



# Effective protocol for continuous pericapsular nerve group block in femur fracture patients undergoing hip surgery: two case reports

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Pericapsular nerve group (PENG) block was introduced as an effective way to control postoperative pain in patients who have undergone hip surgery. Therefore, we would like to discuss how to perform PENG block accurately on the basis of two cases, both of which involved hip fracture patients. Ultrasound-guided continuous PENG block was performed, and postoperative pain was adequately controlled in both cases. To mount the catheter in the correct position, it should be inserted after the needle enters at the lowest angle possible. If it is confirmed that the psoas tendon is pushed upward without an increase in injection pressure during drug injection, an accurate continuous PENG block has been achieved. We also analyzed fluoroscopic images to determine how the drug spread, and we observed that the drug spread around the hip capsule along the iliacus and psoas muscle.

**Keywords:** Case reports; Hip fractures; Nerve block; Pain, postoperative; Pericapsular nerve group block

## Introduction

Most patients with femur fractures are older and have comorbidities, putting them at a higher risk of complications after surgery [1,2]. Therefore, appropriate postoperative management is crucial for speeding up recovery and improving prognosis [3]. Pain management plays a pivotal role in postoperative care, necessitating continuous monitoring and proper control to achieve Enhanced Recovery After Surgery [3,4]. With adequate pain control, we can facilitate early ambulation, mobilization, and rehabilitation, ultimately reducing complications and expediting recovery [5].

Traditionally, femoral nerve block or fascia iliaca com-

partment block have been employed to manage pain in hip surgery patients [6,7]. However, these blocks can sometimes lead to muscle weakness, and nerves may branch at a level higher than the level at which the block is performed, resulting in an incomplete block [8-10].

Recently, the pericapsular nerve group (PENG) block has emerged as an effective method for postoperative pain control in hip fracture patients [6,10]. Yet, the precise ultrasound pattern and drug distribution during accurate continuous PENG blocks have not been clearly elucidated. Therefore, we aim to present ultrasound and fluoroscope image findings from successful cases of continuous PENG block, shedding light on its efficacy.

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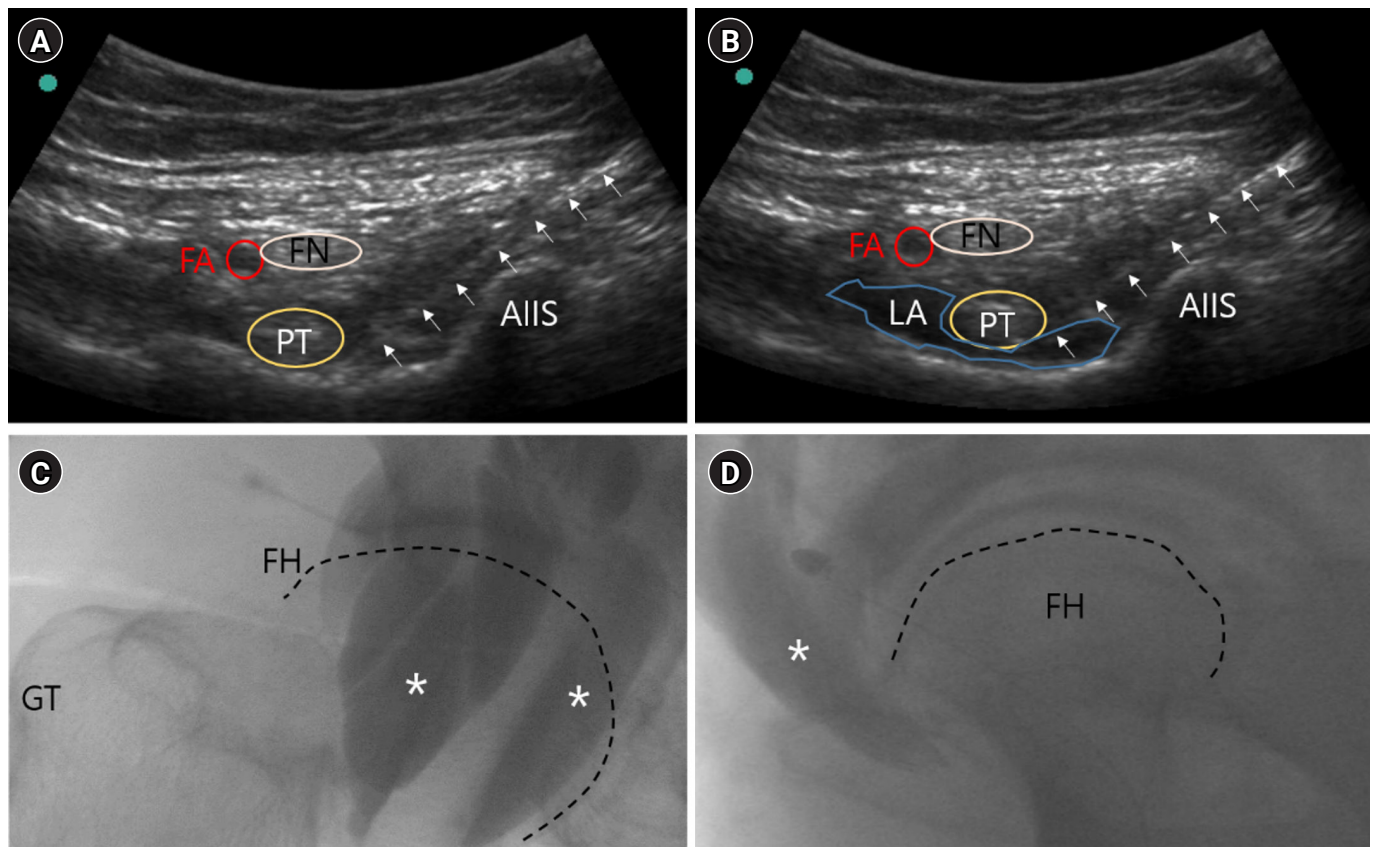
## Case

