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Pericapsular Nerve Group (PENG) Block as Opioid-Sparing Postoperative Analgesia in a Geriatric Patient Undergoing Cemented Hip Hemiarthroplasty with Traumatic Intracerebral Hemorrhage and Right Bundle Branch Block: A Case Report

Sugeng Budi Santoso[1], Septian Adi Permana[1], Algi Iskandar[1*]

[1]Department of Anesthesiology and Intensive Care Therapy, Faculty of Medicine, Universitas Sebelas Maret/Dr. Moewardi Regional General Hospital, Surakarta, Indonesia

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Corresponding author:

Algi Iskandar

E-mail address:

algiiskandar6909@gmail.com

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A B S T R A C T

Introduction: Postoperative pain control in geriatric hip-fracture patients is challenging, and the challenge is magnified when neurological and cardiovascular comorbidities restrict the safe use of systemic opioids. Opioids, the analgesic standard, carry risks of respiratory depression, sedation, and hemodynamic instability that are particularly hazardous after intracranial hemorrhage and in cardiac conduction disease. The pericapsular nerve group (PENG) block is a sensory-selective, motor-sparing regional technique that may reconcile effective analgesia with these constraints.

Case presentation: A 64-year-old man presented after a 2-meter fall with a displaced closed right intertrochanteric femoral fracture (Boyd-Griffin II), minimal traumatic intracerebral hemorrhage (right frontal lobe, ICH score 0), and electrocardiographic right bundle branch block (RBBB). He was classified ASA III and underwent cemented hip hemiarthroplasty under general endotracheal anesthesia. A multimodal, opioid-minimizing strategy centered on an ultrasound-guided PENG block combined with intravenous paracetamol was implemented. Analgesia was effective, systemic opioid requirements were minimized, the Glasgow Coma Scale remained E4V5M6, and hemodynamic and neurological parameters stayed stable throughout the high-care postoperative period.

Conclusion: In a high-risk geriatric patient in whom opioids threatened both neuromonitoring and cardiac stability, a PENG block-centered multimodal regimen delivered reliable analgesia while preserving neurological assessability and hemodynamic stability. The PENG block is a safe, practical regional option for complex hip-fracture surgery and merits prospective study in comparably comorbid populations.

1. Introduction

Fragility fractures of the hip are among the most consequential injuries of older age. Approximately 1.6 million hip fractures occur worldwide each year, and with progressive population aging the global burden is projected to rise steeply over the coming decades. These injuries are not merely orthopedic events; they are sentinel markers of frailty that carry substantial excess morbidity and mortality. Large cohort analyses have shown that the early postoperative period after hip-fracture surgery is associated with considerably higher complication and death rates than elective hip replacement, underscoring the fragility of this population and the narrow physiological margins

within which they must be managed[1]. For most patients, surgical fixation or arthroplasty is the definitive treatment, and timely operation is associated with improved outcomes; the international HIP ATTACK trial and subsequent work have reinforced that the perioperative pathway—including pain control that permits early mobilization—is a central determinant of recovery[2].

Severe postoperative pain is a predictable feature of proximal femoral surgery such as hemiarthroplasty, and inadequately treated pain is far more than a comfort issue. It provokes a sympathetic stress response, impairs ventilation, delays ambulation, and is associated with delirium, thromboembolism, pneumonia, and prolonged hospitalization in older adults. The conventional analgesic backbone has been systemic opioids, yet opioids are double-edged in the geriatric patient: respiratory depression, excessive sedation, postoperative nausea and vomiting, ileus, and delirium are all dose-related hazards that disproportionately affect the elderly. These limitations have driven a decisive shift toward multimodal, opioid-sparing analgesia, in which regional techniques play a pivotal role in reducing opioid exposure after major joint surgery[3].

Against this background, the pericapsular nerve group (PENG) block has emerged as a particularly attractive regional option. First described by Girón-Arango and colleagues in 2018, the PENG block is an ultrasound-guided fascial-plane injection that deposits local anesthetic in the musculofascial plane between the psoas tendon and the iliopubic eminence, targeting the articular sensory branches that innervate the anterior hip capsule—principally branches of the femoral, obturator, and accessory obturator nerves[4]. Because these articular branches are the dominant nociceptive supply to the anterior capsule, the PENG block can provide potent analgesia for hip-region pain. Crucially, by sparing the main motor trunks of the femoral nerve it aims to preserve quadriceps strength, in contrast with femoral nerve or conventional fascia iliaca blocks, thereby supporting the early mobilization that is so important in preventing deconditioning, venous thromboembolism, and pulmonary complications in older patients[5,6]. Cadaveric and radiological injectate-spread studies have since clarified the anatomy of capsular coverage and the volume-dependence of spread, providing a mechanistic foundation for the technique[7,8].

