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Pericapsular nerve group block results in a longer analgesic effect and shorter time to discharge than femoral nerve block in patients after hip fracture surgery: a single-center double-blinded randomized trial

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Abstract

Objective: The pericapsular nerve group (PENG) block is a regional block that possibly provides better analgesia than that of the femoral nerve block (FNB) for hip fracture surgery. A randomized comparative trial performed in our institution showed that the PENG block may provide improved pain reduction compared with the FNB while preserving quadriceps strength.

Methods: In this single-center, double-blinded, randomized comparative trial, patients who underwent hip fracture surgery were randomized to receive either a FNB or PENG block for

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analgesia. This analysis reviews the outcomes of the block effect duration and time to discharge readiness.

Results: Sixty patients with similar baseline demographics were randomized. The median FNB duration was 15 hours, 35 minutes (range (hours:minutes) 4:08–30:45), and the median PENG duration was 22 hours, 50 minutes (range 6:00–32:00). The time to discharge readiness was shorter in the PENG group (3 days, range 1–14 days) than that in the FNB group (4 days, range 2–15 days).

Conclusions: The PENG block results in a faster recovery and shorter time to discharge readiness. The duration of the PENG block appears to be longer than that of the FNB.

Keywords

Anesthesia, analgesia, regional analgesia, hip fracture, pericapsular nerve group block, femoral nerve block, pain

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Introduction

Hip fractures are a common and debilitating injury, occurring predominantly in an older, more vulnerable population.[1] Worldwide, approximately 1.5 million patients experience a hip fracture each year.[1] In this cohort, multimodal analgesia is regularly used to manage perioperative pain because adequate pain management has been shown to decrease complications and facilitate postoperative mobilization.[2] Regional anesthesia is often an important component of multimodal analgesia plans, and the ideal regional technique for hip surgery should be motor sparing to allow early postoperative mobilization. Our previously published double-blind, randomized comparative trial showed superior pain score reduction on day 0 postoperatively when a pericapsular nerve group (PENG) block was used compared with a femoral nerve block (FNB) ($p = 0.04$).[3] Greater preservation of the quadriceps strength after the PENG block was also reported both on day 0 ($p < 0.001$) and day 1 postoperatively ($p = 0.003$). The current additional analysis was performed to investigate the patient-reported outcome of block duration of the randomized comparative trial comparing the PENG block and FNB as well as the time to discharge readiness from the hospital.

Patients and methods

This is a further analysis of a single-center, double-blinded, randomized comparative trial conducted at a tertiary trauma hospital in Australia that treats approximately 250 hip fracture patients annually. Local ethics approval was obtained from the Southern Area Local Health Network Human Research Ethics Committee (SALHN/HREC/218.19), and signed informed consent was acquired from all participants. The trial was prospectively registered with the Netherlands Trial Register (NTR; NL8043), including the outcomes of this further analysis. This study conforms to the Consolidated Standards of Reporting Trials (CONSORT) and the CONSORT extension for trials reporting patient-related outcomes.[4,5]

The inclusion criteria were patients with a hip fracture presenting for surgery who were aged 45 years and older, had no

contraindications for regional anesthesia, and were able to provide first party informed consent and reliably report symptoms to the research team. The exclusion criterion was an inability to provide first party informed consent because of cognitive impairment or a language barrier.

Randomization, blinding, and study intervention

Randomization was performed on a 1:1 basis using an online computed randomization generator (www.sealedenvelope.com). All staff were blinded to the intervention.

The allocated block was placed 15 to 45 minutes preoperatively under ultrasound guidance using 20 mL of 0.75% ropivacaine. For patients who weighed <50 kg, the concentration of local anesthetic was reduced while maintaining a total volume of 20 mL, with a maximum total ropivacaine dose of 3 mg/kg. Intravenous dexamethasone (4 mg) was given, and the local anesthetic was not supplemented. The surgical technique performed and the type of anesthesia administered were at the discretion of the treating physicians. Postoperatively, the quadriceps strength was tested in the recovery unit, and the pain score was recorded by a blinded member of the study team using a visual numeric rating scale ranging from 0 to 10, with 0 being the absence of pain and 10 being the worst pain imaginable.

Outcome measures

On day 1, patients were asked by the Acute Pain Service to recall the time that their block ended, which was defined as the return of motor (if initially impaired) and/or sensory function. At the time of block placement, patients were notified that they would be asked this question to help prompt them to note the time when the block ended.

