

# Use of Local Anesthesia Combined with Monitored Anesthesia Care in Cephalomedullary Nailing for Proximal Femoral Fractures: A Minimally Invasive Approach for High-Risk Surgical Candidates

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## Abstract

**Background:** Proximal femoral fractures are among the most common orthopedic injuries in the elderly population, and often pose serious challenges due to multiple comorbidities and the high anesthetic risk in this population. Traditional management typically involves spinal or general anesthesia, which can lead to considerable risk of morbidity and mortality in these high-risk patients. This study aimed to assess the efficacy and safety of local anesthesia combined with monitored anesthesia care as an alternative to general anesthesia in elderly patients with intertrochanteric fractures.

**Methods:** In this retrospective descriptive study, we included patients aged  $\geq 65$  years with displaced intertrochanteric fractures who underwent cephalomedullary nailing under local anesthetic infiltration with monitored anesthesia care. Data were collected on demographics, safety outcomes (complications and mortality), and efficacy measures (surgical time, blood loss, anesthesia induction-to-incision time, and length of stay). Data were analyzed using descriptive statistics. Continuous variables are reported as mean  $\pm$  standard deviation, and categorical variables as frequencies and percentages. No inferential statistics were performed because of the descriptive nature of the study.

**Results:** A total of 35 patients met the inclusion criteria, with a mean age of 76.6 years. Major complications occurred in 6 patients (17.1%), with a 90-day mortality rate of 2.8%. "The mean blood loss was  $108 \pm 35$  cc, surgical time averaged  $33.6 \pm 9.7$  minutes, anesthesia induction-to-incision time was  $6.4 \pm 1.7$  minutes, and the mean length of hospital stay was  $2 \pm 0.9$  days."

**Conclusion:** Local anesthesia with monitored anesthesia care may be a feasible and safe alternative for high-risk patients with proximal femur fractures when general or spinal anesthesia is contraindicated. This approach decreases morbidity and mortality rates while effectively reducing length of hospital stay and surgical time.

**Keywords:** Local anesthesia, Monitored anesthesia care, Proximal femur fracture, Intertrochanteric fracture, Cephalomedullary nailing, Elderly patients

**Conflicts of Interest:** None declared

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## Introduction

Proximal femoral fractures are among the most common orthopedic injuries, particularly in the elderly population (1). Managing these fractures is often challenging because of the elevated risks related to surgery and the high prevalence of comorbidities in this age group (2). As a result, these injuries are associated with considerable mortality, with in-hospital death rates of around 10% and a one-year

mortality rate of approximately 35% (1, 3).

Intertrochanteric (IT) fractures represent a major subset of proximal femur fractures (4). The traditional approach to these fractures usually involves cephalomedullary nailing performed under general anesthesia, which can lead to a significant risk of complications in patients with significant comorbidities, including pulmonary, cardiovascular,

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### ↑What is "already known" in this topic:

General and spinal anesthesia for proximal femur fractures in high-risk patients are associated with increased morbidity and mortality.

### →What this article adds:

This study supports the efficacy and safety of local anesthesia with MAC as a viable alternative, reducing complications and hospital stays.

or renal dysfunction (5-7). Thus, identifying less invasive anesthetic techniques to minimize peri- and post-operative complications is essential (5).

Local anesthesia through soft-tissue infiltration combined with Monitored Anesthesia Care (MAC) provides a minimally invasive alternative approach for cephalomedullary nailing of proximal femur fractures (8, 9). This approach can help maintain hemodynamic stability, reduce recovery time, and lower the incidence of postoperative complications compared to general anesthesia (8, 9). By avoiding the systemic effects of general anesthesia, this technique is particularly useful for medically complex patients who are unlikely to tolerate the physiological stress of intubation, mechanical ventilation, and the related perioperative risks (8, 9). However, published evidence on the safety and efficacy of this approach remains limited, with only a small number of studies available (8, 9).

This current study investigates the use of local anesthetic infiltration with MAC for the surgical fixation of intertrochanteric fractures in elderly patients for whom general anesthesia is linked to a high risk of morbidity and mortality. The primary goal was to assess the safety and efficacy of this technique as an alternative to general anesthesia.

