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Effect of suprainguinal fascia iliaca block versus lumbar erector spinae plane block on pain scores during spinal anesthesia positioning in hip fracture surgery: a prospective observational study

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Effect of suprainguinal fascia iliaca block versus lumbar erector spinae plane block on pain scores during spinal anesthesia positioning in hip fracture surgery: a prospective observational study

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Abstract

Background: Hip fractures in older adults are associated with high morbidity and mortality. Preoperative peripheral nerve blocks reduce pain and opioid requirements. We aimed to compare the effects of suprainguinal fascia iliaca block (SIFIB) and lumbar erector spinae plane block (LESP) on pain during positioning for spinal anesthesia, postoperative pain, and opioid consumption in patients undergoing hip fracture surgery.

Methods: In this prospective observational study, 206 patients aged 18–90 years with American Society of Anesthesiologists (ASA) physical status I–III who were scheduled for hip fracture surgery under spinal anesthesia were enrolled and assessed in two groups according to the perioperative analgesia technique applied: SIFIB (n = 112) or LESP (n = 94). After exclusions, 185 patients were analyzed. The primary outcome was the Numeric Rating Scale (NRS (Numeric Rating Scale) score recorded while the patient was placed in the sitting position for spinal anesthesia. Secondary outcomes were NRS scores before and after the block; NRS scores at postoperative hours 0, 2, 6, 12 and 24; total 24-h morphine consumption; patient-controlled analgesia (PCA) boluses; rescue analgesia; complications; time to mobilization; length of hospital stay; and Quality of Recovery-15 (QoR-15) scores.

Results: The positioning NRS score (SIFIB 3 [3–4] vs. LESP 4 [3–5]; $P = 0.005$) and the post-block NRS score (4 [3–5] vs. 5 [4–5]; $P < 0.001$) were significantly lower in the SIFIB group. Total 24-h morphine consumption (12 [6–21] vs. 18 [10–24] mg; $P = 0.005$), requested and delivered PCA boluses, and the need for rescue analgesia (22% vs. 36%; $P = 0.048$) were also significantly lower in the SIFIB group. Postoperative NRS scores did not differ between the groups at any time point (all $P > 0.05$). Demographic data, time to mobilization, length of hospital stay, QoR-15 scores, and intraoperative/postoperative complication rates were similar.

Conclusions: Both blocks provided effective perioperative analgesia; however, SIFIB was associated with significantly lower pain scores during spinal anesthesia positioning and lower postoperative opioid consumption than LESP.

Trial registration: ClinicalTrials.gov, NCT07639762.

Keywords: Hip fracture; Suprainguinal fascia iliaca block; Lumbar erector spinae plane block; Spinal anesthesia; Positioning pain; Opioid consumption

Background

Hip fractures are among the most serious musculoskeletal injuries in older adults worldwide and carry a substantial burden of morbidity and mortality [1]. Current epidemiological data indicate that approximately 9.6 million new hip fractures occurred among adults aged 55 years and older in 2019, with an incidence of approximately 681 per 100,000 persons; this burden is expected to increase in the coming years given aging global population and the rising prevalence of osteoporotic fractures [2]. Despite marked advances in surgical techniques and perioperative care standards, one-year mortality after hip fracture remains high at 15–30%, and fewer than half of the surviving patients regain their pre-fracture level of functional independence [2].

Effective perioperative pain control is an essential component of Enhanced Recovery After Surgery (ERAS) protocols for hip fracture surgery [3]. Inadequate analgesia not only impairs patient comfort but also directly contributes to clinically important adverse outcomes such as post-operative delirium, delayed mobilization, cardiopulmonary complications, and prolonged hospital stay [3]. The incidence of delirium in this population has been reported over a wide range of 20–70%, and uncontrolled pain is recognized as an independent risk factor for its development; the choice of analgesic strategy is therefore not merely a comfort measure but a clinical decision that directly affects functional prognosis [4].

Spinal anesthesia is a frequently preferred alternative to general anesthesia in hip fracture surgery. Because most patients have coexisting cardiopulmonary disease, avoiding airway instrumentation and the hemodynamic effects of general anesthesia is an important advantage [5]. Regional anesthesia techniques have been reported to reduce perioperative pain and delirium, and the use of neuraxial anesthesia together with peripheral nerve blocks has been reported to shorten hospital stay compered with general anesthesia [6].