The injury pattern in this patient also frames the surgical and anesthetic stakes. Intertrochanteric fractures of the proximal femur are extracapsular fractures that, when displaced, are typically managed operatively to restore stability and permit weight-bearing; in elderly patients with poor bone quality the choice between internal fixation and arthroplasty is influenced by fracture comminution, bone stock, and the goal of early, secure mobilization. A low Singh index, as seen here, reflects advanced proximal-femoral osteoporosis and a tenuous trabecular scaffold, which can compromise the purchase of fixation implants and favors a cemented prosthesis in selected cases. Cemented hemiarthroplasty offers immediate stability and reliable early ambulation, but the cementation step itself carries a distinct physiological hazard—bone cement implantation syndrome—characterized by hypotension, hypoxemia, arrhythmia, and, in severe cases, cardiovascular collapse. In a patient with an underlying conduction abnormality, this intraoperative vulnerability magnifies the importance of an analgesic plan that does not, in turn, add its own hemodynamic instability during the recovery period.

The management dilemma intensifies sharply when a hip-fracture patient carries comorbidities that themselves contraindicate liberal opioid use. In acute brain injury such as intracerebral hemorrhage (ICH), opioid-related sedation and respiratory depression are especially dangerous: hypoventilation raises arterial carbon dioxide, producing cerebral vasodilation and elevation of intracranial pressure, while opioid-induced obtundation confounds serial Glasgow Coma Scale (GCS) assessment—the very neurological monitoring on which safe management of an evolving hemorrhage depends. Analgesic plans in this setting must therefore preserve a clear sensorium. Similarly, in patients with cardiac conduction abnormalities such as right bundle branch block (RBBB),

perioperative hemodynamic stability is paramount; uncontrolled pain triggers tachycardia and hypertension that increase myocardial oxygen demand and the risk of ischemia and arrhythmia, whereas some systemic agents and neuraxial techniques can provoke hypotension or bradycardia that are equally hazardous. A regional technique that delivers strong, localized analgesia with minimal systemic and hemodynamic footprint is thus conceptually ideal for such patients.

A substantial and rapidly maturing evidence base now supports the analgesic efficacy of the PENG block in hip surgery. Multiple randomized controlled trials and several meta-analyses report reduced pain scores and lower opioid consumption after hip-fracture and total hip arthroplasty procedures, with a generally favorable preservation of motor function compared with the fascia iliaca compartment block[9-12]. Nevertheless, the great majority of this literature concerns relatively standard surgical populations. Reports describing the PENG block as the analgesic centerpiece in a single patient who simultaneously carries an acute intracranial hemorrhage and a cardiac conduction disorder—two conditions that independently argue against systemic opioids—remain scarce. This convergence of opioid-restricting comorbidities in a frail geriatric hip-fracture patient constitutes the novelty of the present report. The aim of this case report is to describe the rationale, implementation, and perioperative course of a PENG block-centered, opioid-minimizing multimodal analgesic strategy in a 64-year-old man undergoing cemented hip hemiarthroplasty complicated by minimal traumatic ICH and RBBB, and to situate this experience within the contemporary evidence on regional analgesia for high-risk hip surgery.

2. Case Presentation

Written informed consent was obtained from the patient for the anesthetic and surgical management and for the publication of this case report and the accompanying de-identified clinical images. All patient identifiers were removed and identifying regions of the radiological images were redacted to protect confidentiality.

A 64-year-old man (initials Tn. S) was brought to the emergency department after falling from a height of approximately two meters. He complained of pain in the right thigh and headache. There was a brief loss of consciousness immediately after the fall, but no vomiting and no seizures. He denied any history of hypertension, diabetes mellitus, or stroke. His body weight was 51 kg and height 155 cm, giving a body mass index of 21.2 kg/m².