**Ethical statements:** This study was approved by the Institutional Review Board of the Pusan National University Hospital (IRB No. 2302-011-124). This is a retrospective chart review study and so informed consent was waived.

### Case 1

A 73-year-old male with a right femur neck fracture underwent right total hip arthroplasty surgery. The patient had underlying diabetes and Parkinson's disease. Immediately after intubation, an ultrasound-guided PENG block was administered. During the procedure, a needle was inserted

between the psoas tendon and the pubic ramus, followed by hydrodissection using 10 mL of 0.9% normal saline to create space for catheter placement. Subsequently, the needle was withdrawn, and the catheter was positioned in the same location (Fig. 1A). Upon injection of a 20 mL loading dose, confirmation was obtained as the psoas tendon was pushed upward toward the ultrasound probe (Fig. 1B). Catheter placement was further validated using fluoroscopy, where contrast spread towards the lesser trochanter, the insertion site of the iliacus and psoas muscle, on the hip capsule (Fig. 1C, 1D). The patient's pain remained below a numerical rating scale (NRS) of 3 (Table 1), with no additional analgesic requirements or complications such as



**Fig. 1.** Ultrasound and fluoroscopic images of case 1. (A) The pubic ramus was identified between the iliopubic eminence and the anterior inferior iliac spine (AIIS), and a catheter was mounted between the pubic ramus and the psoas tendon. (B) In total, 20 mL of 0.375% ropivacaine was injected between the psoas tendon and the pubic ramus. Fluid filling is seen between the psoas tendon and the pubic ramus. (C) Posteroanterior image of the hip joint after administering a contrast agent using fluoroscopy. The contrast medium is spread along the iliopsoas muscle passing around the hip joint. (D) Lateral image of the hip joint after administering a contrast agent using fluoroscopy. It was confirmed that the iliopsoas muscle running along the anterior side of the hip joint was imaged. FA, femoral artery; FN, femoral nerve; PT, psoas tendon; LA, local anesthetics; GT, greater trochanter; FH, femoral head (dashed line); asterisk, contrast medium; arrow, catheter.

motor weakness, nausea, vomiting, dizziness, dyspnea, or palpitation.

