

## ORIGINAL RESEARCH

## REGIONAL ANESTHESIA

# Comparison of ultrasound guided erector spinae plane block and fascia iliaca block for postoperative analgesia in hemiarthroplasty: a double-blind randomized trial

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## ABSTRACT

**Background & Objective:** Peripheral nerve blocks are one of the peri-operative analgesic options that abolish surgical stress response, reduce the use of opioids, and control postoperative pain. During the previous few decades regional anesthesia and analgesia techniques have been widely used, especially with the enhanced safety and precision in these procedures with the use of ultrasound. We compared the efficacy of Erector Spinae Plane Block (ESPB) with Fascia Iliaca Block (FIB) for postoperative pain in hemiarthroplasty surgery.

**Methodology:** This randomized double-blind trial included sixty-eight cases scheduled for hemiarthroplasty under spinal anesthesia. Patients were randomly divided into two equal groups: Group ES received ESPB, and Group FI received FIB. Blocks were performed preoperatively using 15 mL bupivacaine 0.25% and 15 mL lidocaine 2%. Postoperatively, pain was assessed with Visual Analogue Scale (VAS) at 1 h, 2 h, 6 h, 12 h and 24 h.

**Results:** The mean time to first dose and the amount of morphine used in the first 24 hours were comparable between Group ES and Group FI. Visual analogue scale measurements at rest and movement showed insignificant differences between both groups at 1 h, 2 h, 6 h, 12 h and 24 h. Quadriceps motor impairment revealed significant reduction in Group ES compared to Group FI (11.76 vs 44.12%,  $P = 0.006$ ).

**Conclusions:** In hemiarthroplasty, the analgesic profile of erector spinae plane block was comparable with fascia iliaca block with superiority of the former in preserving the quadriceps motor power.

**Keywords:** Ultrasound, Erector Spinae Plane Block, Fascia Iliaca Block, Analgesia, Hemiarthroplasty

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## 1. INTRODUCTION

Adequate pain management is very important for the quality of postoperative rehabilitation and recovery as it

aids early ambulation, shortens hospital stay and improves the quality of life.<sup>1</sup> For effective pain control after hemiarthroplasty, multimodal analgesic regimens have been applied. Regional nerve blocks can be

employed as part of this regimen. Although there are wide variations in the used techniques, no one is universally accepted as an ideal.<sup>2</sup>

Fascia iliaca block (FIB) is a method used for blocking the lumbar plexus. The hip joint is innervated by the branches of the sciatic, obturator, and femoral nerves.<sup>3-5</sup> Blocking lumbar plexus via the FIB ensures an effective approach for the postoperative pain control following hip and femur fractures.<sup>6, 7</sup>

FIB doesn't affect the muscle power of quadriceps femoris; therefore it won't increase the possibility of fall during rehabilitation. It has been proved that FIB reduces the opioid use and controls pain in patients with hip and proximal femur operations.<sup>3</sup>

The erector spinae plane block (ESPB) is one of the newly utilized techniques for many surgeries such as hip and proximal femur fractures. US guided ESPB performed at L4 level could mimic the effect of epidural analgesia, psoas compartment block and quadratus lumborum block in total hip arthroplasty with low complication risks.<sup>8, 9</sup>

There is paucity in literature about comparing both blocks and controversy of superiority of any one of these in hemiarthroplasty. Thus, we compared the impact and efficacy of ESPB to that of FIB on postoperative pain in hemiarthroplasty.

## 2. METHODOLOGY

The current study was a prospective, double-blind randomized non-inferiority trial performed on 68 patients of both sexes, above 18 y of age, ASA physical status I and II, and scheduled for hemiarthroplasty. The study was done after approval from ethical committee of Faculty of Medicine, Kasr Al Aini Hospital, Cairo, Egypt (Code: MS-619-2021).

Exclusion criteria were procedures of hemiarthroplasty prolonged more than three hours, body mass index (BMI) more than 30 kg/m<sup>2</sup>, history of local anesthetic allergy, local infection at the procedure site, bleeding disorders, psychiatric disease and cognitive disorders, or receiving anticoagulant therapy.

