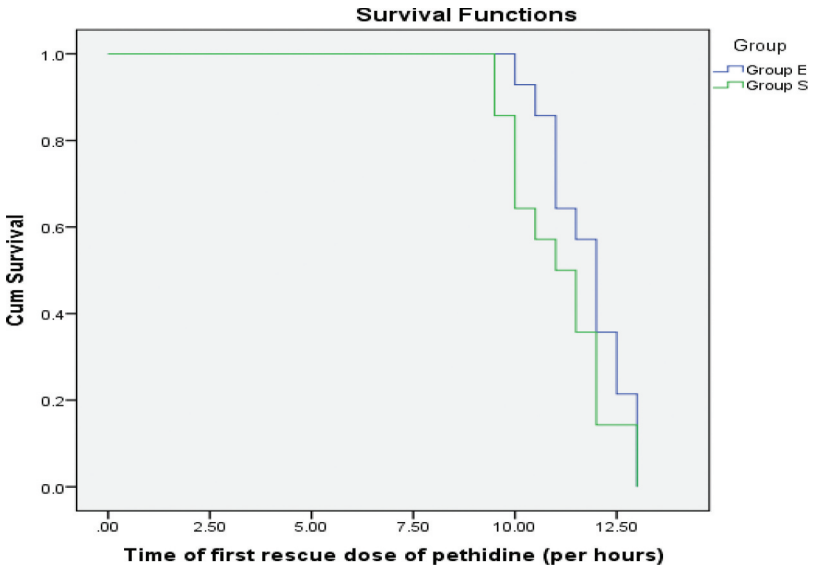


**Figure 4.** Kaplan Meier curve between group E and group S regarding time of first rescue dose of pethidine (hours).

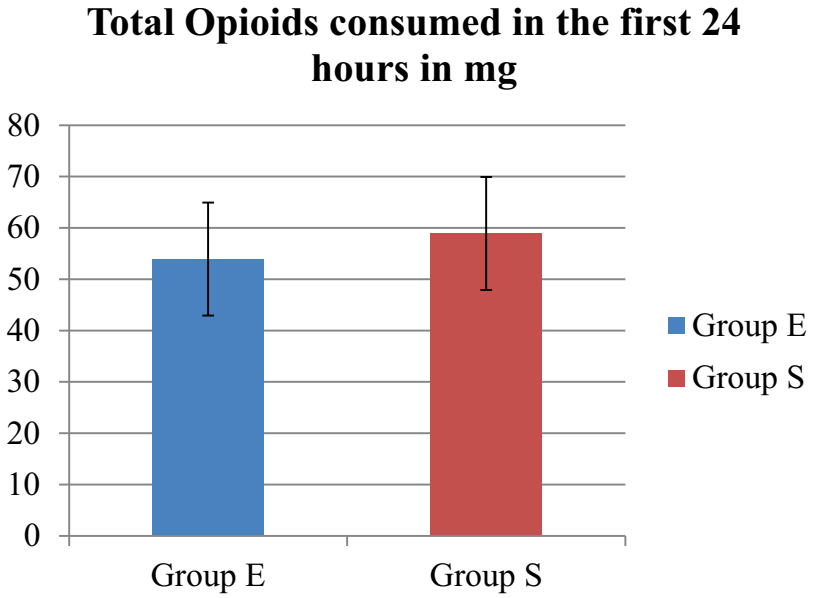


**Figure 5.** Total Opioids consumption in the first 24 hours in mg among the studied groups. Error bars represent 95% confidence interval.

