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Advances in Anesthesia and Pain Medicine

*Advances in Anesthesia and Pain Medicine 2026; 4:69*
*doi:10.4081/aapm.2026.69*



# Lumbosacral erector spinae plane block for hip fractures in the elderly: a two-center case series and descriptive analysis

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## Abstract

Hip fractures in frail elderly patients pose significant anesthetic challenges due to comorbidities and contraindications to neuraxial techniques. This two-center retrospective case series evaluated the feasibility of combined lumbosacral erector spinae plane (ESP) block with femoral or pericapsular nerve group (PENG) block as the anesthetic approach for hip fracture surgery in 14 high-risk patients with American Society of Anesthesiologist – Physical Status (ASA-PS) III-IV, aged 78-102 years. All procedures were ultrasound-guided and performed under light sedation by experienced anesthesiologist; preoperative, intraoperative, end-of-surgery, 12-hour, and 24-hour postoperative pain were recorded using the Numeric Rating Scale (NRS). Preoperative pain (median NRS 5.5) decreased markedly after anesthesia (median intraoperative NRS 2.0), with all patients maintaining NRS<4 intra- and postoperatively. No conversion to general or neuraxial anesthesia was required, and no complications occurred. Pain control remained stable up to 24 hours postoperatively. These findings suggest that the lumbosacral ESP block combined with femoral or PENG block could offer a safe and effective alternative for anesthesia and analgesia in elderly patients undergoing hip fracture repair.

**Key words:** erector spinae plane block; hip fractures; surgery; regional anesthesia; case report.

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## Introduction

Hip fractures in elderly, frail patients are associated with high morbidity, mortality, and a significant socioeconomic burden. Effective perioperative analgesia is crucial in this vulnerable population, as it improves comfort, facilitates early mobilization, reduces complications, and mitigates postoperative cognitive dysfunction. However, anesthetic management is frequently complicated by multiple comorbidities, multiple medications, and contraindications to commonly used techniques, especially neuraxial anesthesia.

The hip joint receives its sensory innervation from both the lumbar and sacral plexuses: the femoral and obturator nerves innervate the anterior capsule, whereas the posterior capsule is supplied by the nerve to the quadratus femoris, with contributions from the superior gluteal and sciatic nerves.[1,2] This complex innervation contributes to the significant pain experienced in femoral fractures and poses a challenge for achieving complete analgesia.

Peripheral nerve blocks are widely used as part of multimodal analgesia. Techniques such as the femoral nerve block (FNB), fascia iliaca compartment block, lumbar plexus block, and more recently the pericapsular nerve group (PENG) block, have been shown to reduce pain and opioid consumption.[3-6] However, each has limitations: lumbar plexus blocks are technically demanding and potentially unsafe in anticoagulated patients due to the risk of retroperitoneal hematoma, while more superficial blocks often fail to provide adequate coverage for posterior hip pain.[7,8]

Spinal anesthesia is the most common approach for hip fracture repair, but in elderly patients it can cause profound hypotension with myocardial or cerebral hypoperfusion.[9,10] Contraindications such as anticoagulation or spinal pathology further limit their use. General anesthesia represents an alternative, but it is associated with postoperative delirium, hemodynamic instability, and cognitive decline in frail elderly patients.[11-13]

The *Società Italiana di Anestesia, Analgesia, Rianimazione e Terapia Intensiva* (Italian Society of Anesthesia, Analgesia, Resuscitation and Intensive Care; SIAARTI) guidelines highlight the importance of tailored anesthetic management and recommend multimodal analgesia strategies, including peripheral nerve blocks, to improve outcomes and reduce opioid-related complications in elderly patients with femoral fractures.[14]

The erector spinae plane (ESP) block, first described by Forero *et al.* in 2016, has gained attention as a versatile regional tech-

nique.[15] Cadaveric and radiologic studies demonstrated its potential for extensive cranio-caudal and anterior spread toward dorsal and ventral rami.[16] When performed at lumbar and sacral levels, the ESP block can provide coverage of both lumbar (L2-L4) and sacral (S1-S3) contributions to hip innervation.[17,18] De Cassai and Tonetti further confirmed the anatomical rationale by demonstrating variable but clinically relevant local anesthetic spread.[19] Clinical reports and small trials suggest that lumbar ESP blocks may provide effective analgesia, hemodynamic stability, and opioid-sparing benefits in hip fracture surgery and arthroplasty.[20-22]

Due to its superficial location, the ESP block is considered safer than deep plexus or neuraxial techniques, even in anticoagulated patients, and it can be performed in lateral or prone position, which is advantageous in patients unable to tolerate supine positioning because of pain.