### 2.1. Randomization and blinding

We allocated patients in a random and parallel manner in two groups via computer-generated random numbers and opaque sealed envelopes. The first group (Group ES)

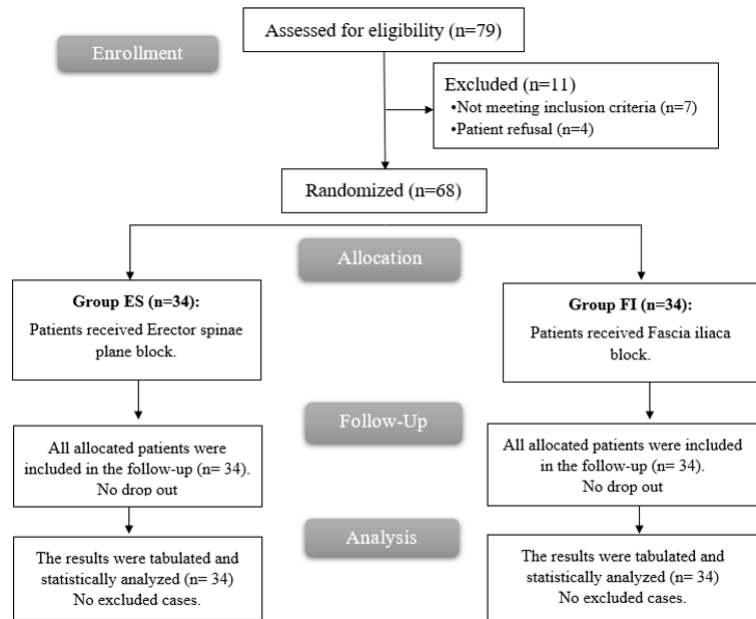


Figure 1: CONSORT flowchart of the enrolled patients

received ESPB, and the 2nd group (Group FI) received FIB.

All blocks were performed preoperatively in a well-equipped preparation room. Standard anesthesia monitors were applied after insertion of an 18G, IV cannula and injection of 1 mg intravenous midazolam for sedation. Both blocks were performed under standard aseptic technique using bupivacaine 0.25% 15 mL plus lidocaine 2% 15 mL. Siemens ACUSON X300 Ultrasound System equipped with a high frequency linear probe was used to guide the blocks.

### 2.2. Erector spinae plane block technique

Either in prone or sitting position, the transverse processes of L4 will be identified in the parasagittal plane and 100 to 150 cm 22-gauge needle was inserted across the erector spinae muscle in between the 2 transverse processes, and local anesthesia was given to hydro dissect the muscle off of the transverse process and expand the erector spinae plane.

### 2.3. Fascia iliaca block technique

We put the probe parallel to inguinal ligament at inguinal crease, and identified the fascia iliaca, fascia lata, femoral artery and nerve and the iliacus muscle. Then, with rotation of the probe 90°-135° in the counter-clockwise direction, the probe was made parallel to vertebral axis, insertion of 22G spinal needle was carried out in-plane and thereafter pushed towards the iliacus muscle and fascia iliaca. Following confirmation of the

passage of the needle via the fascia iliaca, the local anesthetic solution was injected.

After performing the block, the patients were transferred to operating room (OR), where continuous monitoring of the ECG, non-invasive blood pressure, pulse oximetry, and temperature was done throughout the surgical procedure.

All of the patients had spinal anesthesia with 25 µg fentanyl and 25 mg heavy bupivacaine (total 4 mL) at lumbar 3/4 level. No local infiltration of local anesthetic was performed by surgeons.

After completion of the surgery, the cases were transferred to the PACU where mean arterial pressure, heart rate and VAS scores during rest and on movement were noted immediately on arrival and at 2, 4, 6, 12 and 24 h following operation. Rescue analgesia was administered in the form of IV morphine 3 mg bolus dose if the pain score was >3; with a maximum allowed dose was 0.1 mg/kg/day.

We evaluated postoperative nausea and vomiting (PONV) on a verbal scale (where none = no nausea, mild = nausea without vomiting, moderate = one episode of vomiting, severe = more than one episode of vomiting). Inj ondansetron 0.1 mg/kg IV was used for cases who suffered from moderate to severe PONV.

