Original Article

Pericapsular nerve group block and lateral femoral cutaneous nerve block versus fascia iliaca block for multimodal analgesia after total hip replacement surgery: A retrospective analysis

ABSTRACT

Background: Optimal pain control with limited muscle weakness is paramount for a swift initiation of physical therapy and early discharge. Fascia iliaca compartment block (FICB) has been recommended since it offers good pain control with a low risk of motor block. Pericapsular nerve group (PENG) block with lateral femoral cutaneous block (LFCN) has been proposed as an effective alternative to FICB that offers better pain control with a considerably lower risk of motor block. We aimed to compare the aforementioned blocks and determine which one yielded the lowest numeric rating scale (NRS) score.

Methods: We designed a retrospective analysis of patients undergoing elective total hip arthroplasty. The primary outcome was the NRS score at 6, 12, and 24 hours. The secondary outcomes were total opioid consumption, time to first PRN opioid, and time to first postoperative ambulation.

Results: 52 patients were recruited, (13 PENG plus LFCN, 39 FICB). PENG plus LCFN resulted in a lower NRS at all three-time points (mean difference and 95%CI at 6 h 0.378 [-0.483; 1.240], at 12 h 0.336 [-0.378; 1.050], and at 24 h 0.464 [0.013; 0.914] $P = 0.02$). Moreover, less PRN opioids were requested in the PENG plus LCFN vs. FICB group (0 [0;7.5] vs 60 [15;80] milligrams of morphine equivalents, $P = 0.001$). No delay in the first ambulation or initiation of physical rehabilitation was reported in either group.

Conclusions: PENG plus LCFN seems to offer better pain control and lead to less PRN opioids. Neither block hindered physical therapy nor ambulation. These results need to be confirmed with a larger prospective and randomized study.

Key words: Anesthesia, FIC, hip, LFCN, PENG, regional

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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 allows for a faster postoperative recovery.[5-9] Optimal pain control should entail a multimodal approach comprised of paracetamol, non-steroidal anti-inflammatory drugs (NSAIDs), 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[25-27] 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 in patients receiving spinal anesthesia was found. The papers that compared the aforementioned blocks in conjunction with general anesthesia seem to favor PENG plus LFCN block in terms of faster first postoperative walk, less motor block, and better pain control.[31]

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 our institution. The study was approved by the ethics committee. 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 hours, expressed as a numeric rating scale (NRS), between PENG and LCFN. Secondary outcomes included total opioid consumption expressed as milligrams of morphine equivalents (MME), time to first opioid request, and time to first postoperative ambulation.

The study population was obtained from the hospital's operating room digital charting program using the international classification of diseases 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 including the type of peripheral nerve block performed, signed consent form for spinal anesthesia, and peripheral nerve block. The exclusion criteria were: incomplete chart and where 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 6-1224 hours postoperatively, 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 Sufentanil 5 mcg, and the 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 were performed with a curvilinear probe (2–5 MHz) with a 80mm ultrasound-compatible needle. 20ml of 0.5% ropivacaine wasinjected 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, 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.[32] 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.[32]

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 analog 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) was 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 interactions 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.

Results

A total of 60 patients underwent elective total hip replacement surgery during the study period. Eight patients were excluded after exclusion criteria were applied. Among them, five patients had no peripheral block clearly reported on the anesthesiology chart, one received a different peripheral block from those specified in the study, and two patients did not receive any peripheral block since the attending anesthesiologist deemed the procedure unfeasible due to poor echographic window. Of the 52 remaining patients, 13 received PENG + LFCN block, and 39 received FICB [Figure 1]. The study population had no difference in baseline characteristics [Table 1].

Patients receiving PENG + LCFN had a statistically significant lower reported pain NRS at all time points (mean difference and 95% CI at 6h 0.378 [-0.483; 1.240], at 12h 0.336 [-0.378; 1.050], and at 24h 0.464 [0.013; 0.914] $P = 0.02$), as shown in both Figure 2 and Table 2.