### Methods

This was a retrospective observational study conducted at our tertiary referral hospital. Written informed consent was obtained from all patients and their families before their inclusion in the study, and all ethical principles and guidelines were followed throughout the trial. Between 2020 and 2023, elderly patients presenting to our tertiary care center with intertrochanteric fractures who underwent cephalomedullary nailing under local anesthetic infiltration with MAC were included in this work. Due to ethical considerations, a control group was not included. All enrolled patients were specifically deemed unfit for general or spinal anesthesia, and assigning them to such interventions would have constituted a violation of ethical standards and patient safety. This study adhered to the STROBE guidelines for observational research. As a retrospective case series, no prior sample size calculation was performed. The main limitation includes the lack of a control group and the potential for selection bias, given that only patients with contraindications to general or spinal anesthesia were included. Confounding factors were not controlled due to the descriptive nature of the study, and no inferential statistics were applied. Inclusion criteria were age 65 years and older, OTA classification 31-A1 and 31-A2, a high risk of morbidity and mortality with general or spinal anesthesia, American Society of Anesthesiologists (ASA) class  $\geq 3$ , and a minimum follow-up of 90 days. Patients with neurological impairments interfering with recovery or assessment (e.g., severe dementia), known bleeding disorders, patients without contraindications to general or spinal anesthesia, and patients allergic to the anesthetic agents were excluded from the study. Thirty-five patients who met the study criteria were assessed.

All procedures were performed by one orthopedic surgeon (MA) in the same medical center. A Gamma nailing

system was used to fix displaced intertrochanteric fractures. Local anesthetic infiltration usually involves the administration of 1% lidocaine (1%) and bupivacaine (0.25%) at the surgical site. Lidocaine was administered at a dose of 5 mg/kg and bupivacaine at 2 mg/kg, providing adequate analgesia during the procedure while minimizing the risk of toxicity. Soft-tissue infiltration was guided by C-arm fluoroscopy at the following locations: the skin incision site, posterior and anterior to the fracture site, and at the insertion site for the blade and screw (Figure 1). MAC was provided by an anesthesiologist to monitor vital signs and maintain patient comfort, typically including supplemental oxygen and intravenous sedatives such as fentanyl or midazolam as needed, and patients were stable during surgery. To minimize surgical time and reduce bleeding, pain, and radiation exposure during fluoroscopy in the initial stages of cephalomedullary nailing, a slightly modified technique is employed in patients with severe osteoporosis. After choosing the appropriate nail size based on the individual patient's medullary canal, the pro-

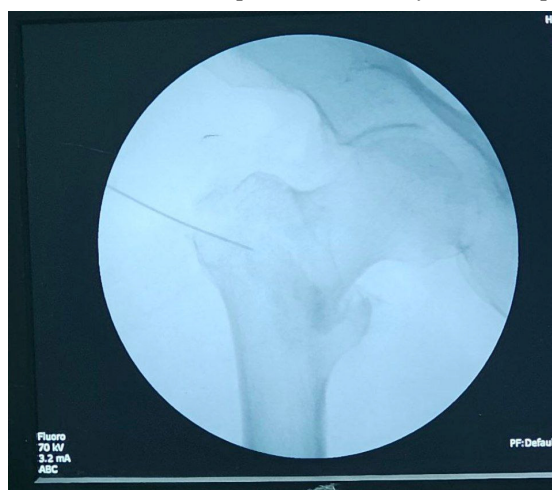


Figure 1. Soft-tissue infiltration of the local anesthetic solution under C-arm fluoroscopy guidance to ensure accurate placement and optimal pain control

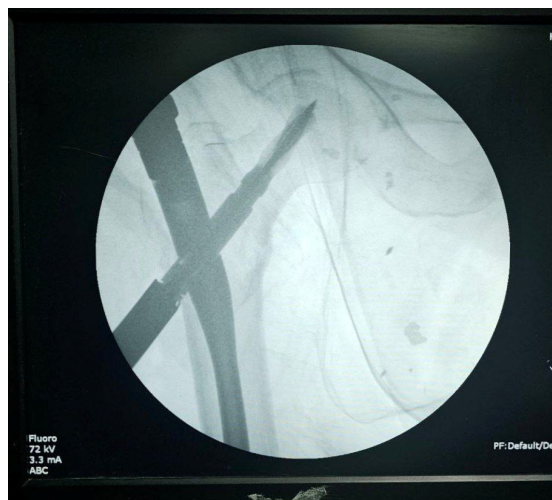


Figure 2. Fixation of fracture site without reaming

cedure begins with the tip of the nail, pushed with the pressure of the hand, rather than the traditional starting point of the awl and ream. Under continuous C-arm fluoroscopic guidance, the nail tip is carefully introduced into the medullary canal (Figure 2).