The sensory level was evaluated by cold (ice) at the same intervals, while preoperative and postoperative muscle power was assessed using Medical Research Council Scale of muscle power (muscle contracts normally against full power and 0 no contraction). Total ambulation distance achieved was recorded on postoperative day 1.

The primary outcome included the time of first rescue morphine, while the secondary outcomes included VAS, HR, MAP and total morphine consumption postoperatively.

#### 2.4. Sample size calculation

The sample size was calculated via PASS software (version 11.0; NCSS PASS, UT, USA). The sample size depended upon the following considerations: 95% confidence limit, 90% power of the study, group ratio 1:1, the common standard deviation of the time to first

**Table 1: Comparison of demographic data in the studied groups**

Parameters	Group ES (n = 34)	Group FI (n = 34)	P-value
Age (y)	40.03 ± 12.39	44.62 ± 12.68	0.136
Sex	Female	12 (35.3)	0.604
	Male	24 (70.6)	
Weight (kg)	72.09 ± 7.4	73.88 ± 8.09	0.343
Height (cm)	167.38 ± 7.5	168.12 ± 6.1	0.659
BMI (kg/m <sup>2</sup> )	25.83 ± 2.97	26.18 ± 2.87	0.618
ASA physical status	I	15 (44.12)	0.088
	II	19 (55.88)	
Duration of surgery (min)	197.79 ± 55.64	216.03 ± 63.27	0.211

Data presented as mean ± SD or number (%); ES: Erector spinae, FI: Fascia iliaca.

analgesic need was 9.6 min according to a previous study,<sup>10</sup> the non-inferiority margin was set to 5 min and addition of 2 cases to each group was done to cater for the dropouts and technique failure. Therefore, 34 patients were recruited in each group.

#### 2.5. Statistical analysis

Data Entry was done by SPSS version 26.0 (IBM, Chicago, IL, USA). Variables were examined for

normality. Categorical variables were presented in the form of numbers and percentage; we utilized Chi square and Fisher's exact tests when appropriate. Continuous variables were expressed using mean ± SD for normally distributed data or median and interquartile range (IQR) for not normally distributed data; the T test, Mann-Whitney and other tests of significance were used for comparison. P < 0.05 was considered to be statistically significant.

### 3. RESULTS

In the present study, 79 patients were enrolled; out of them, seven cases didn't meet the criteria and four cases refused to participate in the study, hence 68 patients were included. Random allocation of the included cases in two equal groups was carried out (34 cases in each). All cases were followed-up and analyzed statistically (Figure 1).

Age, gender, weight, height, BMI, ASA physical status and duration of operation showed comparable results in both groups (Table 1).

VAS score measurements at rest and at movement were statistically insignificantly different between both groups at 1, 2, 6, 12 and 24 h postoperative (Table 2).

Morphine was received in 5 patients (14.71%) in Group ES, compared to 7 (20.59%) cases in Group FI. The mean opioid dose consumed by patients in Group ES was

**Table 2: Comparative VAS score at rest and movement at different time points**

Time	Group ES (n = 34)	Group FI (n = 34)	P-value
<b>At rest</b>			
1 h	0 (0 - 0)	0 (0 - 0)	---
2 h	1 (0 - 2)	1 (0 - 1)	0.090
6 h	2 (1 - 2)	2 (2 - 2)	0.176
12 h	2 (1.25 - 3)	3 (2 - 3)	0.064
24 h	2.5 (2 - 3)	3 (2 - 3)	0.092
<b>At movement</b>			
1 h	1 (0 - 1)	1 (1 - 1)	0.114
2 h	2 (1.25 - 3)	2 (2 - 3)	0.520
6 h	3 (3 - 3)	3 (3 - 4)	0.072
12 h	3 (3 - 4)	4 (3 - 4)	0.279
24 h	3 (3 - 5)	4 (3 - 5)	0.288

