# Pericapsular nerve group block (PENG) and lateral femoral cutaneous nerve (LFCN) block versus fascia iliaca (FIC) block for multimodal analgesia after total hip replacement surgery: a retrospective analysis.

**Concise title:** PENG + LFCN block vs FIC block for pain management after hip replacement surgery: a retrospective study.

Alessandro Girombelli MD[1], Francesco Vetrone MD[1], Francesco Saglietti MD[2], Andrea Galimberti MD[1], Andrea Fusaro MD[4], Michele Umbrello MD[3], Angelo Pezzi MD[1].

[1] *Anesthesiology and critical care medicine, Department of Surgery and Emergency, ASST Nord Milano, Bassini hospital, via Gorki, 50 - 20092 Cinisello Balsamo (MI) Italy.*
[2] *Department of Anesthesiology and critical care medicine, Azienda Ospedaliera S. Croce e Carle, Via Michele Coppino, 26, 12100 Cuneo (CN), Italy.*
[3] *Anesthesiology and critical care medicine, SC Anestesia e Rianimazione II, ASST Santi Paolo e Carlo – Polo Universitario, Ospedale San Carlo Borromeo, Via Pio II, 3, 20153 Milano (MI), Italy.*
[4] O*rthopedic surgery division, ASST Nord Milano, Ospedale Bassini, via Gorki, 50 - 20092 Cinisello Balsamo (MI) Italy.*

# Introduction

Postoperative pain control is a cornerstone of the perioperative management for orthopedic surgery as it allows for a prompt mobilization and initiation of physical therapy and thus better perioperative outcomes [1–4]. This is especially true for old and frail patients undergoing hip replacement surgery, where optimal pain control limits the risk of postoperative delirium, expedites the initiation of physical rehabilitation and grants a faster postoperative recovery [5–9]. Optimal pain control should entail a multimodal approach comprised of acetaminophen, NSAIDs (non-steroidal anti-inflammatory drugs), and PRN opioids paired with spinal anesthesia and peripheral nerve blocks [10–13].

Fascia iliaca compartment block (FICB) has been vastly employed for pain management for elective surgery of the hip as well as for pain relief for hip fractures[14–17]. This technique blocks the lateral femoral cutaneous nerve (LFCN), covering the surgical incision, and the femoral nerve but is unable to reach the obturator and the accessory obturator nerves, thus sparing two of the three nerves that innervate the hip. Furthermore, there is a chance of quadriceps muscle weakness since the local anesthetic reaches the femoral nerve[18]. Regardless, this is the currently recommended nerve block for hip surgery [2].

The pericapsular nerve group (PENG) block is a novel block for hip surgery and pain management in hip fractures that is slowly gaining popularity[19]. This technique blocks all three nerves that innervate the anterior aspect of the hip with a single injection. This block yields excellent pain control with an extremely low incidence of motor block when compared to FICB[20–24]. This approach is unable to manage the pain from the surgical incision since it spares the LFCN. For this reason, adding the LFCN block to the PENG block has been proposed[26-27] The studies comparing PENG to FICB are limited and burdened by significant heterogeneity (i.e. type, volume and concentration of local anesthetic, choice of general vs spinal anesthesia, etc.). The combination of PENG plus LFCN block is a relatively new approach with only a small number of case series and case reports available in the literature [27–30]. No study comparing PENG plus LFCN block with FICB was found.

The aim of the current investigation was to determine which of these two blocks resulted in the lowest NRS score. Our hypothesis is that PENG plus LFCN block offers better pain management with the lowest risk of motor block and possibly lower PRN opioid consumption compared to FICB.