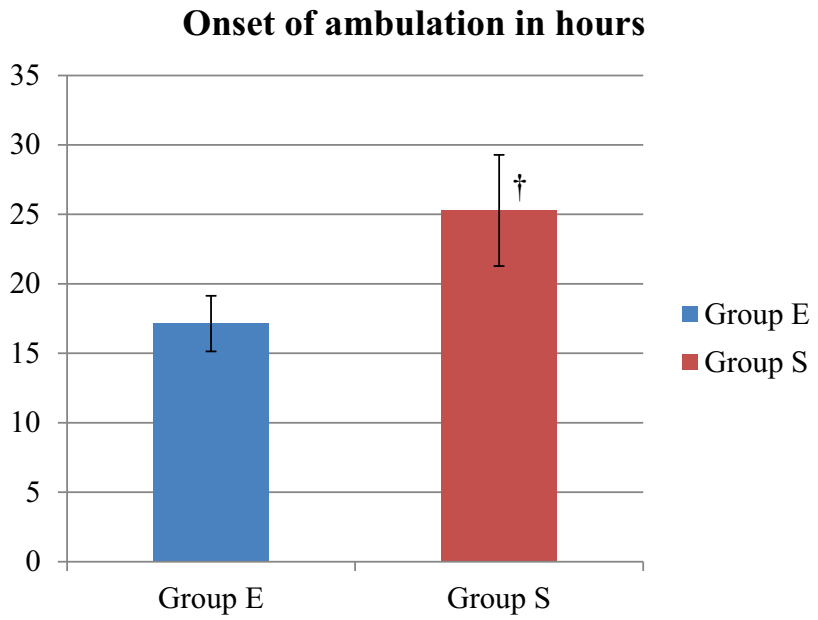


**Figure 6.** Onset of ambulation among the studied groups. † Significantly higher than Group E; Error bars represent 95% confidence interval.

**Table 4.** Comparison between both groups based on complications.

| | Group E ($n = 28$) | Group S ($n = 28$) | p-value |
|---|---|---|---|
| Hematoma | | | |
| No | 28 (100.0%) | 26 (92.9%) | 0.491 |
| Yes | 0 (0.0%) | 2 (7.1%) | |
| Hypotension | | | |
| No | 25 (89.3%) | 27 (96.4%) | 0.612 |
| Yes | 3 (10.7%) | 1 (3.6%) | |
| Bradycardia | | | |
| No | 27 (96.4%) | 28 (100.0%) | 1.000 |
| Yes | 1 (3.6%) | 0 (0.0%) | |
| PONV | | | |
| No | 26 (92.9%) | 27 (96.4%) | 1.000 |
| Yes | 2 (7.1%) | 1 (3.6%) | |

*Using: x2: Chi-square test for Number (%) or Fisher's exact test, when appropriate.*
*p-value >0.05 is insignificant; *p-value <0.05 is significant; **p-value <0.001 is highly significant.*

this finding is compatible with Lei Xu et al. (2020) study [9]. The pain scores exhibited no variations, and this finding is compatible with the study of Ozturk and Bilgili (2023) [10]; the FIB group showed significantly lower NRS scores at 12, 24, and 36 hours after the postoperatively than the controls, while NRS in the SIFI group during the 12th and 36th hour were similar to the NRS in the L-ESPB group.

Also, we found that group E had an almost similar analgesic effect with group S. There was no statistically meaningful distinction regarding pethidine consumption, which agree with Flaviano et al. (2023) [9]. Comparing the analgesic effectiveness and motor block between the Fascia Iliaca Block (FIB) and the Erector Spinae Plane (ESP) block after total hip arthroplasty. The ESPB and FIB provide comparable advantages in reducing opioid usage during the initial 24 hours following surgery. Also, this finding is compatible with Lei Xu et al. (2020) study [9], the substitution of fascia iliaca catheters with continuous ESP blocks following total hip arthroplasty. There were no differences in opioid use. Opioid consumption was 15.0 (7.5–37.5) mg for the FI group versus 15.0 (7.5–32.6) mg for the ESP group, with a P-value of 0.703. This is also compatible with the study of Ozturk and Bilgili (2023) [10] Comparing the effectiveness of postoperative pain relief between SIFI and Lumbar Erector Spinae Plane Block (L-ESPB) in patients who undergo surgery for proximal femur fractures, The control group had a higher cumulative Morphine use, while the FIB and L-ESPB groups exhibited similar cumulative Morphine use at each time point.

We also found that the beginning of ambulation per hour was significantly higher in group S than group E, in agreement with the study of Flaviano et al. (2023) [8]. The ESPB group demonstrated reduced quadriceps motor impairment within the initial 48 hours following surgery, resulting in better preservation of quadriceps motor strength compared to the FIB group. Also, this finding is compatible with Lei Xu et al. (2020) study [10], wherein early ambulation is enhanced by substituting continuous ESP blocks for FI catheters. In 2021, Mujahid et al. demonstrated that this particular intervention offered effective pain relief following surgery for duration of 24 hours while also enabling patients to mobilize early [11].