*Data are presented as median (IQR). ES: Erector spinae, FI: Fascia iliaca*

**Table 3: Comparison of opioid dose and time to first analgesic**

Variable	Group ES (n = 34)	Group FI (n = 34)	P-value
<b>Patient requiring rescue morphine</b>	5 (14.71)	7 (20.59)	0.751
<b>Time to rescue analgesia (h)</b>	12.8 ± 1.3	11.71 ± 2.06	0.326
<b>Morphine given in 1st 24 h (mg)</b>	5.4 ± 1.34	5.57 ± 1.13	0.815

*Data are presented as mean ± SD or number (%). ES: Erector spinae, FI: Fascia iliaca.*

**Table 4: Quadriceps motor impairment and incidence of PONV**

Variable	Group ES (n = 34)	Group FI (n = 34)	P
<b>Quadriceps motor impairment</b>	4 (11.76)	15 (44.12)	<b>0.006*</b>
<b>PONV</b>	4 (11.76)	3 (8.8)	1

*Data presented as number (%). \*P ≤ 0.05 considered as significant; PONV: Postoperative nausea and vomiting.*

5.4 ± 1.34 mg while in Group FI it was 5.57 ± 1.13 mg. The mean time to first dose in Group ES was 12.8 ± 1.3 h while in Group FI it was 11.71 ± 2.06 h. These measurements were comparable in between the groups (Table 3).

MAP and HR measurements were statistically equivalent in both groups at 1, 2, 6, 12 and at 24 hours following operation (Figure 2).

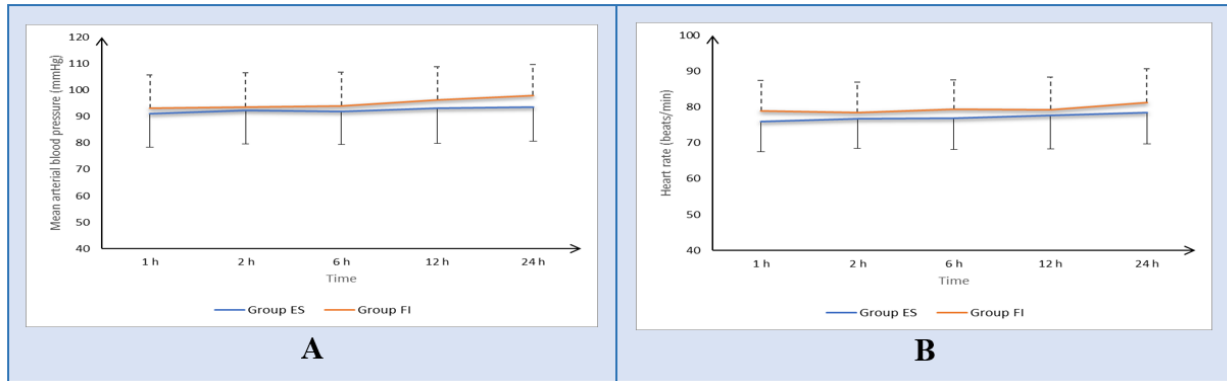
Quadriceps motor impairment showed significant decrease in Group ES compared to Group FI (4 (11.76%) vs 15 (44.12%), P = 0.006). The incidence of PONV 4

(11.76%) in Group FI and 3 (8.8%) in Group ES. The differences were insignificant (Table 4).

## 4. DISCUSSION

Hip arthroplasty is an extremely painful procedure. Regional analgesia helps to reduce the use of opioids, post-anesthesia recovery room time and duration of hospitalization.<sup>11, 12</sup>

Ultrasound-guided FIB is commonly used to control peri-operative analgesia in hip operations in both adults and children.<sup>13</sup> FIB is a superior analgesic option in operations of the pelvis as well as lower extremities and



**Figure 2: Line graph representing A) mean arterial pressure and B) heart rate in the two groups ES: Erector spinae, FI: Fascia iliaca**

was regarded to be better than the use of general anesthesia in a study carried out by Zhang et al.<sup>14</sup> It was proved to be better compared to 3-in-1 block in a study carried out by Dalens et al. as well as to systemic analgesic usage in another study conducted by Neubrand et al. and Eastburn et al.<sup>15-17</sup>