**Table 1.** Postoperative pain scores for 3 days

Variable	Case 1		Case 2	
	Rest	Movement	Rest	Movement
NRS before surgery	4	7	5	8
NRS at 1 hr	2	NA	1	NA
NRS at 6 hr	1	3	2	3
NRS at 24 hr	1	3	2	3
NRS at 48 hr	1	2	2	3
NRS at 72 hr	1	2	2	3

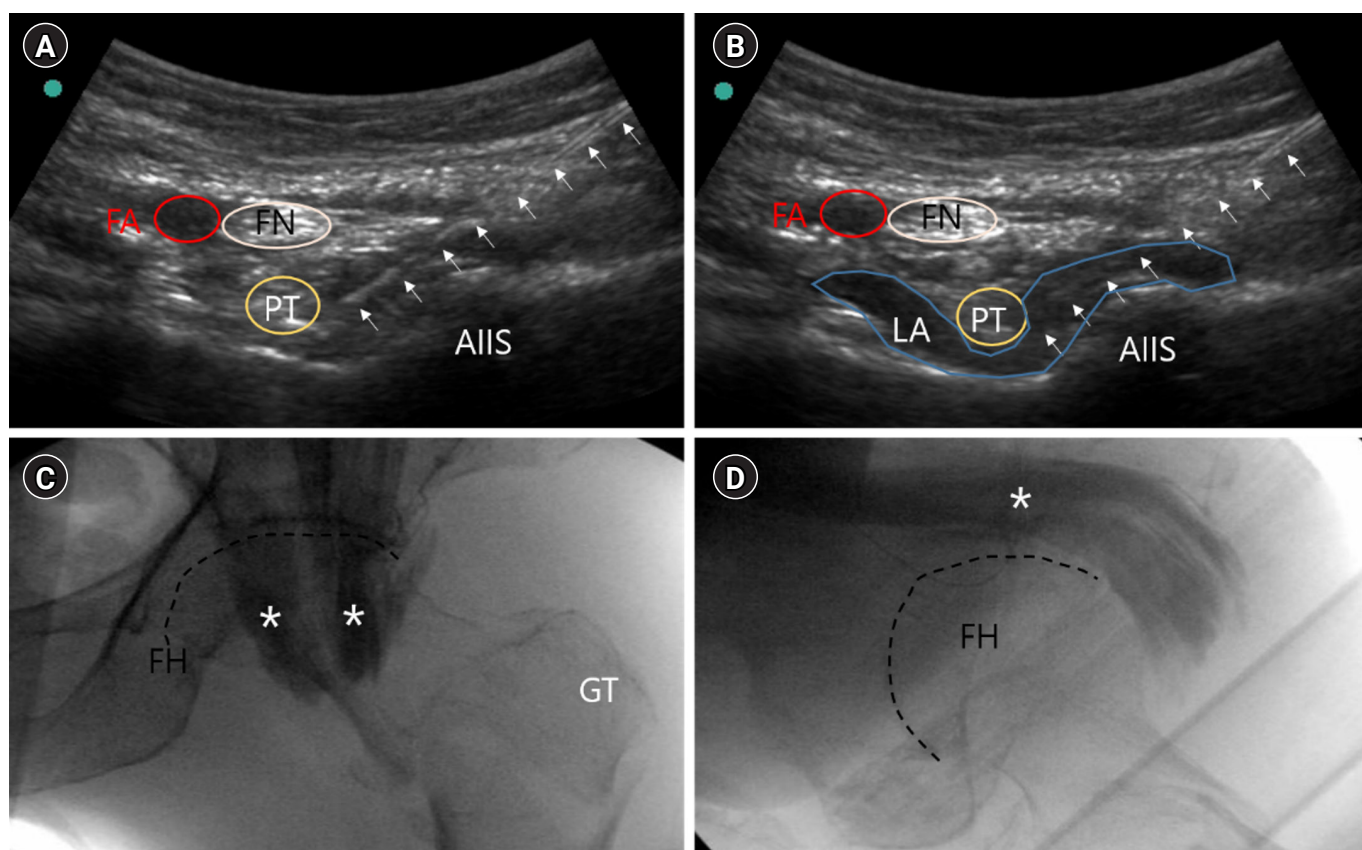
NRS, numerical rating scale; NA, not applicable.