On arrival he appeared moderately ill but was fully conscious, with a Glasgow Coma Scale of E4V5M6. Admission vital signs, as detailed in Table 1, were a blood pressure of 129/88 mmHg, heart rate 61 beats per minute, respiratory rate 19 breaths per minute, and peripheral oxygen saturation 97% on room air. Laboratory investigation on 19 April 2025 revealed leukocytosis (white-cell count 13,400/μL) and a random blood glucose of 173 mg/dL—the two values flagged in red in Table 1—while hemoglobin, hematocrit, platelet count, renal function, and the coagulation profile were within normal limits, and the blood group was B. The complete set of baseline clinical characteristics, vital signs, and key investigations is presented in Table 1.

Imaging defined the injury and its comorbid context, and the composite radiological findings are presented in Figure 1. As shown in Figure 1A, the chest radiograph demonstrated no cardiopulmonary abnormality. The anteroposterior pelvic and right femoral radiograph (Figure 1B) revealed a complete, displaced intertrochanteric fracture of the right femur classified as Boyd-Griffin type II. Non-contrast multislice computed tomography (MSCT) of the head, performed on 19 April 2025 and represented in Figure 1C, showed a small intracerebral hemorrhage in the right frontal lobe with an estimated volume of approximately 0.01 cc, together with multiple lacunar infarcts at the genu of the internal capsule bilaterally; the calculated ICH score was 0. The electrocardiogram recorded on 20 April 2025 showed sinus rhythm at 75 beats per minute with a normal axis and a positive right bundle branch block pattern, without evidence of hypertrophy or ischemia.

Table 1. Baseline clinical characteristics, admission vital signs, and key investigations of the patient.

Parameter	Finding
Age / Gender	64 years / Male
Anthropometry	51 kg, 155 cm (BMI 21.2 kg/m²)
Mechanism of injury	Fall from ≈2 m; transient loss of consciousness, no vomiting/seizure
Glasgow Coma Scale	E4V5M6 (total 15)
Blood pressure	129/88 mmHg
Heart rate	61 beats/min
Respiratory rate	19 breaths/min
SpO_2 (room air)	97%
White-cell count	13,400/µL (leukocytosis)
Random blood glucose	173 mg/dL
Hemoglobin / Hematocrit / Platelets	Within normal limits
Renal function / Coagulation	Within normal limits
Blood group	B
Chest radiograph	Heart and lungs unremarkable
Pelvis / femur radiograph	Complete displaced right intertrochanteric fracture, Boyd-Griffin II
Non-contrast head MSCT	Right frontal ICH (≈0.01 cc); multiple lacunar infarcts, bilateral genu of internal capsule
ICH score	0
Electrocardiogram	Sinus rhythm 75/min, normal axis, RBBB positive; no ischemia/hypertrophy
Singh index (proximal femur)	Grade IV (osteoporotic)
ASA physical status	III

Notes: Values in red denote results outside the reference range. BMI: body mass index; MSCT: multislice computed tomography; ICH: intracerebral hemorrhage; RBBB: right bundle branch block; ASA: American Society of Anesthesiologists; SpO_2: peripheral oxygen saturation.