Despite these encouraging findings, evidence on the lumbar-sacral ESP block as the sole anesthetic technique for femoral fracture repair in high-risk patients remains scarce. The aim of this study is to uncover the potential benefits of ESP combined with PENG or FNB in elderly patients with femur fracture to put the basis for future research. In this case series, we report our experience using the lumbar-sacral ESP block as the sole anesthetic approach in patients unsuitable for neuraxial anesthesia to evaluate its feasibility, intraoperative effectiveness, hemodynamic stability, and potential to reduce systemic opioid requirements.

## Materials and Methods

### Patients' information

*Supplementary Table 1* reports the description of the patients included in this case series and their pain scores during operation, at the end of the operation, and at 12 and 24 hours.

The population included in our case series consisted of 14 patients, aged between 78 and 102 years (overall mean age: 88 years). Twelve patients underwent gamma nail fixation and 2 underwent endoprosthesis. All patients presented multiple comorbidities, including cardiovascular disease, diabetes, chronic obstructive pulmonary disease, obesity, chronic renal failure, and previous cerebrovascular events.

### Interventions

Our study was conducted at two centers: Santa Maria della Misericordia Hospital in Sorrento (Naples) and S. Sebastiano Hospital in Frascati (Rome), Italy. A total of 14 patients underwent surgical treatment, including gamma nail fixation of the femur in 12 cases and femoral endoprosthesis/hemiarthroplasty in 2 cases.

Considering the presence of neuraxial anesthesia contraindications (*e.g.*, use of anticoagulants and/or antiplatelet therapy) or the possible hemodynamic instability, defined as a mean arterial pressure (MAP) less than 65 mmHg with or without bradycardia less than 50, after obtaining written informed consent from the patients, loco-regional anesthesia (LRA) was proposed as the anesthetic technique of choice.

Specifically, an ipsilateral FNB was added in 11 cases and was performed with a linear probe, while in the remaining 3 cases an ipsilateral PENG block was performed with a convex probe in sitting position. After the first block, a combined lumbar and sacral ESP was performed on the side of the fracture in sitting position.

Regarding the FNB, ropivacaine was chosen in all cases, with a constant volume of 10 mL but at different concentrations: ropivacaine 0.3% in 2 cases, 0.5% in 1 case, 0.375% in 4 cases, and 0.2% in 4 cases. In the 3 cases in which the PENG block was performed, ropivacaine 0.375% was used with a volume of 20 mL.

As for the lumbar and sacral ESP block technique, which is the focus of our study, this was performed with the patient in the sitting position using a convex ultrasound probe, after femoral or PENG performing to facilitate the sitting position. The lumbar level chosen for injection was L1 in 9 cases and L3 in the remaining 5 cases. For the sacral block, the level was always S1. The local anesthetic used in both procedures was ropivacaine, with a volume of 20 mL but at different concentrations: 0.2% in 8 cases and 0.375% in 6 cases.

It should be emphasized that all procedures were carried out in accordance with current international recommendations and always under ultrasound guidance, in order to minimize the expected complications of LRA (*e.g.*, episodes of local anesthetic toxicity syndrome).

Patients who received an ESP+PENG blocks exhibited a slightly higher degree of baseline motor impairment compared to those who received an FNB+ESP blocks.

Specifically, the PENG+ESP cohort presented with preoperative Bromage scores ranging between 1/3 and 2/3, whereas the FNB+ESP cohort showed slightly lower scores concentrated between 0/3 and 1/3. Despite these variations in initial motor function, both the PENG and FNB combined with ESP achieved identical results on the preoperative Hollmen scale, with every single patient across both techniques maintaining a maximum score of 4/4, indicating fully intact baseline sensory function prior to the administration of the regional anesthesia.

All anesthetic procedures were performed at least 30 minutes before the start of surgery. After the LRA, sedative/hypnotic agents were administered to improve intraoperative patient comfort, with the goal of achieving a level of −1 to 0 on the Richmond Agitation-Sedation Scale (RASS) scale recorded every 5 minutes and monitored with an appropriate monitoring system for anesthesia.