A particularly challenging phase of the perioperative course is positioning the patient for neuraxial anesthesia; the movements required for the sitting or lateral decubitus position can trigger severe mechanical pain at the fracture site and at times make successful block placement technically difficult [7]. Placing the spinal needle at the correct level with a minimum number of attempts depends on adequate spinal flexion and on the patient remaining still and cooperative; uncontrolled positioning pain can compromise this cooperation, increase the number of attempts and the procedure time, cause hemodynamic stress through a pain-related sympathetic response, and lead to additional tissue damage at the

fracture site [7]. Pain during positioning is therefore a clinically relevant issue that should be assessed separately. In addition, pain after hip fracture surgery is often moderate to severe. The current Procedure-Specific Postoperative Pain Management (PROSPECT) guideline recommends a multimodal analgesic strategy that includes ultrasound-guided peripheral nerve blocks in addition to paracetamol and non-steroidal anti-inflammatory drugs in order to minimize opioid consumption and opioid-related adverse effects [4].

The suprainguinal modification of the fascia iliaca compartment block (SIFIB) has been widely adopted for preoperative analgesia in patients with hip fracture because the local anesthetic spreads cephalad within the compartment toward the lumbar plexus, reliably blocking the femoral and lateral femoral cutaneous nerves (LFCN) and less reliably and more variably the obturator nerve, and because it can be performed in the supine position [8, 9]. Anesthesia compared with the classical infrainguinal approach or systemic opioids alone, SIFIB has been shown to reduce positioning pain and facilitate spinal [9, 10].

On the other hand, the erector spinae plane block, originally described by Forero et al. for thoracic neuropathic pain syndromes [11], has been adapted to the lumbar region (LESP) as an alternative, muscle-strength-sparing regional technique for hip and proximal femur surgery. The local anesthetic is injected into the fascial plane deep to the erector spinae muscle at the level of the lumbar transverse processes and is thought to reach the ventral rami of the lumbar plexus through paravertebral spread, providing analgesia while preserving quadriceps motor function [12]. Several randomized controlled trials have compared LESP with alternative techniques, such as the pericapsular nerve group (PENG) block, the lumbar plexus block, and the infrainguinal fascia iliaca block, for analgesia after hip and proximal femur surgery and have generally reported similar opioid-sparing effects [12–15]. However, studies that directly compare SIFIB with LESP and evaluate both positioning pain during spinal anesthesia and postoperative analgesic outcomes in patients with hip fracture are limited.

The primary aim of this study was to evaluate the effect of preoperative SIFIB and LESP on NRS scores recorded while patients were placed in the sitting position for spinal anesthesia in hip fracture surgery. Our secondary aims were to evaluate their effects on postoperative opioid consumption, rescue analgesic requirement, postoperative NRS scores, complications, time to mobilization, length of hospital stay, and quality of recovery.

Methods

Study design and ethical approval

This study was conducted at Sancaktepe Şehit Prof. Dr. İlhan Varank Training and Research Hospital between May 2025 and January 2026 after approval by the institutional ethics committee (protocol number: 2025/168; meeting date: 16 May 2025; ClinicalTrials.gov identifier: NCT07639762). The study was conducted in accordance with the Declaration of Helsinki and is reported in accordance with the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guideline for observational studies. The aim was to prospectively evaluate postoperative outcomes in patients who received different perioperative analgesia approaches routinely applied in clinical practice. Written and verbal informed consent was obtained from all patients after they had been informed about the study.

Study population

A total of 206 patients aged 18–90 years with ASA physical status I–III who were scheduled for hip fracture surgery under spinal anesthesia were included. Exclusion criteria were refusal to participate, ASA physical status IV–V, allergy to local anesthetics, coagulopathy, infection at the planned block site, central or autonomic nervous system disease, and chronic analgesic use. Patient flow and reasons for exclusion are presented in Fig. 1.