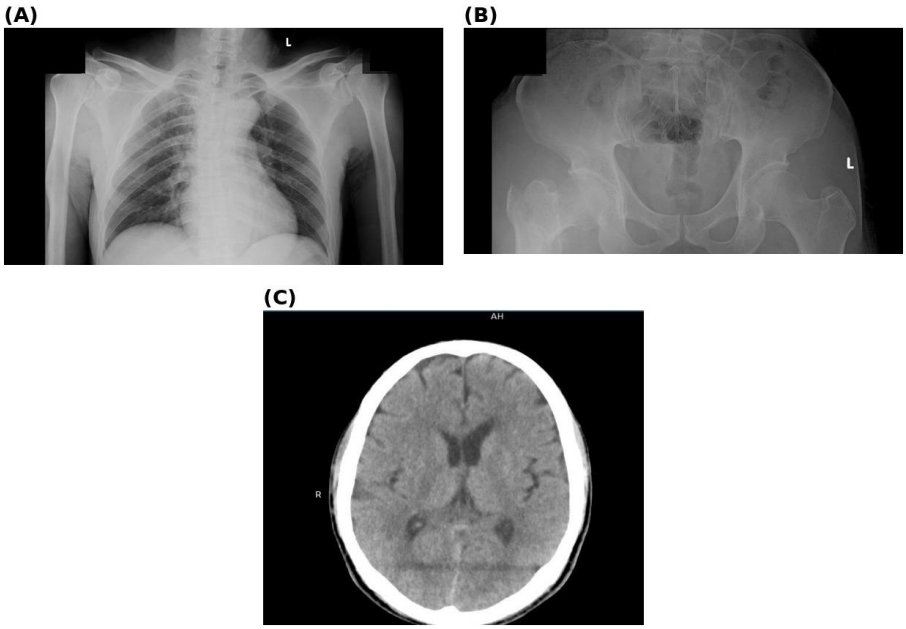

Figure 1. Admission imaging. (A) Chest radiograph showing no cardiopulmonary abnormality. (B) Anteroposterior pelvic radiograph demonstrating a complete, displaced intertrochanteric fracture of the right femur (Boyd-Griffin type II). (C) Representative axial slice of the non-contrast head MSCT; the sub-centimetre right frontal hemorrhage was identified on a separate slice. Patient identifiers have been redacted to preserve confidentiality.

Synthesizing these data, the preoperative diagnoses were: (1) closed intertrochanteric fracture of the right femur, Boyd-Griffin type II (ICD-10 S72.14), on osteoporotic bone with a Singh index of IV (M81.0); (2) cerebral observation for a ruled-out condition with GCS E4V5M6 and minimal traumatic ICH (R40.243); (3) right bundle branch block; and (4) leukocytosis. The patient was assigned an American Society of Anesthesiologists (ASA) physical status of III. The ICH score of 0 corresponds to a low predicted early-mortality risk, and the normal coagulation profile was reassuring both for the intracranial hemorrhage and for the safety of performing a fascial-plane regional block.

Management was deliberately multidisciplinary. The neurosurgical attending physician reviewed the intracranial findings and granted clearance for orthopedic surgery, recommending conservative treatment of the hemorrhage with mannitol (Totilac) 100 mL every 8 hours and close monitoring of the GCS, vital signs, and any lateralizing neurological signs. The cardiology attending physician emphasized that the RBBB on the electrocardiogram should be treated as a focus of vigilance throughout the perioperative period, prioritizing hemodynamic stability and avoidance of myocardial stress. On the basis of these consultations and the patient's overall profile, the anesthesia team planned general anesthesia with endotracheal intubation (GA-ETT). The orthopedic team planned a cemented right hip hemiarthroplasty with greater trochanteric fixation. Two units of packed red cells were prepared, and postoperative care was arranged in the high-care unit (HCU).

The analgesic plan was the crux of perioperative decision-making. Because both the intracranial hemorrhage and the conduction abnormality argued strongly against liberal systemic opioids, the anesthesia team designed a multimodal, opioid-minimizing regimen built around an ultrasound-guided PENG block supplemented with intravenous paracetamol. Under sterile conditions and real-time ultrasound guidance, the anterior inferior iliac spine, iliopubic eminence, and psoas tendon were identified, and local anesthetic was deposited in the fascial plane between the psoas tendon and the iliopubic eminence to bathe the articular branches supplying the anterior hip capsule, as captured on the intraprocedural sonogram shown in Figure 2. The needle trajectory toward this target plane is indicated in Figure 2. The technique was selected specifically for its capacity to deliver targeted capsular analgesia while sparing quadriceps motor function and exerting minimal systemic and hemodynamic effect.

Figure 2. Intraprocedural ultrasound image during the pericapsular nerve group (PENG) block. The dotted line indicates the planned needle trajectory toward the fascial plane between the psoas tendon and the iliopubic eminence, the target for local anesthetic deposition around the articular sensory branches of the anterior hip capsule.

Perioperative monitoring was structured around the patient's two principal vulnerabilities. Neurologically, serial assessment of the GCS and observation for any pupillary asymmetry, focal motor deficit, or other lateralizing sign were continued in parallel with the conservative anti-edema measure of intravenous mannitol, in keeping with the neurosurgical plan for an ICH score of 0 that did not warrant evacuation. Cardiovascularly, continuous electrocardiographic and blood-pressure monitoring were maintained to detect any new conduction disturbance, ischemic change, or hemodynamic instability, with particular vigilance during and immediately after cementation. The high-care unit was selected as the postoperative environment precisely because it permits this intensity of combined neurological and hemodynamic surveillance, and the analgesic plan was designed so that pain control would never come at the cost of the clarity of that surveillance.