Ultrasound guided ESPB is a recently introduced regional analgesic approach in different surgeries of the abdomen, pelvis, and hip.<sup>18</sup> More studies were conducted previously to evaluate ESPB in hip surgery in adult patients. Abdelnasser et al.<sup>19</sup> found that pain scores and morphine utilization were significantly reduced in ESPB when compared to controls and analgesia was longer in ESPB group. Ahiskalioglu et al. documented that combining ESPB with mild sedatives provided sufficient and safe anesthesia in high-risk elderly cases.<sup>20</sup> El Koundi et al. demonstrated that ESPB carried out at L2 level as an adjuvant to general anesthesia might serve as an efficient modality to provide reliable analgesia in hip surgery in pediatric cases.<sup>21</sup> Tulgar et al. suggested that ESPB group exhibited promising outcomes as regards to the block success rates, duration, reduced frequency of postoperative rescue analgesics needed in addition to the stable hemodynamics peri-operatively.<sup>8</sup>

In our study, it was revealed that ESPB and FIB showed comparable efficacy as regional anesthetic techniques that can be used in hip surgeries. In coherence with the current results, Flaviano et al. revealed no statistically significant difference in morphine utilization at 24 h, pain scores, PONV after total hip arthroplasty.<sup>22</sup>

In disagreement with our results, Kacioglu et al. found that the dynamic pain scores on movement in the postoperative first hour and postoperative opioid utilization during the first postoperative 8 h were significantly lower in the ESPB group compared to the FICB group.<sup>23</sup> The side effects of the opioids weren't different between both groups. This difference may be attributed to the fact that they used 30 mL 0.25%

bupivacaine only, while in our result we used 15 mL of bupivacaine 0.25% and 15 mL of lidocaine 2%.

Peri-operative hemodynamic status was comparable in both groups, and remained stable. This phenomenon may be elucidated by the fact that the ESPB specifically targets the dorsal and ventral rami of spinal nerves, whereas the FIB concentrates on the femoral, lateral femoral cutaneous, and obturator nerves. Such targeting may result in the block of sympathetic fibers, thereby inducing vasodilation and a subsequent decrease in HR and ABP.<sup>24,25</sup>

In the current trial, quadriceps exhibited a significantly less motor impairment in Group ESPB compared to Group FIB. In agreement to our findings, Flaviano et al. documented better preservation of the quadriceps motor strength in the ESPB group in comparison with the FIB group.<sup>22</sup>

## 5. LIMITATIONS

The limitations of the current study include a small sized sample, being carried out in a single center. Further studies comparing other techniques, additives, volumes and concentrations and in other procedures are recommended.

## 6. CONCLUSION

Postoperative pain scores and opioid consumption were comparable between erector spinae plane block and fascia iliaca compartment block in patients undergoing hemiarthroplasty under spinal anesthesia. Erector spinae plane block was found to have less adverse effect on the quadriceps motor power.

## 7. Data availability

The numerical data generated during this research is available with the authors.

## 8. Acknowledgement

We gratefully thank Faculty of Medicine, Cairo University, Cairo, Egypt, for facilitating this research.

## 9. Conflict of interest

The study utilized the hospital resources only, and no external or industry funding was involved.