Patient eligibility and group assignment

Patients were categorized into two groups according to the perioperative analgesia technique applied during clinical management. The anesthesiologist responsible for postoperative assessments and data collection and the ward nurses were blinded to group categorization throughout the study period. Patients were not informed about their analgesia technique group during postoperative outcome assessments.

Anesthesia and analgesia management

After written consent had been obtained, all patients were taken to the regional block area. Standard monitoring was applied, and intravenous (IV) midazolam 0.01 mg/ midazolam was administered as premedication.

SIFIB group. With the patient in the supine position, the skin on the operative side was cleaned with an antiseptic solution. A linear ultrasound probe (Philips Affiniti 30, the Netherlands) was placed in the parasagittal plane over the iliac ligament. The probe was then slid inferomedially along the inguinal ligament to obtain the “bow-tie” view with the iliacus

muscle in the center. The sartorius and internal oblique muscles formed the bow-tie appearance, and the fascia iliaca was visualized beneath them. The deep circumflex iliac artery, located above the fascia iliaca, was used as the anatomical landmark for needle insertion. A 22-G, 80-mm block needle (BRAUN Stimuplex Ultra360, Germany) was advanced in-plane in the parasagittal direction into the fascia iliaca compartment. After the needle tip position and negative aspiration were confirmed, 30 mL of 0.25% bupivacaine was injected while the spread of the local anesthetic was monitored in real time.

LESP group. Patients were placed in the lateral decubitus position with the operative side up. After skin cleaning, a convex ultrasound probe was first placed in the sagittal orientation over the midline spinous processes at L3–L5 and then moved laterally to visualize the erector spinae muscle and the L3 transverse process. A 22-G, 80-mm needle was advanced in-plane from the lateral edge of the transverse process to the fascial plane anterior to the erector spinae muscle. After cranial and caudal spread beneath the muscle was confirmed, 30 mL of 0.25% bupivacaine was injected into the interfascial plane deep to the erector spinae muscle at the lumbar level.

Twenty minutes after the injection, dermatomal sensory block was assessed in all patients by pinprick testing with a blunt-tipped needle; decreased sensation in the L1–L3 dermatomes compared with the contralateral side was checked. The patients were then taken to the operating room and placed in the sitting position for spinal anesthesia, and positioning NRS scores were recorded at that time. Spinal anesthesia was performed at the L3–L4 or L4–L5 interspace using a 25-G Quincke needle via median approach. After free cerebrospinal fluid flow was confirmed, 3 mL of 0.5% hyperbaric bupivacaine was administered into the subarachnoid space. The dose of hyperbaric bupivacaine was adjusted according to height: it was reduced by 0.2 mL in patients shorter than 150 cm and increased by 0.2 mL in patients taller than 180 cm.

Intraoperative hemodynamic parameters, complications, surgical time, and anesthesia time were recorded. “Surgical time” was defined as the time from handing the patient over to the surgical team after the onset of adequate spinal block to completion of the wound dressing, and ‘anesthesia time’ as the total time from the patient’s entry into the operating room to transfer to the post-anesthesia care unit (PACU).

Postoperative management

In both groups, postoperative analgesia was provided by IV morphine PCA programmed with no basal infusion, a 2-mg bolus dose, a 20-min lockout interval, and a 4-h limit of 20 mg. Patients were transferred from the PACU to the ward when the Modified Aldrete Score was ≥ 9.

Motor block was assessed using the modified Bromage scale (0 = full movement, able to move the knee and ankle freely; 1 = unable to raise the knee, able to move the ankle; 2 = unable to move the knee or ankle). Motor block was considered resolved when the score was 0, and this time point was recorded as hour 0. IV paracetamol (1 g) was administered every 8 h postoperatively. IV tramadol (1 mg/kg) was planned as rescue analgesia when the NRS score was ≥ 4 despite paracetamol and morphine PCA. IV ondansetron (4 mg) was administered for nausea or vomiting. The PCA device was discontinued at postoperative hour 24, and total morphine consumption and the numbers of requested and delivered boluses were recorded. NRS scores were assessed at postoperative hours 0, 2, 6, 12, and 24. Rescue analgesic requirement, intraoperative/postoperative complications, time to first mobilization, and length of hospital stay (number of days spent in hospital after surgery) were recorded. The Quality of Recovery-15 (QoR-15) questionnaire was administered at postoperative hour 24 to assess quality of recovery. Motor block, postoperative NRS scores, and the QoR-15 questionnaire were assessed by an anesthesiology resident who was blinded to the analgesia technique performed.