### Data collection

Clinical data were obtained retrospectively by reviewing the patient's charts and included demographics, safety, and efficacy data. Demographic variables included age, sex, body mass index, American Society of Anesthesiologists classification (ASA), preoperative heart ejection fraction, and comorbidities such as cerebrovascular accident (CVA) and diabetes history. Safety data included surgical complications and 90-day mortality. Complications were classified as minor and major. Minor complications included mild wound infections managed conservatively with antibiotics, superficial hematoma at the surgical site, postoperative nausea or vomiting, transient hypotension or bradycardia managed with medication adjustments, minor respiratory disturbances, such as mild hypoxia corrected with supplemental oxygen, pain at the surgical site beyond typical expectations, requiring additional analgesics, and mild urinary retention that resolves with a short-term catheter. Major complications included deep wound infections or osteomyelitis needing surgical debridement, significant hematoma needing drainage, respiratory complications like pneumonia or acute respiratory distress syndrome (ARDS), severe cardiovascular events such as myocardial infarction, pulmonary embolism, or stroke, prolonged hypotension or arrhythmia needing intensive care, or death related to the surgical procedure or anesthesia. Efficacy data included the surgical time, blood loss, length of hospital stay, and anesthesia induction to incision time.

### Statistical Analysis

This study was descriptive and retrospective in nature. Continuous variables such as age, body mass index, surgical time, blood loss, and length of hospital stay are presented as mean  $\pm$  standard deviation. Categorical variables, including sex, ASA class, and complications, are reported as frequencies and percentages. No inferential statistical tests were performed because of the descriptive design of the study. All analyses were carried out using SPSS software (IBM Corp., Armonk, NY, USA).

## Results

### Demographic data

A total of 35 patients, with a mean age of  $76.6 \pm 7.7$  years (range 65-91), were included in the study. The study population included 18 (51.4%) males and 17 (48.6%) females. Eighteen (51.4%) patients were diabetic. Six (17.1%) patients had a CVA history. Four (11.4%) patients had renal disease. Two (5.7%) patients had pulmonary disorders. The mean preoperative heart ejection fraction was  $22.7 \pm 3.7$  (range 15-30). The baseline characteristics of the patients are summarized in more detail in Table 1.

### Safety evaluation

Complications occurred in 18 (51.4%) patients and included 12 (34.3%) minor and six (17.1%) major complications. Only one death occurred during the 90-day follow-up of the patients. Accordingly, the 90-day mortality rate was 2.8%. This death occurred four days after the operation in the ICU. The patient had a severe underlying condition and died of intestinal obstruction.

### Efficacy evaluation

The mean blood loss of the patients was  $108 \pm 35$  cc (range 50-200). The mean surgical time was  $33.6 \pm 9.7$  min (range 15-50 min). The mean duration from induction of anesthesia to incision was  $6.4 \pm 1.7$  min (range 3-10). The mean length of hospital stay was  $2 \pm 0.9$  days (range 1-4). The safety and efficacy data are summarized in Table 2.

## Discussion

Many elderly patients with significant comorbidities cannot undergo general anesthesia safely, as it often involves signing high-risk consent forms acknowledging a significant risk of perioperative mortality (10). This level of risk usually led family members to refuse the procedure out of fear of potential mortality. Consequently, these patients often went untreated in our center, facing severe complications such as pulmonary embolism, rapid onset of pressure ulcers within days, or other life-threatening

Table 1. Baseline characteristic features of patients with an intertrochanteric fracture managed by local anesthesia with monitored anesthesia care

Variable	Mean $\pm$ SD or number (%)
Age (year)	76.6 $\pm$ 7.7
Sex	Male 18 (51.4)
	Female 17 (48.6)
Body mass index (kg/m <sup>2</sup> )	25.2 $\pm$ 3
ASA class	18 (51.4)
	III 17 (48.6)
	IV 22.7 $\pm$ 3.7
Heart ejection fraction	18 (51.4)
Diabetes (Yes)	6 (17.1)
CVA history (Yes)	4 (11.7)
Renal Disease (Yes)	2 (5.7)
Pulmonary disease (Yes)	

SD: standard deviation; ASA: American Society of Anesthesiologists; CVA: Cerebrovascular Disease

Table 2. Safety and efficacy of local anesthesia with monitored anesthesia care in patients with an intertrochanteric fracture undergoing cephalomedullary nailing

Variable	Mean $\pm$ SD or number (%)
Complications	Minor 12 (34.3)
	Measure 6 (17.1)
Death	1 (2.8)
Blood loss (cc)	108 $\pm$ 35
Surgical time (min)	33.6 $\pm$ 9.7
Anesthesia induction to incision time (min)	6.4 $\pm$ 1.7
Length of hospital stay (days)	2 $\pm$ 0.9

conditions that virtually guarantee a poor outcome without surgery (11). In response to this issue, we adapted an alternative approach to address this issue by utilizing local anesthesia with MAC for these high-risk patients. Our findings show that this technique is safe and effectively reduces anesthesia risks while also ensuring family members feel secure enough to consent to treatment.