## 10. Authors' contribution

MBA: Concept, corresponding author

MMM: SMMA: MMB: Conduct of the study, manuscript preparation

## 11. REFERENCES

- Guerra ML, Singh PJ, Taylor NF. Early mobilization of patients who have had a hip or knee joint replacement reduces length of stay in hospital: a systematic review. *Clin Rehabil.* 2015;29:844-54. [PubMed] DOI: [10.1177/0269215514558641](https://doi.org/10.1177/0269215514558641)
- Bugada D, Bellini V, Lorini LF, Mariano ER. Update on selective regional analgesia for hip surgery patients. *Anesthesiol Clin.* 2018;36:403-15. [PubMed] DOI: [10.1016/j.anclin.2018.04.001](https://doi.org/10.1016/j.anclin.2018.04.001)
- Yun MJ, Kim YH, Han MK, Kim JH, Hwang JW, Do SH. Analgesia before a spinal block for femoral neck fracture: fascia iliaca compartment block. *Acta Anaesthesiol Scand.* 2009;53:1282-7. [PubMed] DOI: [10.1111/j.1399-6576.2009.02052.x](https://doi.org/10.1111/j.1399-6576.2009.02052.x)
- Nuthep L, Klanarong S, Tangwiwat S. The analgesic effect of adding ultrasound-guided pericapsular nerve group block to suprainguinal fascia iliaca compartment block for hip fracture surgery: a prospective randomized controlled trial. *Medicine.* 2023;102(44):e35649. [PubMed] DOI: [10.1097/MD.00000000000035649](https://doi.org/10.1097/MD.00000000000035649)
- Mirkheshti A, Hashemian M, Abtahi D, Shayegh S, Manafi-Rasi A, Sayadi S, et al. Quadratus lumborum block versus fascia iliaca compartment block for acetabular fracture surgery by Stoppa method: a double-blind, randomized, noninferiority trial. *Pain Res Manag.* 2024;2024:3720344. [PubMed] DOI: [10.1155/2024/3720344](https://doi.org/10.1155/2024/3720344)
- Stevens M, Harrison G, McGrail M. A modified fascia iliaca compartment block has significant morphine-sparing effect after total hip arthroplasty. *Anaesth Intensive Care.* 2007;35:949-52. [PubMed] DOI: [10.1177/0310057X0703500615](https://doi.org/10.1177/0310057X0703500615)
- Hao C, Li C, Cao R, Dai Y, Xu C, Ma L, et al. Effects of perioperative fascia iliaca compartment block on postoperative pain and hip function in elderly patients with hip fracture. *Geriatr Orthop Surg Rehabil.* 2022;13:21-514. [PubMed] DOI: [10.1177/21514593221092883](https://doi.org/10.1177/21514593221092883)
- Tulgar S, Senturk O. Ultrasound guided erector spinae plane block at L-4 transverse process level provides effective postoperative analgesia for total hip arthroplasty. *J Clin Anesth.* 2018;44:68. [PubMed] DOI: [10.1016/j.jclinane.2017.11.006](https://doi.org/10.1016/j.jclinane.2017.11.006)
- Eishazly M, Shaban A, Gouda N, Rashad M, Soaida SM. Ultrasound-guided lumbar erector spinae plane block versus caudal block for postoperative analgesia in pediatric hip and proximal femur surgery: a randomized controlled study. *Korean J Anesthesiol.* 2023;76:194-202. [PubMed] DOI: [10.4097/kja.22421](https://doi.org/10.4097/kja.22421)
- Ozdemir H, Araz C, Karaca O, Turk E. Comparison of ultrasound-guided erector spinae plane block and subcostal transversus abdominis plane block for postoperative analgesia after laparoscopic cholecystectomy: a randomized, controlled trial. *J Investig Surg.* 2022;35:870-7. [PubMed] DOI: [10.1080/08941939.2021.1931574](https://doi.org/10.1080/08941939.2021.1931574)
- Neumann C, Gehlen L, Weinhold L, Straßberger-Nerschbach N, Soehle M, Kornilov E, et al. Influence of intraoperative nociception during hip or knee arthroplasty with supplementary regional anaesthesia on postoperative pain and opioid consumption. *Medicina.* 2023;59:1166. [PubMed] DOI: [10.3390/medicina59061166](https://doi.org/10.3390/medicina59061166)
- He N, Xue FS, Li CW. Comparing analgesic efficacy of different regional blocks after total hip arthroplasty. *J Arthroplasty.* 2024;39:e30-e31. [PubMed] DOI: [10.1016/j.arth.2023.12.031](https://doi.org/10.1016/j.arth.2023.12.031)
- Anger M, Valovska T, Beloeil H, Lirk P, Joshi GP, Van de Velde M, et al. Prospect guideline for total hip arthroplasty: a systematic review and procedure-specific postoperative pain management recommendations. *Anaesthesia.* 2021;76:1082-97. [PubMed] DOI: [10.1111/anae.15498](https://doi.org/10.1111/anae.15498)
- Zhang P, Li J, Song Y, Wang X. The efficiency and safety of fascia iliaca block for pain control after total joint arthroplasty: a meta-analysis. *Medicine (Baltimore).* 2017;96:e6592. [PubMed] DOI: [10.1097/MD.0000000000006592](https://doi.org/10.1097/MD.0000000000006592)
- Dalens B, Vanneuville G, Tanguy A. Comparison of the fascia iliaca compartment block with the 3-in-1 block in children. *Anesth Analg.* 1989;69:705-13. [PubMed]
- Neubrand TL, Roswell K, Deakyne S, Kocher K, Wathen J. Fascia iliaca compartment nerve block versus systemic pain control for acute femur fractures in the pediatric emergency department. *Pediatr Emerg Care.* 2014;30:469-73. [PubMed] DOI: [10.1097/PEC.0000000000000163](https://doi.org/10.1097/PEC.0000000000000163)
- Eastburn E, Hernandez MA, Boretzky K. Technical success of the ultrasound-guided supra-inguinal fascia iliaca compartment block in older children and adolescents for hip arthroscopy. *Paediatr Anaesth.* 2017;27:1120-4. [PubMed] DOI: [10.1111/pan.13227](https://doi.org/10.1111/pan.13227)
- Kaya C, Dost B, Tulgar S. Sacral erector spinae plane block provides surgical anesthesia in ambulatory anorectal surgery: two case reports. *Cureus.* 2021;13:12-598. [PubMed] DOI: [10.7759/cureus.12598](https://doi.org/10.7759/cureus.12598)
- Abdelnasser A, Zoheir H, Rady A, Ramzy M, Abdelhamid BM. Effectiveness of ultrasound-guided erector spinae plane block for postoperative pain control in hip replacement surgeries: a pilot study. *J Clin Anesth.* 2020;62:109-732. [PubMed] DOI: [10.1016/j.jclinane.2020.109732](https://doi.org/10.1016/j.jclinane.2020.109732)
- Ahiskalioglu A, Tulgar S, Celik M, Ozer Z, Alici HA, Aydin ME. Lumbar erector spinae plane block as a main anesthetic method for hip surgery in high-risk elderly patients: initial experience with a magnetic resonance imaging. *Eurasian J Med.* 2020;52:16-20. [PubMed] DOI: [10.5152/eurasianjmed.2020.19224](https://doi.org/10.5152/eurasianjmed.2020.19224)
- Elkoundi A, Bentalha A, El Kettani SE-C, Mosadik A, El Koraichi A. Erector spinae plane block for pediatric hip surgery: a case report. *Korean J Anesthesiol.* 2019;72:68-71. [PubMed] DOI: [10.4097/kja.d.18.00149](https://doi.org/10.4097/kja.d.18.00149)