Outcomes

The primary outcome was the NRS score recorded while patients were placed in the sitting position for spinal anesthesia. Secondary outcomes were NRS scores before and after the block; NRS scores at postoperative hours 0, 2, 6, 12, and 24; total 24-h morphine consumption; requested and delivered PCA boluses; rescue analgesic requirement; complications; time to first mobilization; length of hospital stay; and QoR-15 score at postoperative hour 24.

Statistical analysis

The sample size calculation was performed before the study began using G*Power software (version 3.1) on the based data of Bravo et al., comparing SIFIB with lumbar plexus block. Assuming an effect size of Cohen's $d = 0.667$, $\alpha = 0.05$, and a statistical power $(1 - \beta)$ of 95%, at least 59 patients per group (total ≥ 118) were required [16, 17]. Because of the

prospective observational design, all eligible consecutive patients during the 6-month study period were included, and the final analysis cohort consisted of 185 patients. This sample size exceeded the required minimum and provided a statistical power of over 99% for the detected effect size.

Statistical analysis was performed using SPSS version 27.0. The normality of continuous variables was assessed with the Shapiro–Wilk test. Normally distributed continuous data were presented as mean ± standard deviation and compared using the independent-samples *t*-test. Non-normally distributed data were expressed as median (minimum–maximum) and compared using the Mann–Whitney *U* test. Categorical variables were reported as frequency (*n*, %) and compared using the chi-square or Fisher's exact test; risk differences and 95% confidence intervals were reported where appropriate. A P value < 0.05 was considered statistically significant.

Results

Of the 223 patients assessed for eligibility, 17 were excluded (10 with ASA IV, 7 who refused to participate), and 206 patients were enrolled. During follow-up, 8 patients from the SIFIB group (2 deaths, 6 conversions to general anesthesia) and 13 patients from the LESP group (3 deaths, 7 conversions to general anesthesia, 3 with missing data) were excluded from the analysis. The final analysis was thus performed on 185 patients (SIFIB group: $n = 104$; LESP group: $n = 81$) (Fig. 1). There were no significant differences between the two groups in baseline demographic characteristics, surgical variables, or clinical parameters (Table 1).

Reasons for conversion to general anesthesia: spinal anesthesia was converted to general anesthesia in 6 patients in the SIFIB group (failed spinal anesthesia in 2, prolonged surgical time in 3, and hemodynamic instability in 1) and in 7 patients in the LESP group (failed spinal anesthesia in 4, prolonged surgical time in 1, intraoperative arrhythmia in 1, and hemodynamic instability in 1).

The post-block NRS scores (SIFIB: 4 [3–5]; LESP: 5 [4–5]; $P < 0.001$) and the positioning NRS scores during spinal anesthesia (SIFIB: 3 [3–4]; LESP: 4 [3–5]; $P = 0.005$) were significantly lower in the SIFIB group. Pre-block NRS scores did not differ significantly between the groups (SIFIB: 6 [5–8]; LESP: 7 [6–8]; $P = 0.055$). NRS scores at postoperative hours 0, 2, 6, 12, and 24 did not differ significantly between the groups ($P > 0.05$ for all) (Table 2).

Regarding postoperative opioid consumption, total morphine consumption was significantly lower in the SIFIB group than in the LESP group (12 [6–21] mg vs. 18 [10–24] mg; $P = 0.005$). Patients in the SIFIB group requested fewer PCA boluses (8 [5–15] vs. 10 [6–16]; $P = 0.018$) and received fewer PCA boluses (6 [4–11] vs. 9 [5–12]; $P = 0.010$). In addition, the need for rescue analgesia was significantly lower in the SIFIB group (23 [22%] vs. 29 [36%]; $P = 0.048$) (Table 3).

No statistically significant differences were observed between the groups in intraoperative or postoperative complication rates, time to first mobilization, length of hospital stay, or QoR-15 score at postoperative hour 24 (Table 4).