## Case 2

An 83-year-old female with a left femoral intertrochanteric fracture underwent closed reduction and internal fixation with trochanteric fixation nail-advanced surgery. The patient had underlying diabetes and hypertension. Anesthesia and the PENG procedure were performed similarly to the first case and confirmed via ultrasound and fluoroscopy (Fig. 2). Post-surgery, the patient consistently reported pain levels below NRS 3, with no complications (Table 1).

## Continuous PENG block

All procedures were performed under general anesthesia with the patient in the supine position. Utilizing a 3 MHz



**Fig. 2.** Ultrasound and fluoroscopic images of case 2. (A) The pubic ramus was identified between the iliopubic eminence and the anterior inferior iliac spine (AIIS), and the catheter was mounted between the pubic ramus and psoas tendon. (B) Ropivacaine (0.375%) was injected between the psoas tendon and the pubic ramus. As the fluid fills between the psoas tendon and the pubic ramus, it is seen that the interspace expands. (C) Posteroanterior image of the hip joint after administering a contrast agent using fluoroscopy. The contrast medium is spread along the iliopsoas muscle passing around the hip joint. (D) A lateral image of the hip joint after administering a contrast agent using fluoroscopy. It was confirmed that the iliopsoas muscle running along the anterior side of the hip joint was imaged. FA, femoral artery; FN, femoral nerve; PT, psoas tendon; LA, local anesthetics; GT, greater trochanter; FH, femoral head (dashed line); asterisk, contrast medium; arrow, catheter.

convex probe, the ultrasound examination was conducted in the transverse (horizontal) direction to locate the anterior superior iliac spine (ASIS). After sliding the ultrasound probe caudally, when the anterior inferior iliac spine (AIIS) was visible, the probe was rotated about 45° so that AIIS and iliopectic eminence (IPE) appeared on one screen. At this location, a high-density psoas tendon was identified between AIIS and IPE and above the pubic ramus. Using an 18 G×51 mm E-cath needle (E-Cath Plus, PAJUNK), advanced the needle from lateral to medial under in-plane technique until reach the pubic ramus. Confirmation of the needle tip placement between the psoas tendon and the pubic ramus was followed by aspiration to ensure it was not intravascular. Subsequently, the needle was withdrawn, and the accurate catheter placement was confirmed using ultrasound imaging. Additionally, fluoroscopic imaging with contrast agent (Pamiray 300; iopamidol, 300 mg iodine per milliliter) was performed to ascertain the spreading pattern.

A 10 mL bolus of 0.9% normal saline was administered to confirm needle position and facilitate catheter placement via hydrodissection. Following catheter insertion at the same site, a loading dose of 20 mL of 0.375% ropivacaine along with 2 mL of contrast was injected. Post-surgery, continuous infusion of 0.2% ropivacaine at a rate of 5 mL/hr was initiated through the catheter. Sensory loss was confirmed through a pinprick test on the anteromedial thigh in the recovery room approximately 20 minutes after surgery.

## Discussion

We performed an ultrasound-guided PENG block for postoperative pain control in patients who underwent hip surgery, and confirmed the drug diffusion pattern using a fluoroscope. In both cases, the continuous PENG block achieved successful postoperative pain control with no complications.

In general, patients who underwent hip surgery reported severe pain, and despite receiving conventional pain management after surgery, they complained of pain with an NRS score of 4 or more [11]. For patients undergoing hip surgery, pain control is a critical factor because better pain control can reduce complications and promote faster recovery and rehabilitation [4]. In our case, all patients reported NRS score of 3 or less after the surgery, suggesting that the PENG block was effective in postoperative pain

control. PENG block is an effective way to control hip pain [12-14]. However, since the duration is limited, a single injection alone cannot provide sufficient pain relief [10,15]. Therefore, we performed continuous PENG block instead of single injection. The position of the needle and catheter is very important when performing the PENG block.

