

# X-Ray-Guided Spinal Anaesthesia for a Complex Patient Undergoing Intramedullary Fixation of Atypical Subtrochanteric Femur Fracture

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## Abstract

While current evidence suggests that the choice between spinal and general anaesthesia for neck of femur fracture patients does not significantly affect overall mortality or most major perioperative outcomes, there remains a need for the trauma anaesthetist to tailor their technique to the individual patient. We report on the use of a C-arm fluoroscopy-guided spinal anaesthetic in a neck of femur fracture patient who was at high risk for general anaesthesia and had background bilateral sciatica, a condition increasing the risks of neurological injury associated with procedural failure and multiple attempts at a landmark approach. Chronic pain anaesthetists with expertise in C-arm fluoroscopy for spinal interventions are well placed to train colleagues and widen competence in this technique.

## Keywords

X-Ray-Guided Spinal Anaesthesia, Fluoroscopy-Guided Spinal Anaesthesia, Trauma Anaesthesia, Neck of Femur Fracture, Frailty

## 1. Introduction

Hip fractures are among the most common injuries in the elderly population in the UK. These injuries significantly impact the patient's quality of life and impose a substantial financial burden on the NHS. NICE and British Orthopaedic Association guidelines recommend that hip fracture surgeries be performed on the day of injury or within 36 hours, provided that correctable physiological disturbances such as anaemia, electrolyte imbalances, and exacerbations of airway disease are

addressed [1].

Based on a robust systematic review, spinal anaesthesia has been shown to be more effective than general anaesthesia in preventing acute kidney injury in patients undergoing hip fracture surgery. However, the risks of mortality, delirium, pneumonia, hypotension, and acute coronary syndrome appear similar for both types of anaesthesia [2]. Spinal anaesthesia, while generally preferred, can be particularly challenging in the elderly due to anatomical changes such as thickening of the supraspinous ligament and reduced interspinous space, which contribute to higher failure rates [3] [4]. In addition to pre-procedural ultrasound scanning, fluoroscopic techniques can also aid spinal anaesthesia. We present here the case of a medically complex lady in her seventies who underwent X-ray-guided spinal anaesthesia for hip fracture surgery.

## 2. Case Presentation

This elderly lady in her late seventies presented for Left Femur Long Trochanteric Fixation Nail Advanced (TFNA) surgery with cable and bone grafting following a fall in a supermarket that resulted in a left femur fracture. Given her previous history of colorectal cancer treated with chemotherapy and surgery in 2021, the consultant orthopaedic surgeon deemed it necessary to postpone the surgery to investigate further, suspecting a pathological fracture. They requested a computed tomography scan of the thorax, abdomen, and pelvis (CT-TAP) to exclude the possibility of cancer recurrence. The CT scan revealed bilateral pleural effusions with adjacent subsegmental basal atelectasis, a 5.6-mm nodule in the right middle lobe, and a 1.3 cm consolidation patch in the right middle lobe, raising concerns about her respiratory status.

These findings highlighted the importance of a careful anaesthetic plan, particularly to avoid general anaesthesia, which could exacerbate her respiratory conditions. The comprehensive imaging also provided valuable information on the patient's overall health, helping to guide the anaesthetic approach.

## 3. Medical Background

The patient's medical history was significant for adenocarcinoma of the rectum (treated in 2021 with chemotherapy and surgery, resulting in a left colostomy), bronchiectasis with recurrent chest infections, hypothyroidism, osteoporosis, spondylosis, bilateral sciatica secondary to disc prolapses at L3-4 and L4-5, osteoarthritis, and previous surgeries including hysterectomy and haemorrhoidectomy. She was frail and on multiple medications, including Levothyroxine, Omeprazole, Adcal, Paracetamol, and Lactulose, with no known drug allergies.

## 4. Assessment, Optimisation and Consent

The patient underwent a thorough pre-operative assessment, including routine blood tests. Given her complex medical history, including respiratory compromise indicated by the CT findings, we deemed general anaesthesia too risky. The

presence of pleural effusions, atelectasis, and the lung nodule further complicated the decision-making process. We also considered landmark or even an ultrasound-guided spinal anaesthetic to be risky due to the potential for failure and nerve damage, particularly given her bilateral sciatica. After an in-depth discussion of the risks and benefits, a shared decision was made to proceed with a combination of ultrasound-guided femoral and lateral cutaneous nerve blocks and X-ray-guided spinal anaesthesia. The involvement of a consultant anaesthetist with a pain medicine background and therefore expertise in X-ray-guided procedures was crucial, as this approach was expected to maximise first-pass success and minimise complications. Other more advanced regional options, such as a combined spinal epidural, were not chosen due to the higher incidence of complications, the procedure being technically more challenging, and the potential for increased pain arising from being kept in the lateral position with the fractured hip down for a longer period of time.

## 5. Interventions

### Monitoring

We used standard AAGBI monitoring, including pulse oximetry, non-invasive blood pressure monitoring, 3-lead ECG, end-tidal capnography via a capnomask, and temperature and urine output monitoring. We placed an 18-gauge intravenous cannula alongside two pre-existing 20-gauge cannulae. We calculated the maximum allowable dose of local anaesthetic and divided it between the spinal anaesthesia and nerve blocks.