In their 2018 study, Tulgar et al. applied it to 12 patients who underwent proximal femur and hip surgery. The patient underwent ESPB while under general anesthesia in the lateral position at the conclusion of their surgeries. Following the administration of contrast material, a post-contrast CT

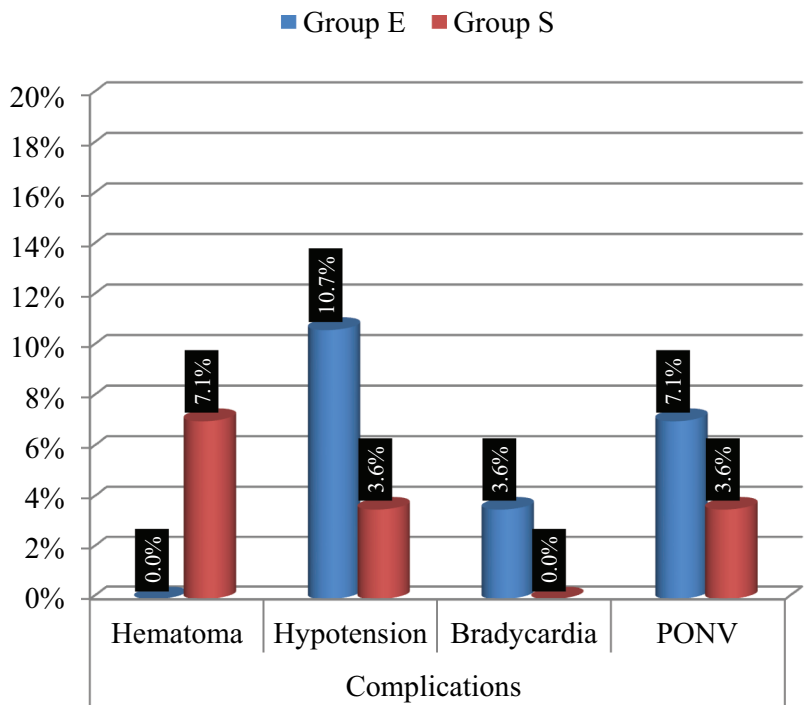


**Figure 7.** Incidence of complications among the studied groups.

evaluation revealed the presence of contrast extending from the T12 to the S1 vertebrae, specifically located posteriorly to the transverse processes. When lumbar ESPB is carried out at the L4 vertebral level as part of multimodal analgesia, it results in effective post-operative pain relief and significantly reduces the need for pain medication. Following ESPB, CT imaging revealed that contrast material was dispersed throughout the lumbar plexus. After hip surgery, lumbar ESPB can be effectively employed for post-operative analgesia [4].

Wang et al. (2021) discovered that the suprainguinal fascia iliaca block group exhibited significantly lower VAS scores during resting and moving conditions on the first and second days, when compared to the no-block group. Furthermore, cumulative fentanyl consumption over the 48-hour period following the surgery and the block group exhibited reduced fentanyl consumption in the PACU, both of which were statistically significant ($p < 0.01$) [12].

In their 2019 study, Alrayashi et al. examined the effectiveness of a SIFI block in promoting the patient's recovery after hip surgery arthroscopy. The study applied on 716 patients. The findings revealed that the group who received the block had significantly lower opioid consumption compared to those who did not undergo the procedure [13].

In their 2022 study, Bansal et al. performed a double-blinded randomized trial on 32 patients experiencing above-knee orthopedic surgery under spinal anesthesia. The results of the trial showed that the suprainguinal FICB demonstrated higher analgesic effectiveness compared to the infrainguinal FICB. This was evidenced by reduced pain intensity, decreased tramadol consumption over a 24-hour period, and higher patient satisfaction levels [14].

There were various limitations to this study. First, the results of our institutional population may not apply to other groups because it was conducted at a single center. Second, the surgical team was not the same in all cases. Third, comparing the two block procedures might be restricted to hospitals with experience in regional anesthesia as the physicians performing the blocks are specialists in this field. The posterolateral approach was used for total hip arthroplasty (THA) in all the patients included in our study, indicating its potential suitability for the ESPB. Nevertheless, it remains uncertain whether these findings can be applied to studies that employ an anterior approach. Lastly, we conducted our research in a multimodal analgesia and enhanced recovery environment. Consequently, these outcomes might vary among patients who do not undergo such as perioperative care level.

## 10. Conclusion

We concluded that suprainguinal fascia iliaca plane block and erector spinae plane block had the same analgesic effect with no significant difference in pain scores, amount of opioid consumed, and rescue analgesia, but ESP had motor sparing effect enhancing early ambulation in patients undergoing THA.

## Disclosure statement

No potential conflict of interest was reported by the authors.

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