The surgical procedure was completed as planned. In the postoperative period, the multimodal regimen centered on the PENG block provided effective analgesia: pain was well controlled, and systemic opioid requirements were minimized rather than relied upon as the primary modality. Neurological status remained reassuring, with the GCS maintained at E4V5M6 and no new lateralizing signs, allowing reliable serial neurological assessment unobscured by sedation. Hemodynamic parameters remained stable, with no episodes of significant tachycardia, hypertension, hypotension, or arrhythmia attributable to uncontrolled pain. The patient was monitored in the high-care unit in accordance with the preoperative plan, and his combined neurological and cardiovascular status remained stable throughout this period. Notably, the adverse events specifically anticipated and monitored for did not occur: there was no intraoperative bone cement implantation syndrome, no new conduction disturbance or ischemic change on electrocardiographic monitoring, and no postoperative neurological deterioration or new lateralizing sign. Detailed quantitative pain scores and opioid-dose tabulations were not formally recorded as part of this clinical case and are therefore reported qualitatively; the favorable course described here is consistent with, rather than proof of, a causal benefit of the block.

3. Discussion

Effective postoperative analgesia is a cornerstone of care after major orthopedic procedures such as hip hemiarthroplasty. Cemented hemiarthroplasty, frequently performed in elderly patients with proximal femoral fractures, produces severe pain that demands a multimodal strategy to facilitate early rehabilitation, reduce morbidity, and accelerate recovery. The complexity of pain management rises further in patients with significant comorbidities—such as traumatic brain injury and cardiovascular disease—because these conditions constrain the use of certain systemic analgesics on account of their potential adverse effects. In this context, the PENG block has been introduced as a promising regional modality offering a favorable safety profile for vulnerable patient populations. The present case illustrates how a PENG block-centered approach can resolve a genuine therapeutic conflict between the need for strong analgesia and the imperative to protect neurological monitoring and cardiac stability.

Anatomical and mechanistic basis of the PENG block

The PENG block, a relatively recent fascial-plane technique, targets the articular branches that innervate the anterior capsule of the hip joint—branches arising from the femoral, obturator, and accessory obturator nerves—without producing significant motor weakness of the thigh musculature[4]. Its mechanism involves deposition of local anesthetic in the plane between the iliopsoas tendon and the hip-joint capsule, immediately anterior to the superior pubic ramus and beneath the anterior inferior iliac spine. Anatomical and radiological injectate-spread studies have demonstrated that the extent of capsular and peri-capsular coverage is volume-dependent, and that larger volumes may extend spread beyond the intended target, which has implications for both efficacy and selectivity[7,8]. The principal advantage of the PENG block is its capacity to provide powerful

analgesia for the hip while preserving quadriceps strength, thereby enabling earlier mobilization and rehabilitation—an objective of particular importance in older adults, in whom immobility predisposes to deep vein thrombosis, pneumonia, pressure injury, and functional decline[5,6,13].

Efficacy and the contemporary evidence base

The analgesic efficacy of the PENG block in hip surgery is now supported by a coherent body of randomized and pooled evidence. Systematic reviews and meta-analyses of randomized controlled trials have consistently reported reductions in postoperative pain scores and in opioid consumption among patients undergoing hip surgery, including hip-fracture and total hip arthroplasty cohorts[9,11,12]. A recurring and clinically meaningful theme in head-to-head trials is that the PENG block provides analgesia comparable to the suprainguinal fascia iliaca block while better preserving quadriceps motor power, a difference that translates directly into the early-mobilization advantage so valuable in this population[10,14,15]. Representative trials and pooled analyses are detailed in Table 2, which juxtaposes the design, population, comparator, and principal finding of each study; as summarized in Table 2, the meta-analytic evidence converges on reduced opioid demand and lower pain intensity, while the randomized comparisons against the fascia iliaca block consistently report preserved quadriceps power. In elderly hip-fracture patients specifically, and as listed in Table 2, the PENG block has improved early pain control[16], and adjunctive strategies—such as combining the PENG block with a lateral femoral cutaneous nerve block, or extending its duration with liposomal bupivacaine—have been explored to broaden cutaneous coverage and prolong analgesia[17-19]. Trials in arthroplasty have additionally documented improvements in the quality of recovery and in patient-centered outcomes after a PENG block[20-23]. In hip-fracture cohorts specifically, randomized comparisons of the PENG block against the fascia iliaca block have reported at least equivalent perioperative analgesia, supporting the interchangeable—and in motor terms, advantageous—use of the PENG block in this setting[24]. Taken together, the literature converges on a consistent message: the PENG block reliably reduces opioid requirements and dynamic pain while imposing a smaller motor and systemic penalty than its main regional competitors, a balance of properties that is precisely what a frail, comorbid hip-fracture patient requires.