Discussion

In this prospective observational study, we examined the effect of preoperative SIFIB and LESP on pain during spinal anesthesia positioning in patients undergoing hip fracture surgery. Post-block and positioning pain scores, as well as 24-h opioid consumption and rescue analgesic requirement, were lower in the SIFIB group; no differences were found in postoperative pain scores, mobilization, length of hospital stay, quality of recovery, or complications.

In patients with hip fracture, positioning pain is not only a source of subjective discomfort but also a clinically important problem that can make the neuraxial procedure technically difficult, reduce patient cooperation, and cause additional tissue damage at the fracture line [7]. The contribution of preoperatively performed peripheral nerve blocks to analgesia during positioning is therefore regarded as one of the determinants of the overall clinical value of the technique. Nidgundi et al. [18] reported reduced pain scores and easier positioning in patients who received preoperative SIFIB for hip fracture surgery. Tulgar et al. [19] described the use of LESP for postoperative analgesia in patients undergoing hip fracture surgery, and in another study [20], reported that 40 mL of local anesthetic injected at the level of the L4 vertebra spread to the lumbar plexus and neural foramina and provided effective analgesia without motor block. Hanych et al. [21] reported that LESP provided effective analgesia as an alternative to epidural analgesia in patients undergoing hip surgery. LESP has also been described as a technique that preserves quadriceps motor function [12, 14]; this feature may be advantageous in patients in whom early mobilization is targeted. Accordingly, although LESP should not be regarded as the first-choice block for positioning pain, it is an evidence-supported option for perioperative analgesia in patients with hip fracture; to our knowledge,

this study is the first to directly compare the performance of this option with SIFIB during spinal positioning. In both block groups, NRS scores during spinal positioning were accompanied by an acceptable reduction relative to pre-block values.

The similarity of postoperative NRS scores at all time points is consistent with studies reporting that regional techniques with different anatomical approaches can provide comparable postoperative pain control in hip surgery [14, 15].

Fewer PCA boluses, lower total morphine consumption, and less rescue analgesic requirement were observed in the SIFIB group. This finding is consistent with a randomized trial reporting that SIFIB reduced 24-h opioid consumption compared with LESP [22]. The opioid-sparing effect of LESP may be time-limited: lumbar ESP was reported to reduce opioid consumption significantly only in the first 8 h after total hip arthroplasty [23], and a meta-analysis reported that its advantage in pain scores diminished after approximately the 9th hour [24]. Because opioid exposure in older patients with hip fracture is associated with delirium, respiratory depression, sedation, and delayed mobilization [3], the lower opioid consumption observed in the SIFIB group may be clinically beneficial; however, the absolute difference (6 mg of morphine) is small and did not produce a measurable difference in delirium or mobilization.

The similarity of time to mobilization, length of hospital stay, quality of recovery, and complication rates suggests that both techniques can be used safely in this population; this result is in line with the ERAS and PROSPECT approaches [4] and with systematic reviews supporting the safety of the erector spinae plane block [25]. The two techniques can therefore be selected according to the experience of the practitioner, the patient's tolerance of positioning, and institutional resources.

Limitations

This study has several limitations. First, it has an observational, single-center design. Second, the type of block and the position in which it was performed (supine vs. lateral decubitus) could not be separated; it is therefore not possible to say whether the difference between the groups arises from the block itself or from the position in which it was performed. Third, postoperative follow-up was limited to 24 h; long-term outcomes related to functional recovery and quality of life were not evaluated.

Conclusions

In this prospective observational study, pain scores during spinal anesthesia positioning and 24-h opioid consumption were lower in patients who received SIFIB for hip fracture surgery than in those who received LESP. In compared with the LESP group, NRS scores also decreased clinically meaningfully compered with pre-block value, although a small difference in positioning scores between the two groups remained. Because the postoperative pain course, time to mobilization, length of hospital stay, and quality of recovery were similar, SIFIB may be preferred because it can be performed in the supine position and was associated with lower positioning pain and opioid consumption, whereas LESP remains an evidence-supported, motor-sparing alternative.