# Methods

## Study design

This single-center, retrospective investigation was conducted at ASST Nord Milano Bassini hospital. The study was approved by the ethics committee “Comitato Etico Milano Area 3”. Because of the retrospective nature of the study and since no patient follow-up was performed, the requirement for written informed consent was waived by the ethics committee. The main outcome of the study was the comparison of postoperative pain at 6, 12 and 24 h, expressed as NRS (numeric rating scale), between PENG and LCFN . Secondary outcomes included total opioid consumption expressed as milligrams of morphine equivalents (MME), time to first opioid request, time to first postoperative ambulation.

The study population was obtained from the hospital’s operating room digital charting program using the ICD code “*primary hip arthritis*” and “*total hip replacement surgery*” from April 2022 to November 2022. The inclusion criteria were: elective total hip replacement surgery for non-traumatic hip disease, age >18 years, complete clinical chart included the type of peripheral nerve block performed, signed consent form for spinal anesthesia and peripheral nerve block. The exclusion criteria were: incomplete chart, a peripheral nerve block other than PENG or FICB was

performed. Age, sex, weight, height, BMI, ASA clinical status, type of peripheral block, NRS score respectively at 6-12-24 hours post operatively, time to first PRN opioid request, total PRN opioid dose, time to first postoperative ambulation, adverse events such as nausea, vomiting and hypotension if reported were obtained from the clinical chart and digitally recorded on a Excel spreadsheet (Microsoft Office, Redmond, USA).

All patients underwent surgery with the anterior approach technique to hip replacement. Spinal anesthesia was performed with 0.5% hyperbaric bupivacaine 0.05mg/height in cm plus intrathecal sufentanyl 5mcg, peripheral nerve block was performed prior to surgical incision. Both blocks were performed under ultrasound guidance (Ecube i7, Alpinion, Biolive group,Seoul, South Korea). FICB was performed using a linear ultrasound probe (7.5-12 MHz) and a 50mm ultrasound compatible needle. 20ml of 0.5% ropivacaine were injected and proper local anesthetic spread was confirmed with ultrasound. PENG plus LFCN block was performed with a curvilinear probe (2-5 MHz) with a 80mm ultrasound compatible needle. 20ml of 0.5% ropivacaine were injected for PENG and 10ml of 0.5% ropivacaine for LFCN. Proper spread of local anesthetic was confirmed with ultrasound.

All patients received 1g acetaminophen every 8h (i.v. intraoperatively then p.o.), NSAIDs (non-steroidal anti-inflammatory drugs), namely ibuprofen 400mg every 8h (i.v. intraoperatively then p.o.) and PRN opioid if NRS >5, targeting an initial dose of maximum 30 MME, in accordance with the recent guidelines on opioid prescription for opioid naïve patients[31]. For those patients already receiving opioids for subacute or chronic pain, PRN opioids are still prescribed and tapered according to the intensity of postoperative pain while maintaining the initial opioid prescription[31].

## Statistical analysis

Categorical variables were expressed as absolute frequencies (n) and percentages (%) while continuous variables were reported as median and interquartile range (IQR, with 25° e 75° percentile) given the limited number of observations. Data analysis was conducted with STATA 14.0 (StataCorp LLC, College Station, TEXAS, USA).

The following statistical tests were chosen:

- Fisher's exact test for categorical variables
- Student's t test, or its non-parametric analogue the Two-sample Wilcoxon rank-sum test where used for continuous variables, based on the distribution of the variables
- Two way ANOVA for repeated measurements, for the comparison between the different variables in the two cohorts at different time points. The type of peripheral block (inter-subject variable) and time (intra-subject variable) were considered independent categorical variables. The interaction between the type of block and time (combined time and group effect) were also included in the model. The statistical significance of the intra-subject factor was corrected with the Greenhouse-Geisser method. If a statistically significant interaction between variables occurred then a Siegel-Tukey Test for multiple interaction was employed. Three p-values(p) are thus reported: P(block): group effect, to compare the different NRS scores between cohorts or sub-populations, P(time): time effect, to compare the NRS scores at different time points; P(block*time): combined effect, to take the interaction between the group and time effect into account.