Table 2. Selected randomized controlled trials and meta-analyses of the pericapsular nerve group (PENG) block in hip surgery.

Study	Design	Population / Comparator	Principal finding
Yu et al., 2023	Meta-analysis of RCTs	Hip surgery; PENG vs comparators	Reduced opioid demand and lower pain intensity after surgery
Andrade et al., 2023	Meta-analysis of RCTs	Hip surgery; PENG vs fascia iliaca block	Comparable analgesia with better quadriceps preservation for PENG
Aliste et al., 2021	RCT	Total hip arthroplasty; PENG vs suprainguinal fascia iliaca	Similar analgesia; less motor block with PENG
Lin et al., 2023	Double-blind RCT	Elderly hip fracture; PENG vs control	Improved early dynamic pain control
Kim E. et al., 2023	Meta-analysis of RCTs	Total hip arthroplasty	Reduced pain scores and opioid consumption
Duan et al., 2023	RCT	Total hip arthroplasty; continuous PENG vs continuous FICB	Effective analgesia with preserved quadriceps strength
Mostafa et al., 2023	RCT	Hip arthroplasty; PENG vs control	Lower opioid use and improved analgesia

Notes: RCT: randomized controlled trial; PENG: pericapsular nerve group; FICB: fascia iliaca compartment block.

Bone cement implantation syndrome and the conduction-compromised heart

The decision to perform a cemented hemiarthroplasty added a specific intraoperative consideration that is inseparable from the analgesic strategy. Bone cement implantation syndrome can produce abrupt hypotension, hypoxemia, and dysrhythmia during prosthesis cementation, and a patient with right bundle branch block has a reduced conduction reserve with which to tolerate such an insult. In this clinical logic, every avoidable source of perioperative hemodynamic perturbation should be eliminated. Systemic opioids, with their potential for bradycardia, vasodilation, and respiratory depression, represent one such avoidable source; a regional block that controls pain without these effects therefore complements the broader goal of cardiovascular stability that begins intraoperatively and must be sustained into the recovery period. The uneventful hemodynamic course observed here, although it cannot be attributed to the PENG block alone, is at least consistent with a plan deliberately constructed to minimize cardiovascular stressors at every stage.

Postoperative delirium, cognition, and the opioid-sparing imperative

Beyond the immediate concerns of intracranial pressure and cardiac stability, opioid minimization carries a further benefit that is especially salient in older surgical patients: the mitigation of postoperative delirium and cognitive disturbance. Delirium after hip-fracture surgery is common, distressing, and independently associated with prolonged hospitalization, functional decline, and mortality, and both uncontrolled pain and opioid exposure are recognized precipitants. A regional technique that achieves adequate analgesia while reducing systemic opioid load may help to interrupt this cycle, and in a patient already under neurological surveillance for an intracranial hemorrhage, the capacity to keep the sensorium clear has the additional value of distinguishing a true neurological deterioration from drug-induced obtundation. The PENG block thus serves two overlapping purposes in this patient—protecting the injured brain and preserving cognition—through the same mechanism of opioid sparing.

Opioid minimization and the injured brain

In patients with traumatic brain injury, analgesic decisions must account for their impact on neurological status. Systemic opioids, although effective at relieving pain, can cause respiratory depression, sedation, nausea, and vomiting—each of which may obscure neurological evaluation and contribute to elevated intracranial pressure. Hypoventilation increases arterial carbon dioxide, driving cerebral vasodilation and a rise in intracranial pressure, while sedation degrades the reliability of serial GCS assessment that underpins the safe observation of an intracerebral hemorrhage. The PENG block offers a non-opioid alternative, or substantially reduces opioid requirements, thereby minimizing these undesirable neurological effects and permitting more accurate monitoring of mental status. By attenuating the stress response to pain, regional analgesia may also support intracranial homeostasis. In the present patient, this reasoning aligned precisely with the neurosurgical recommendation for vigilant GCS monitoring, and the preserved E4V5M6 status throughout the postoperative course is consistent with an analgesic plan that did not compromise the sensorium.