Traditionally, proximal femoral fractures in elderly patients are repaired under general or spinal anesthesia. In a study by Loncaric-Katusin et al., the 30-day mortality rates among patients receiving general or spinal anesthesia were 10.4% and 10.5%, respectively, with an average hospital stay of around 12 days (12). Among very elderly patients, mortality rates can be even higher; Heuer et al. reported a 22.2% mortality rate during in-hospital care for patients over 90 years old (13, 14). The postoperative complication rate is up to 28%, with pneumonia being the most common complication (15). Among patients managed with general anesthesia, the approximate surgical and anesthesia times were reported to be 55 minutes and 86 minutes, respectively (16). In the present study, only one death occurred during a hospital stay (2.9%). The overall rate of major complications was 17.1%. These results suggest that the use of local anesthetic infiltration with MAC may provide a safer alternative for high-risk patients, while also shortening operative and anesthesia times and reducing hospitalization length.

Several investigations have aimed to address the morbidity and mortality associated with general anesthesia in patients with proximal femur fractures and high anesthetic risk. Peripheral nerve blocks have often been employed as alternatives to general anesthesia in these patients (17-20). Although this approach substantially reduced morbidity and mortality (17-19, 21), it requires more technical expertise and specialized training, which may not be universally available. However, local anesthesia infiltration is relatively simple to administer in every setting and does not require extensive experience or preparation.

To date, only a few studies have evaluated the efficacy of local anesthesia infiltration combined with MAC as an alternative to general anesthesia for the fixation of proximal femur fractures in medically complex patients. Bi et al. in 2018 described a technical approach method for the surgical management of hip fractures applying a short cephalomedullary nail. They used this approach for the management of proximal femoral fractures in 32-year-old male patients with multiple comorbidities, including end-stage renal disease, congestive heart failure, tricuspid regurgitation, and severe pulmonary hypertension. No medical complications occurred during the hospital stay. Also, the one-year follow-up of the patient was event-free (9). More recently, in 2023, Testa et al. compared the safety and efficacy of local anesthesia infiltration with MAC against general and spinal anesthesia. The findings showed that the local anesthesia group had significantly shorter surgery and reduced anesthesia induction-to-incision times compared to the other groups. Additionally, this group demonstrated a trend toward decreased need for vasopressors during surgery and fewer cases of postoperative delirium (8). These findings, in line with the results of

the present study, support the safety and efficacy of local anesthesia with MAC as the alternative anesthetic option for high-risk patients with proximal femur fractures.

The present study had several limitations. The primary limitation was its retrospective design and the small sample size. Additionally, the absence of a control group receiving alternative anesthetic approaches, such as general or spinal anesthesia, further limits the study's conclusions. Therefore, future controlled, prospective randomized studies with larger patient populations are necessary to better assess the value of this anesthetic method for high-risk patients with proximal femur fractures. Given the absence of a control group and the descriptive nature of this report, the findings should be interpreted cautiously. While these results may guide clinicians managing similar high-risk patients, they do not establish definitive evidence for practice change and should be viewed as hypothesis-generating.

### Conclusion

Local anesthesia combined with MAC is a safe alternative to general or spinal anesthesia for managing patients with proximal femur fractures who are at high risk for anesthesia complications. This approach not only results in lower rates of morbidity and mortality but also effectively reduces surgical time and length of hospital stay. Therefore, we recommend this anesthetic strategy for patients for whom general or regional anesthesia poses significant risks.

### Authors' Contributions

Mikael Hajializadeh (MH) conceived and designed the study, performed the surgeries, collected the data, analyzed the results, and wrote the main manuscript text. MH also prepared all the figures. MH reviewed and approved the final manuscript.

### Ethical Considerations

This study was conducted in accordance with the ethical standards of our institutional review board and the 1964 Helsinki Declaration and its later revisions. The research protocol was reviewed and approved by the Ethics Committee of Iran University of Medical Sciences (IR.IUMS.REC.1404.574).

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### Conflict of Interests

The authors declare that they have no competing interests.

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