### Performance of regional anaesthesia

In the anaesthetic room, we successfully performed ultrasound-guided femoral and lateral cutaneous nerve blocks. We administered a dose of 0.25 mg/kg ketamine as sedoanalgesia, taking into account the patient's chronic back pain. Ketamine was chosen for its potent analgesic properties and preservation of respiratory drive at the dose chosen, an important consideration in view of the patient's respiratory compromise. We positioned the patient in the left lateral decubitus position on the operating table. To optimise ergonomics and imaging, we positioned the C-arm below the patient, providing the best possible view of the interlaminar space. We took X-rays and adjusted the C-arm to obtain a "gun-barrel" view of the needle entry, ensuring precise placement into the spinal canal. A recreated demonstration of the setup used in the case is shown in **Figure 1**. The operator chose a paramedian approach to bypass the thickened interspinous ligaments, which can complicate midline approaches in patients with challenging anatomy. Under full sterile precautions, spinal anaesthesia was successfully performed on the first attempt. The patient was kept in the lateral position for two minutes post-injection before being repositioned supine for the surgery. We confirmed the block height and the procedure was able to commence. During the surgery, the proximal lag screw initially missed the nail, necessitating a repeat attempt, which extended the surgery duration to over two hours.



**Figure 1.** Demonstration of the ergonomics and C-arm orientation used for this X-ray-guided spinal anaesthetic. Both the patient and the anaesthetist in this figure are actors.

X-ray-guided spinal anaesthesia involves using fluoroscopy to obtain a precise “gun-barrel” view of the needle entry into the interlaminar space. By optimising the C-arm positioning, the anaesthetist can accurately visualise the needle’s trajectory as it passes through the tissues into the spinal canal. The paramedian approach, often preferred in cases with difficult anatomy, allows the needle to bypass thickened ligaments that may impede a midline approach. This method provides real-time feedback, enabling the anaesthetist to make immediate adjustments, thereby increasing the likelihood of a successful first attempt and reducing the risk of complications associated with multiple needle passes.

## 6. Discussion

Traditionally, spinal anaesthesia has been performed using a landmark technique, often resulting in a first-pass success rate between 60% and 70% [3]. More recently, pre-positional spinal ultrasound has gained popularity for improving first-pass success rates, with studies showing a 79% reduction in failure when ultrasound guidance is used [5]. Perlas *et al.* also reported a 49% reduction in the risk of spinal anaesthesia failure when ultrasound was used [6]. However, real-time ultrasound-guided spinal anaesthesia has not been widely adopted, partly due to concerns about the potential introduction of ultrasound gel into the subarachnoid space, which could lead to complications [7]. Moreover, even with ultrasound guidance, the first-pass success rate has been reported to be around 87%, leaving room for improvement, particularly in patients with complex anatomies [8].

In the present case, we deemed general anaesthesia to be risky due to the patient’s respiratory issues, including pleural effusions, bronchiectasis, basal atelec-

tasis, consolidation, and a lung nodule requiring further investigation. Landmark-based spinal anaesthesia also posed significant risks, particularly the possibility of multiple attempts exacerbating her pre-existing bilateral sciatica and increasing the risk of meningitis. X-ray-guided spinal anaesthesia was chosen to mitigate these risks, offering a safer and more controlled approach, especially in a lateral position.

The use of X-ray guidance in spinal anaesthesia, though less common, is supported by a few case reports and studies. For instance, in 2022, Omodu *et al.* published a case series of seven patients at a single centre in Nigeria who had predicted difficult spinal anaesthesia and underwent successful subarachnoid block using C-arm fluoroscopy [9]. Another study by Berde *et al.* reported on six patients with prior posterior spinal fusion who underwent lumbar punctures using a combination of ultrasound and C-arm fluoroscopy guidance [10]. These reports highlight the potential of fluoroscopy-guided spinal anaesthesia in complex cases, particularly when performed by anaesthetists skilled in X-ray-guided procedures.

While the use of ionising radiation in spinal anaesthesia is not without risks, including potential side effects such as burns, genetic mutations, and tumourigenesis, these risks can be minimised with careful planning and appropriate precautions. The “ALARA principle” (keeping radiation exposure “As Low As Reasonably Achievable”) was followed throughout this procedure. The increasing age of the UK population suggests that anatomically challenging spinal anaesthetics will become more common, making it essential to expand training in fluoroscopy-guided techniques for trauma and regional anaesthesia specialists. Increasing inter-specialty collaboration between trauma anaesthetists and pain medicine experts is likely to be highly valuable. This approach could improve outcomes for patients with complex anatomies, ensuring safer and more effective anaesthetic management.

## 7. Patient Perspective

When followed up post-operatively, the patient described a very positive experience of the X-ray guided spinal procedure and the intra-operative analgesia it provided, highly praising the entire theatre team involved in her perioperative care.

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## Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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