Hemodynamic stability and cardiac conduction disease

Comparable considerations apply to patients with cardiovascular disease. Opioids and other systemic anesthetic agents can precipitate hemodynamic disturbances—hypotension, bradycardia, or tachycardia—that may aggravate pre-existing cardiac conditions. Conversely, uncontrolled pain provokes an exaggerated sympathetic response with tachycardia and hypertension, increasing myocardial oxygen demand and the risk of ischemia and arrhythmia. Because of its localized action, the PENG block exerts minimal systemic hemodynamic effect, making it an attractive choice for patients with ischemic heart disease, heart failure, or conduction abnormalities. By reducing the need for systemic opioids, it can help maintain cardiovascular stability and lower the risk of

perioperative myocardial ischemia and arrhythmia. This profile is especially relevant in the setting of RBBB, where the anesthetic emphasis is on avoiding both the sympathetic surges of untreated pain and the abrupt hemodynamic shifts that can accompany neuraxial techniques or opioid boluses. The hemodynamic equanimity observed in this patient is congruent with the cardiology team's emphasis on stability.

Choosing among regional and general techniques

The selection of an anesthetic and analgesic strategy in geriatric hip-fracture surgery remains an individualized judgment. Comparative analyses of general versus regional anesthesia in this population have not established the unequivocal superiority of either approach for hard outcomes, reinforcing that the optimal technique depends on patient-specific risk[25]. Neuraxial techniques such as spinal anesthesia are widely used and effective for hip-fracture surgery[26], and even in patients with high cardiovascular risk, carefully titrated unilateral spinal anesthesia can be safe[27]; total intravenous anesthesia has likewise been applied successfully in geriatric patients with severe systemic disease[28]. In the present case, the team elected general endotracheal anesthesia for intraoperative airway control and operating conditions, and reserved the PENG block for targeted postoperative analgesia. This combination achieved a dual objective: optimal immobility and surgical conditions during the procedure, followed by a postoperative period characterized by controlled pain, a reliably assessable neurological status, and stable hemodynamics—exactly the priorities dictated by the coexisting ICH and RBBB. Within the broader movement toward opioid-sparing, regional-based pathways after joint surgery[3], this case exemplifies how a single well-chosen fascial-plane block can become the linchpin of a safe analgesic plan in a patient for whom the conventional opioid backbone is hazardous. The accumulated five-year experience with the PENG block supports its expanding role in precisely such complex scenarios[29-31].

It is worth making explicit why general anesthesia supplemented by a PENG block was preferred over a primary neuraxial approach in this particular patient, given that spinal anesthesia is otherwise a well-validated technique for hip-fracture surgery[25,26]. Although neuraxial anesthesia avoids airway instrumentation and reduces certain systemic exposures, it introduces sympatholysis that can cause clinically significant hypotension—poorly tolerated by a heart with limited conduction reserve and potentially additive to the hypotension of bone cement implantation syndrome. The sitting or lateral positioning required for spinal placement is also uncomfortable and hemodynamically provocative in a patient with an acutely painful displaced fracture, and in the context of an intracranial hemorrhage any procedure that perturbs intracranial pressure dynamics or cerebrospinal fluid pressure invites additional caution. A controlled general anesthetic secured the airway and provided stable operating conditions, while the PENG block supplied the postoperative analgesia that general anesthesia alone cannot, and did so without the sympathetic blockade of a neuraxial technique. This rationale is consistent with the observation that no single anesthetic modality is universally superior in geriatric hip fracture and that technique should be tailored to the dominant risks of the individual[27,28].