The hip capsule is innervated by the femoral nerve, obturator nerve, and accessory obturator nerve, identified as passing over the pubic ramus [9,16]. PENG blocks performed on the pubic ramus, where these nerves pass, are very effective in controlling pain around the hip capsule, and if the catheter is placed in the correct location, it can be seen that the drug spreads between the psoas tendon and the pubic ramus [10,17]. Therefore, if it is confirmed that the space between the psoas tendon and the pubic ramus is widened when injecting the drug in the ultrasound image, the catheter can be guaranteed to be placed in the correct position [17].

We performed the PENG block immediately after anesthesia for preventive pain management. Preoperative nerve blocks can decrease pain-associated inflammatory cytokines, leading to a reduction in pain sensitization. This, in turn, results in less discomfort before and after surgery and helps avoid the development of chronic pain [18]. Although postoperative nerve blocks have a longer duration, we thought the preoperative procedure was more advantageous because we performed a continuous peripheral nerve block.

However, even if the needle and catheter were placed in the correct position, there were cases where the drug was not injected well due to high injection pressure. Elevated injection pressure is thought to be caused by the catheter kinking due to a steep needle entry angle, or being stuck in the ligament around the hip capsule [19]. Therefore, increased injection pressure can be reduced by making the needle entry angle as gentle as possible while avoiding AIIS and inserting the catheter after slightly withdrawing the needle after touching the pubic ramus. Afterwards, if excessively high injection pressure is not applied to the catheter and the widening between the psoas tendon and the pubic ramus is confirmed by the ultrasound, it can be considered that the catheter is placed in the correct position.

We also checked the fluoroscopic image using a contrast medium to identify how the drug spreads, and to confirm the appropriate position of the catheter. Psoas muscle and



iliacus muscle pass through the place where we want to mount catheter [9]. Therefore, it was thought that if the catheter was placed in the correct position, it would be contrasted along the psoas muscle and iliacus muscle around the hip capsule. These muscles originate from the vertebra and iliac fossa, respectively, and insert into the lesser trochanter [20]. We confirmed that the contrast agent covered the hip capsule along the course of these muscles, and it could be thought that the nerves passing below the psoas tendon would be well covered if this pattern was seen.

In our cases, the surgery was performed through a 10–12 cm posterolateral longitudinal incision, and it is difficult to expect a complete analgesic effect from the PENG block to the incision site. Thus, local anesthetics infiltration was performed. Additionally, we could have expected better pain control if we had performed a lateral femoral cutaneous nerve block. The lateral femoral cutaneous nerve passes just medial to the ASIS and runs between the sartorius and the tensor fascia latae muscle. Therefore, lateral femoral cutaneous nerve block can be performed between the tensor fascia latae and sartorius muscle by sliding the ultrasound probe inferolaterally from the ASIS.

We performed an ultrasound-guided continuous PENG block and checked the spreading pattern of the drug with a fluoroscope to confirm the exact location. To insert the catheter in the correct position, enter the needle at the lowest angle possible, touch the pubic ramus, and then withdraw the needle slightly before inserting the catheter. In this state, if it is confirmed that the psoas tendon is pushed upward without an increase in injection pressure during drug injection, it can be confirmed that an accurate continuous PENG block has been achieved. Although this report is limited to two cases, we believe that accurate PENG block can be used as a tool for effective pain control without complication for patients undergoing hip surgery, and fast recovery and better prognosis after surgery can be expected.

## Article information

### Conflicts of interest

No potential conflict of interest relevant to this article was reported.

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### Author contributions

Conceptualization: EK. Data curation: YJ, SC, SL, NK. Formal analysis: YJ, NK, EK. Funding acquisition: YJ, EK. Investigation: YJ, NK, EK. Methodology: YJ, SL, EK. Project administration: YJ, EK. Resources: YJ, EK. Software: YJ, SC, SL, NK, EK. Supervision: EK. Validation: YJ, SC, NK. Visualization: YJ, SL, NK, EK. Writing – original draft: YJ. Writing – review & editing: EK. All authors read and approved the final manuscript.

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