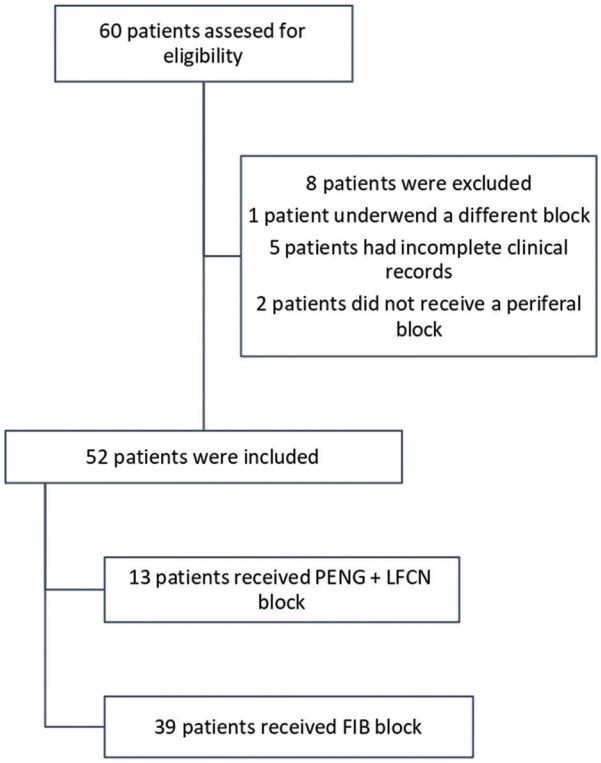

Figure 1: Patient selection. PENG = Pericapsular nerve group, LFCN = Lateral femoral cutaneous nerve, FIB = Fascia iliaca block

Table 1: Patients' characteristics

Variable	PENG plus LFCN (n=13)	FIB (n=39)	p
Age (years)	69±13	70±9	0.8280
Weight (kg)	74±18	79±14	0.3649
Height (cm)	165±11	167±9	0.6737
BMI (kg/m2)	26.9±4.6	28.4±4.4	0.2979
Sex (Male)	6 (46.1%)	17 (43.6%)	0.872
ASA status	2 [2; 3]	2 [2; 3]	0.3485

PENG=Pericapsular nerve group, LFCN=Lateral femoral cutaneous nerve, FIB=Fascia iliaca block. BMI=Body mass index, ASA=American Society of Anesthesiologists physical status classification

Significantly less PRN opioids were requested in the PENG plus LFCN group compared to the FICB group (0 [0;7.5] vs 60 [15;80] MME; $P = 0.001$).

None of the other secondary outcomes were statistically different between groups [Table 3].

No adverse events (i.e. nausea, vomiting, hypotension) nor any delay in physical therapy or first ambulation were reported in either groups.

Discussion

This retrospective clinical investigation showed how PENG plus LFCN offers better postoperative pain management compared to FICB. Furthermore, the PENG plus LFCN group required less PRN opioids compared to the FICB group.

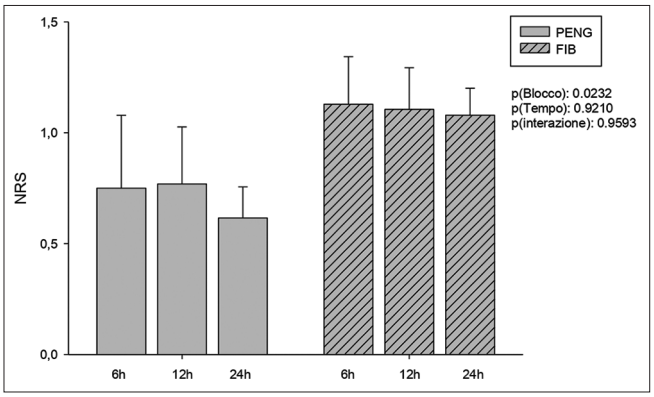

Figure 2: Primary outcome: comparison of self-reported pain scores at 6, 12, and 24 hours after surgery in PENG plus LFCN group compared to FIB group. PENG = Pericapsular nerve group, LFCN = Lateral femoral cutaneous nerve, FIB = Fascia iliaca block, NRS = Numeric rating scale

Table 2: Primary outcome: comparison of self-reported pain scores at 6, 12, 24h after surgery

Variable	PENG (n=13)	FIB (n=39)	P (time)	P (block)	P (interaction)
NRS 6h	1 [0; 1]	1 [0; 1]	0.9210	0.0232	0.9518
NRS 12h	1 [0; 1]	1 [0; 1]			
NRS 24h	1 [0; 1]	1 [1; 1]			

PENG=Pericapsular nerve group, LFCN=Lateral femoral cutaneous nerve, FIB=Fascia iliaca block, NRS=Numeric rating scale

Table 3: Secondary outcomes: time to first request for PRN opioids, total dose of consumed PRN opioid expressed in MME, time to first ambulation