This target was achieved in 3 cases with oral midazolam 1 mg, in another 3 cases with a combination of midazolam 1 mg and intravenous ketamine boluses, in 4 cases with a combination of midazolam 1 mg and continuous propofol infusion, in 1 case with midazolam 1 mg and continuous dexmedetomidine infusion, and in the remaining 3 cases with intravenous propofol boluses.

During the surgery, every 5 minutes, MAP, heart rate (HR), saturation ($SpO_2$), and hemodynamic instability were recorded.

The primary endpoint was the achievement of an intraoperative NRS pain score <4. Secondary endpoints included NRS pain scores at 12 and 24 hours postoperatively, as well as intraoperative HR and $SpO_2$.

## Results

*Supplementary Table 2* reports pain scores and hemodynamic stability description. Preoperative pain was consistently high, with a median NRS of 5.5 (interquartile range [IQR] 4.25-6.75). After loco-regional anesthesia, intraoperative pain was reduced to a median NRS of 2.0 (IQR 1.0-2.0); all 14 patients (100%) achieved intraoperative and postoperative NRS values consistently below 4. The median reduction in pain was 4.0 points (IQR 3.0-4.75), confirming a clinically relevant analgesic benefit from the combined lumbosacral ESP and peripheral nerve block technique. This demonstrates a clinically significant reduction in pain from the preoperative to the intraoperative phase, confirming the effectiveness of the loco-regional approach in providing immediate analgesic benefit for this frail, high-risk population. Intraoperative pain control was effective, with NRS scores of 0 in 2 patients (14.3%),

1 in 4 patients (28.6%), 2 in 7 patients (50%), and 3 in 1 patient (7.1%) (Figure 1).

Postoperative pain remained low across the cohort, with median NRS values of 1 at the end of surgery, 1-2 at 12 hours, and 2 at 24 hours (Figure 2). Importantly, no conversion to general or neuraxial anesthesia was required, confirming the feasibility and safety of the lumbosacral ESP block combined with peripheral nerve block in this frail population. During intraoperative monitoring, the overall mean $SpO_2$ was recorded at 96.64% (±1.25%), while the overall mean heart rate was 65.00 bpm (±6.70). MAP observations varied across the patients, with a cohort average of 72.21 mmHg (±6.45). Additionally, hypotensive episodes were noted in 8 of the 14 patients; these were mostly single occurrences, with only 2 patients experiencing multiple events during their procedure.

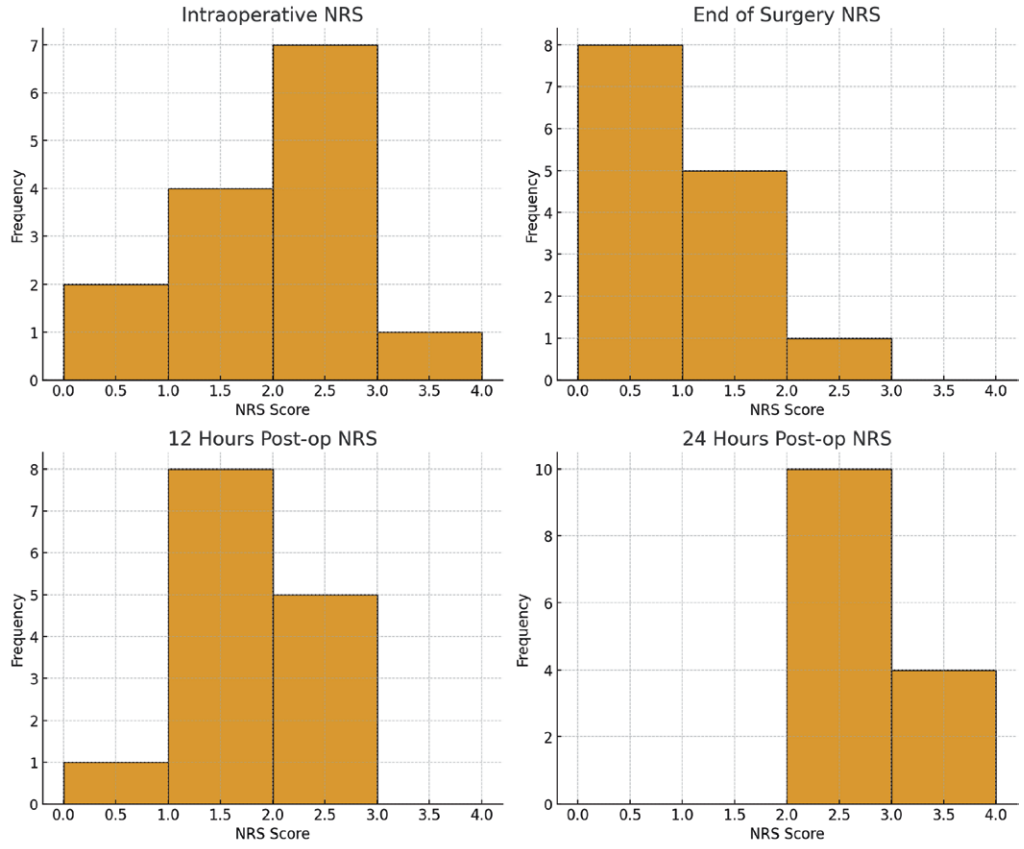
Sensitivity analysis performed after excluding patients with severe dementia confirmed comparable pain scores, with a median preoperative NRS of 6.0 (IQR 4.0-7.0), intraoperative NRS of 2.0 (IQR 1.0-2.0), end-of-surgery NRS of 0.0 (IQR 0.0-1.0), 12-hour postoperative NRS of 1.0 (IQR 1.0-2.0), and 24-hour postoperative NRS of 2 (IQR 2.0-3.0). The median pain reduction from the preoperative to intraoperative phase was 4.0 points (IQR 3.0-5.0), indicating that cognitive impairment did not significantly influence pain assessment or the overall analgesic trend. All patients had a RASS score between −1 and 0, according to the local protocol (*Supplementary Table 1*). All the calculations and graphs were created using R studio.[23]