Abbreviations

ASA: American Society of Anesthesiologists
ERAS: Enhanced Recovery After Surgery
LESP: Lumbar erector spinae plane block
LFCN: Lateral femoral cutaneous nerve
NRS: Numeric Rating Scale
PACU: Post-anesthesia care unit
PCA: Patient-controlled analgesia
PENG: Pericapsular nerve group
PROSPECT: Procedure-Specific Postoperative Pain Management
QoR-15: Quality of Recovery-15
SIFIB: Suprainguinal fascia iliaca block
STROBE: Strengthening the Reporting of Observational Studies in Epidemiology

Declarations

Ethics approval and consent to participate: The study was approved by the institutional ethics committee of Sancaktepe Şehit Prof. Dr. İlhan Varank Training and Research Hospital (protocol number 2025/168; 16 May 2025) and was conducted in accordance with the Declaration of Helsinki. Written and verbal informed consent was obtained from all participants.

Consent for publication: Not applicable.

Availability of data and materials: The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Competing interests: The authors declare that they have no competing interests.

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Authors' contributions: Study conception and design: Ş.A. data collection: Ş.A. and B.G.Ö data analysis: A.A. manuscript drafting: Ş.A. critical revision: Ş.A., B.G.Ö and A.A. All the authors have read and approved the final manuscript.

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Table 1 Baseline demographic and clinical characteristics

Variable	SIFIB group (*n* = 104)	LESP group (*n* = 81)	*P* value
Age (years)	76.0 (70.0–80.0)	73.0 (63.0–80.0)	0.077
BMI (kg/m²)	26.0 (23.8–28.0)	25.0 (23.0–29.0)	0.757
ASA physical status (I/II/III), *n*	0/46/58	0/33/48	0.744
Sex (female/male), *n*	62/42	48/33	1.000
Anesthesia time (min)	120 (100–130)	120 (99–130)	0.635
Surgical time (min)	85 (60–95)	87 (68–100)	0.126

Data are presented as median (min–max) or number. BMI, body mass index; ASA, American Society of Anesthesiologists; SIFIB, suprainguinal fascia iliaca block; LESP, lumbar erector spinae plane block.

Table 2 Pain course (NRS) at perioperative time points

Time point	SIFIB group (*n* = 104)	LESP group (*n* = 81)	*P* value
Pre-block NRS	6 (5–8)	7 (6–8)	0.055
Post-block NRS	4 (3–5)	5 (4–5)	<0.001*
Positioning NRS (spinal)	3 (3–4)	4 (3–5)	0.005*
Postoperative hour 0 NRS	3 (1–4)	2 (1–4)	0.550
Postoperative hour 2 NRS	3 (2–4)	4 (3–5)	0.134
Postoperative hour 6 NRS	4 (3–5)	4 (3–6)	0.629
Postoperative hour 12 NRS	4 (3–5)	4 (3–5)	0.259
Postoperative hour 24 NRS	3 (2–4)	3 (2–4)	0.634

Data are presented as median (min–max). NRS, Numeric Rating Scale. *Statistically significant ($P < 0.05$).

Table 3 Postoperative opioid consumption and rescue analgesia

Parameter	SIFIB group (*n* = 104)	LESP group (*n* = 81)	*P* value
Requested PCA boluses, *n*	8 (5–15)	10 (6–16)	0.018*
Delivered PCA boluses, *n*	6 (4–11)	9 (5–12)	0.010*
Total 24-h morphine (mg)	12 (6–21)	18 (10–24)	0.005*
Rescue analgesia requirement, *n* (%)	23 (22%)	29 (36%)	0.048*

Data are presented as median (min–max) or number (%). PCA, patient-controlled analgesia. *Statistically significant ($P < 0.05$).

Table 4 Secondary recovery and clinical outcomes

Outcome	SIFIB group (*n* = 104)	LESP group (*n* = 81)	*P* value
Intraoperative complication, *n* (%)	9 (8.7%)	9 (11.1%)	0.623
Postoperative complication, *n* (%)	13 (12.5%)	9 (11.1%)	0.823
Time to first mobilization (h)	17 (16–19)	17 (16–19)	0.756
Length of hospital stay (days)	2 (1–3)	2 (1–2)	0.727
QoR-15 score at 24 h	126 (120–132)	129 (119–135)	0.664

Data are presented as median (min–max) or number (%). QoR-15, Quality of Recovery-15.