Performing the block: technique and timing considerations

The reliability of the PENG block depends on disciplined sonoanatomy and thoughtful timing. With a low-frequency curvilinear transducer placed obliquely over the anterior hip, the operator identifies the anterior inferior iliac spine laterally, the iliopubic eminence medially, the pulsatile femoral artery, and the overlying psoas tendon, and advances the needle in plane to deposit local anesthetic in the fascial pocket deep to the psoas tendon. Real-time visualization of an even fluid spread along this plane is the sonographic endpoint that predicts success and guards against intravascular or intramuscular injection. Volume matters: the injectate-spread literature indicates that capsular coverage increases with volume but that excessive volume risks proximal extension toward the femoral nerve and consequent

quadriceps weakness, so a measured volume that balances efficacy against selectivity is preferred[7,8,30]. Timing is equally consequential; performing the block before emergence allows the patient to recover into an already-analgesic state, smoothing the transition from general anesthesia and reducing the early opioid demand that is most likely to depress ventilation and obscure neurological assessment in the critical first hours after surgery.

Clinical implications and lessons learned

Several practical lessons emerge from this experience. First, the case demonstrates the value of treating the analgesic plan as a shared, multidisciplinary decision rather than an isolated anesthetic choice; the neurosurgical insistence on uninterrupted GCS monitoring and the cardiology emphasis on hemodynamic stability were not competing constraints but convergent arguments that both pointed toward opioid minimization, and a single regional technique was able to satisfy both. Second, the case highlights that a fascial-plane block can be deployed not merely as an analgesic adjunct but as the deliberate centerpiece of perioperative pain management when the usual opioid backbone is contraindicated. Third, it underscores the importance of selecting a block whose side-effect profile aligns with the patient's specific vulnerabilities: the motor-sparing character of the PENG block supports the early mobilization that protects against venous thromboembolism and pulmonary complications, while its negligible systemic footprint protects the conduction-compromised heart and the injured brain. Finally, the favorable course argues for incorporating ultrasound-guided regional analgesia into standardized, opioid-sparing care pathways for complex geriatric hip-fracture patients, with prospective documentation of pain scores, opioid consumption, mobilization, and delirium so that the impression of benefit can be tested rather than merely asserted.

Limitations

Several limitations warrant emphasis. First, as a single case report, these observations cannot establish efficacy or safety and are intended to be hypothesis-generating rather than confirmatory. Second, quantitative endpoints—serial numerical pain scores, cumulative opioid doses, and timed mobilization milestones—were not formally captured in this clinical encounter; the favorable course is therefore described qualitatively, and the absence of structured measurement is an acknowledged weakness. Third, the much-cited motor-sparing property of the PENG block is not absolute: scoping reviews have documented that quadriceps weakness can still occur, particularly with larger injectate volumes or proximal spread, so the technique should not be assumed to be uniformly motor-neutral[30]. Finally, definitive confirmation of the block's efficacy and safety in patients with this specific constellation of comorbidities will require prospective, adequately powered randomized trials, along with careful evaluation of injection technique, local-anesthetic volume and concentration, and comparison against alternative regional modalities such as the fascia iliaca or femoral nerve block[9,10]. With such evidence, the PENG block may further refine postoperative pain management for cemented hip hemiarthroplasty in patients with complex comorbidity, enabling faster and safer recovery.

4. Conclusion

Postoperative management of a geriatric hip-fracture patient with coexisting intracranial and cardiovascular comorbidities demands a carefully reasoned analgesic strategy. In this 64-year-old man with a displaced right intertrochanteric fracture, minimal traumatic intracerebral hemorrhage, and right bundle branch block, a PENG block embedded within a multimodal, opioid-minimizing regimen proved to be a safe and effective choice. The technique delivered satisfactory pain control, minimized systemic opioid exposure, and preserved both neurological assessability and cardiovascular stability during the high-care postoperative period. This experience supports the PENG block as a valuable regional analgesic option for high-risk patients undergoing hip surgery and underscores the need for prospective study in comparably comorbid populations.

Declarations

Ethics approval and consent to participate: This case report was conducted in accordance with the principles of the Declaration of Helsinki. Written informed consent was obtained from the patient for anesthetic and surgical management and for the use of his de-identified clinical data and images for educational and publication purposes. This case report was prepared in accordance with the CARE guidelines.

Consent for publication: Written informed consent for publication of this case report and the accompanying de-identified images was obtained from the patient. All patient identifiers have been removed, and identifying regions of the radiological images have been redacted to protect confidentiality.

Availability of data and materials: The clinical data supporting the findings of this case report are available from the corresponding author upon reasonable request, subject to institutional confidentiality requirements.

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

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Authors' contributions: All authors contributed to the clinical management of the patient, the conception of the report, drafting and critical revision of the manuscript, and approved the final version for submission.

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