## Discussion

In our series of 14 elderly, high-risk patients (American Society of Anesthesiologist – Physical Status [ASA-PS] III-IV) undergoing hip fracture surgery, the combined lumbosacral ESP block with either femoral or PENG block provided effective analgesia and intraoperative anesthesia without the need for conversion to general or neuraxial techniques. Moreover, it is important to emphasize the role of appropriate sedation management. Indeed, the use of analgesic techniques allowed adequate sedation while minimizing the need for sedative agents. Importantly, all patients reported NRS scores below 4 at every perioperative assessment, confirming effective pain control. No anesthetic failures or conversions were required, further underscoring the feasibility and safety of this technique in frail patients with significant comorbidities.

Despite the mechanism of action and distribution of local anesthetics still unknown about ESP block, and although the population studied was small, we can confirm that this technique was successful in all patients. This success could be explained by the newest theory about ESP block. Considering the erector spine muscle is formed by three muscles (ilia rib muscle, longest muscle, and spinous muscle), each muscle is covered by a fascia that is in contact with the epidural space; indeed, the injection of a contrast agent in the erector spine plane causes diffusion through the epidural space.[24,25] Moreover, the spinal roots are also in contact with the erector spine fascia.[25]

The use of sitting positions also has its relevance. According to




NRS, Numeric Rating Scale; Post-op, postoperative.