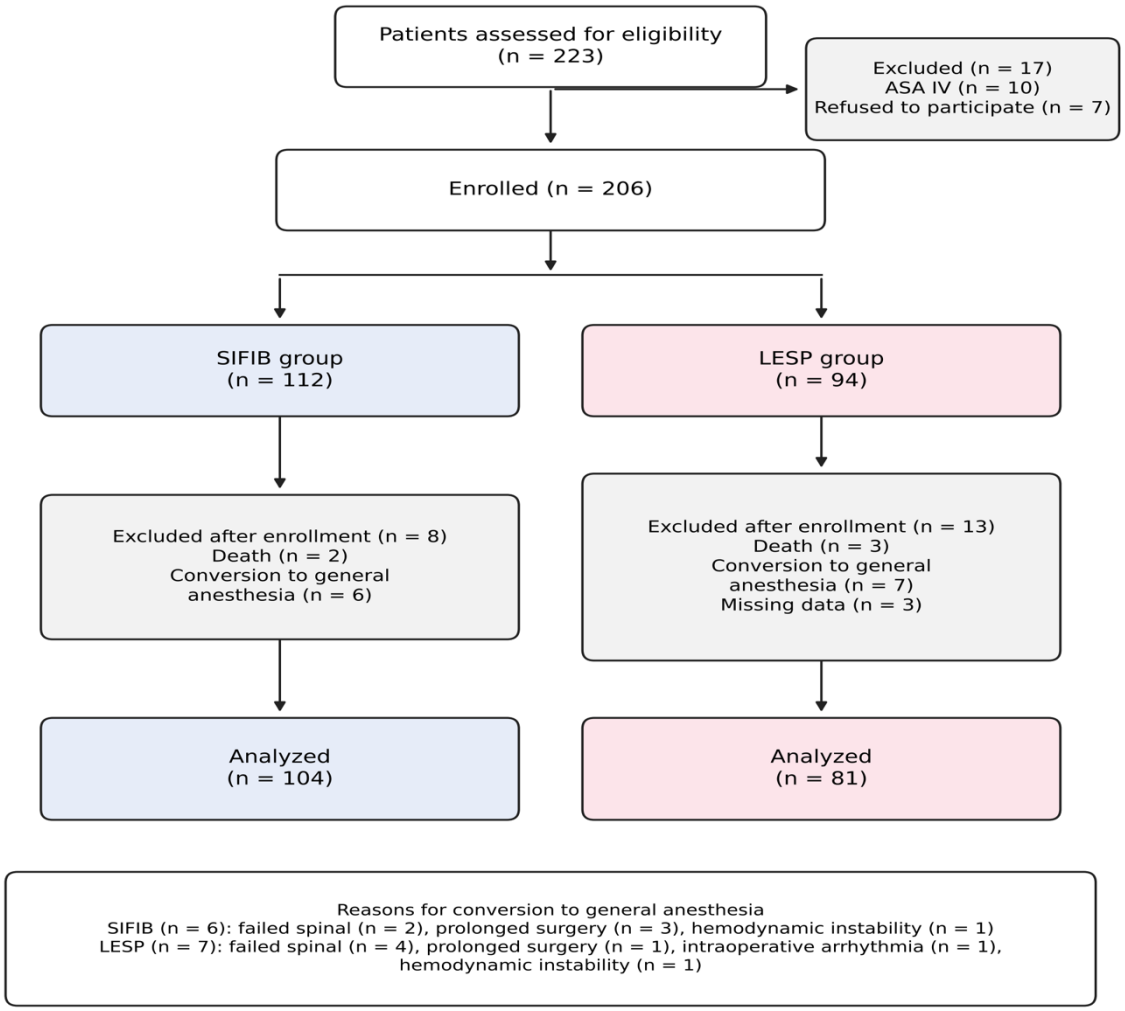


Figure 1: Patient flow diagram (STROBE).

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- STROBEchecklistcompleted.docx