Variable	PENG (n=13)	FIB (n=39)	p
Time to first PRN opioid (hours)	6 [6; 13]	8 [6; 9]	0.9827
Total PRN opioids (MME)	0 [0; 7.5]	60 [15; 80]	0.001
Time to ambulation (hours)	24 [24; 24]	24 [24; 48]	0.2082

PENG=Pericapsular nerve group, LFCN=Lateral femoral cutaneous nerve, FIB=Fascia iliaca block, MME=Morphine milligrams equivalents

Postoperative pain management is of paramount importance in order to tolerate early postoperative physical therapy and expedite discharge home.[33] This is especially true for frail patients, where the risk of triggering postoperative delirium is elevated, thus increasing perioperative morbidity and mortality as well as prolonging the length of hospital stay.[3] The current recommendations are to perform spinal anesthesia and then employ a multimodal pharmacological analgesic approach involving acetaminophen, NSAIDs, PRN opioids, and a peripheral block.[1,2] The current block of choice in many centers is FICB since it offers good pain control with a low risk of motor block and is easy to perform. Recently PENG block has gained popularity as it is able to offer similar, if not better, pain control with an extremely low risk of motor block.[23,24,34] When complemented with LFCN block, the two blocks are capable of offering optimal pain control, covering the surgical incision as well as the hip joint, as suggested by the few available studies.[30]

In our retrospective study, PENG plus LFCN resulted in better pain control compared to FICB with a difference in NRS of around 0.37 at all three-time points. This might seem significant only statistically but not clinically and yet there are quite a few studies that considered clinically significant a difference in NRS score of less than 1.[35-38] Interestingly, the mean NRS score was low in both groups, confirming how a peripheral nerve block greatly improves pain management regardless of the kind of block, as suggested by current guidelines.[2]

On top of the lower reported pain scores, PRN opioid consumption was significantly lower in the PENG plus LFCN group, suggesting how this block grants better postoperative pain control. Furthermore, it could be speculated that FICB required the aid of PRN opioids to reach optimal pain control, whereas PENG plus LFCN did not. This finding merits further investigation. Nonetheless, our data suggests that PENG plus LFCN could be better for minimizing postoperative opioid consumption, in accordance with the recent recommendations on opioid prescription for acute pain management.[32]

No delay in the initiation of physical therapy or in the first ambulation was reported, suggesting neither block interfered with physical therapy nor discharge from the hospital. No adverse effect was reported for either block.

A recent study showed how PENG was superior to FICB only during the first 6 and 24 hours postoperatively but not at 48 hours[42] but the comparison with our study is limited since PENG was not associated with LFCN block. These findings are

in disagreement with another study[20] that reported better pain control and lower PRN opioid consumption in the PENG group compared to the FICB group during the first 48h after surgery. A direct comparison with our study is limited since LFCN block was not performed.[20] Still the results are in agreement with our study.

A retrospective study[24] reported similar findings, with lower pain scores, lower PRN opioid consumption, and shorter length of stay in the PENG group. Comparison with our study is extremely limited since both the control and the study group received FICB, PENG was performed after surgical wound closure and LFCN block was not performed.

A recent randomized controlled trial compared PENG block to no block for patients undergoing total hip arthroplasty under spinal anesthesia.[39] The primary outcome of quality of recovery was superior in the PENG group, and the secondary outcome of opioid consumption was lower in the PENG group. A direct comparison with our study is limited since the authors performed the PENG block without adding the LFCN block and the study's control group did not receive any peripheral nerve blocks.

The literature offers only case series and case reports that compare PENG block alone with PENG plus LFCN block, thus limiting the comparison with our study.[27,28,40,41]

Our study has several limitations. The retrospective nature of the study limited the available data and the variables to those available in the clinical charts. The sample of this study is quite small, limiting the generalization of the results. The significant difference in numerosity between the two groups has been compensated for during statistical analysis and can be due to PENG plus LFCN being a novel peripheral nerve block which, as such, is still being implemented in clinical practice and is possibly less known than FICB.

In conclusion, the results of this study show that PENG along with LFCN block offers better pain control after total hip replacement surgery compared to FICB. Furthermore, PENG plus LFCN appears to reduce PRN opioid requirements allowing for better adherence to current recommendations on opioid prescription. No delay in the first physical rehabilitation or first ambulation was reported for either block. These results need to be confirmed by a larger, randomized study.

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Nil.

Conflicts of interest
There are no conflicts of interest.

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