**Figure 1.** Histogram description of pain scores.

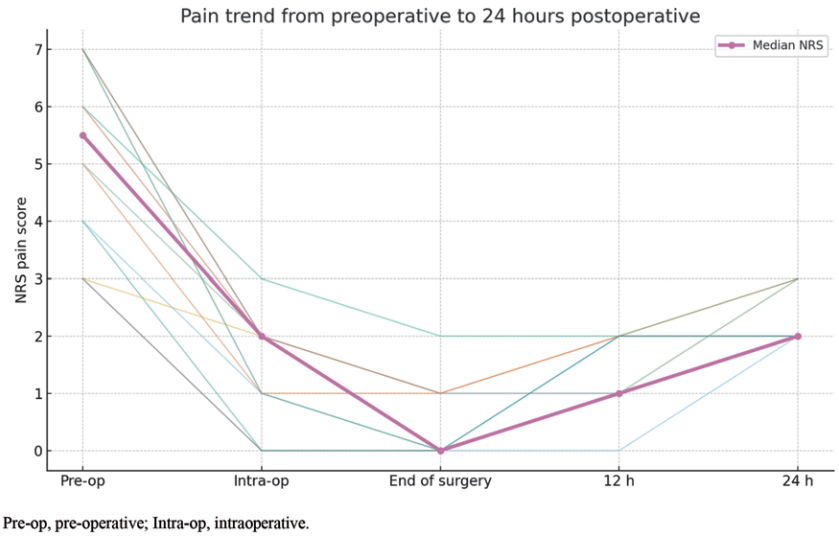



**Figure 2.** Trend graphical representation.

other studies, the sitting position is advantageous over the lateral position for ESP block primarily due to the anatomical effects of gravity and muscle dynamics.[26,27] In a seated position, higher erector spinae muscle tone and the downward hydrostatic pressure of the injected fluid promote a wider craniocaudal (head-to-foot) spread of the local anesthetic, which results in a significantly greater posterolateral sensory block.[26,27]

Additionally, we performed nerves such as femoral and fascial blocks like PENG to facilitate the sitting position during the execution of the ESP block, so patients had less pain during mobilization.

All patients were tested to have an effective diffusion of anesthetic into the dermatomes, interested in the surgical procedure and analgesia for a rather long period, exceeding our expectations despite everyone having an early motor recovery. The need for postoperative analgesia was strongly diminished; this helped us to avoid the use of potentially harmful drugs in frail patients, such as nonsteroidal anti-inflammatory drugs and opioids.

It is important to underline that elderly patient are more affected by post-operative delirium and postoperative cognitive dysfunction with a mortality of 7-10% and that pain, a too deep sedation (RASS<−1), and opioids consumption are recognized as risk factors for both of them;[28,29] controlling the pain with lower rescue drugs and with the use of local anesthetics could reduce the impact of postoperative delirium and postoperative cognitive dysfunction.

These findings highlight the feasibility and safety of this regional technique in frail patients with significant comorbidities and support our consideration as an alternative in selected high-risk populations.

Although the sample size is small, we believe that this study is of considerable interest, as it offers a valid alternative for patients undergoing femoral trauma surgery, in whom the timing of drug discontinuation or the need to adhere to diagnostic and therapeutic care pathways has often, in the past, precluded the use of neuraxial anesthesia techniques.

## Limitations

This study has several limitations. First, it is a retrospective case series with a small sample size (14 patients), which limits the generalizability of the findings and precludes definitive statistical conclusions. Second, the absence of a control group (*e.g.*, neuraxial anesthesia or general anesthesia) does not allow for direct comparisons of efficacy and safety. Third, the heterogeneity of patient characteristics, surgical procedures, comorbidities, and techniques and doses, due to the absence of a protocol regarding the nature of the study, may have influenced the pain scores and perioperative outcomes, reducing the impact of the analysis. Finally, the two patients with severe dementia were not assessed using an appropriate pain assessment scale for patients with advanced dementia; however, we also performed a descriptive analysis excluding these two patients.

## Conclusions

The ESP block could be a safety option for elderly patients undergoing hip repair. ESP block in combination with PENG or femoral blocks seems to control the pain in an effective and safe way. Considering the absence of a control group and the variability of the techniques, studies and randomized clinical controlled trials with robust design are needed to establish the real efficacy of these techniques.

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*Online supplementary material:*

*Supplementary Table 1. Description of cases and their characteristics and interventions.*

*Supplementary Table 2. Pain scores and intraoperative parameters.*

Received: 17 May 2026; Accepted: 27 July 2026.

Cristiano D'Errico: conceptualization; Fabrizio Fattorini, Simone Savino, Fioravante Giordano, Giorgio Ranieri, Rosanna Miccio, Renato Mazzarella, Raffaella Amato: data curation; Fabrizio Fattorini, Simone Savino, Alessandra Gentili: writing – original draft; Giorgio Ranieri, Rosanna Miccio, Renato Mazzarella: preparation and creation of tables and figures; Andrea Uriel de Siena: data analysis and assessment of compliance with the CARE guidelines; Antonio Coviello: writing – review & editing; Giuseppe Lubrano: supervision. All authors have read and approved the final version of the manuscript and agreed to be accountable for all aspects of the work.

Conflict of interest: the authors have no conflict of interest to declare.

Ethics approval and consent to participate: ethics approval was not required. Informed consent was obtained by all patients.

Availability of data and materials: all the recorded data are reported in the manuscript.