22. Flaviano E, Bettinelli S, Assandri M, Muhammad H, Benigni A, Cappelleri G, et al. Erector spinae plane versus fascia iliaca block after total hip arthroplasty: a randomized clinical trial comparing analgesic effectiveness and motor block. *Korean J Anesthesiol.* 2023;76:326-35. [[PubMed](#)] DOI: [10.4097/kja.22669](https://doi.org/10.4097/kja.22669)
23. Kaciroglu A, Ekinci M, Dikici M, Aydemir O, Demiroglu O, Erdogan D, et al. Lumbar erector spinae plane block versus inguinal fascia iliaca compartment block for pain management after total hip arthroplasty: a randomized clinical trial. *Pain Med.* 2024;25(4):257-62. [[PubMed](#)] DOI: [10.1093/pm/pnad166](https://doi.org/10.1093/pm/pnad166)
24. Adhi MP, Syukur RB, Andriyanto L, Hanindito E, Utariani A. Efficacy and safety of single-shot erector spinae plane block for perioperative analgesia in pediatric surgery: A systematic review and meta-analysis. *Anaesth. pain intensive care* 2024;28(2):291-301. [[FreeFull Text](#)] DOI: [10.35975/apic.v28i2.2437](https://doi.org/10.35975/apic.v28i2.2437)
25. Zhang TJ, Zhang JJ, Qu ZY, Zhang HY, Qiu Y, Hua Z. Bilateral erector spinae plane blocks for open posterior lumbar surgery. *J Pain Res.* 2020;13:709-17. [[PubMed](#)] DOI: [10.2147/JPR.S248171](https://doi.org/10.2147/JPR.S248171)