The 'discharge ready' length of stay was defined as the time from the date of surgery to the date that the patient was medically suitable for discharge. The discharge ready length of stay was used rather than the full length of the hospital stay because this parameter is largely affected by the limited number of rehabilitation beds at our institution. Discharge readiness was assessed once per day by a multidisciplinary team, including orthogeriatricians, orthopedic surgeons, nursing staff, and physiotherapists. The discharge criteria included a lack of medical issues requiring inpatient treatment, tolerance of the diet, appropriate control of pain with oral analgesia, adequate mobilization for rehabilitation transfer, and completion of a personalized discharge plan with ongoing goals, appointments, and support. Patients were required to mobilize prior to discharge in a weight bearing manner with or without the use of simple aids, such as a four-wheel walker or walking stick.

Sample size calculation and statistical analyses

The sample size calculation is described in the primary publication.[3] The a priori power calculation was performed using PASS V.14 software (NCSS LLC, Kaysville, UT, USA) on the basis of the pain score reduction as the primary outcome in our previous analysis. This analysis showed mean reductions of 3.4 points after FNB and 7 points after PENG block (both out of 10) on day 0 postoperatively (standard deviation (SD) 2). At that time, no studies had directly compared the two types of regional blocs; hence, the results for FNB were obtained from the Cochrane review, and the PENG results were obtained from a landmark case series.[6] We postulated that despite clinical familiarity with the PENG block, we would be less experienced than the group that

developed the PENG block; therefore, an SD of 3 was used. A two-tailed independent samples t-test was used to detect a difference between two unpaired means with an alpha of 0.05, and a power of 0.95 was also used. The results showed that, to detect a difference of 3 points in pain scores with an SD of 3, 30 patients would be required for each arm, while allowing for an attrition rate of 15%, resulting in the requirement of a total of 60 participants to achieve greater than 95% power.

Data entry and statistical analyses were conducted in a blinded manner. The analysis was performed on an intention-to-treat basis using SPSS version 27 (IBM Corp., Armonk, NY, USA) and GraphPad Prism version 8 (GraphPad Software, La Jolla, CA, USA). The parametricity of continuous variables was determined using the Shapiro–Wilk test. Normally distributed continuous variables are expressed as means with SDs, and nonparametric variables are expressed as medians with ranges. The univariate analysis was carried out using the chi-squared test or Fisher's exact test for categorical variables, the Mann–Whitney U-test for nonparametric continuous variables, and Student's t-test for parametric continuous variables. A p-value of <0.05 was considered statistically significant.

Results

The study was conducted from February to September 2020 and was paused temporarily from 18 March to 5 May 2020 because of state-wide severe acute respiratory syndrome coronavirus 2 restrictions. Sixty patients were included. A flowchart of patient inclusion is shown in Figure 1. All patients completed the study and were included in the intention-to-treat analysis. No patients were lost to follow up.

The preoperative demographics of both groups of 30 patients were similar (Table 1), including the baseline visual numeric rating scale pain scores. The anesthetic and surgical techniques were also similar between the two groups. Ten (33%) and 13 (43%) patients in the FNB group and PENG group, respectively, underwent surgery with spinal anesthesia.

Patients who received a PENG block recovered faster and were considered to be discharge ready earlier postoperatively, with a median of 3 days (range 1–14 days), than those in the FNB group (4 days range 2–15 days; $p = 0.02$) (Table 2).

The median FNB duration could be reliably recalled by 13 patients (43%) and was 15 hours and 35 minutes (range (hours: minutes) 4:08 to 30:45). In the PENG group, the median duration was 22 hours and 50 minutes (range 6:00 to 32:00) as recalled by 11 patients (37%).

Discussion

Research on the PENG block has been limited to a small number of randomized controlled trials and letters to the editor.[3,7–9] While all studies have reported similar findings of improved analgesia and increased preservation of quadriceps strength, much remains unknown about this new regional technique, such as the block duration, minimum effective volume for dosing, patient-related outcome measures, and effect on health economics. This further analysis was aimed to provide clarity regarding the block duration and length of time to hospital discharge readiness.

Despite its short-term duration, the PENG group patients had a shorter in-hospital recovery and time to discharge readiness. The turnaround time from surgery to the patient being discharge ready was significantly shorter in the PENG group by a median of 1 day. This likely reflects the improved pain management and earlier mobilization made possible by the increased preservation of quadriceps strength.[10,11] Discharge readiness

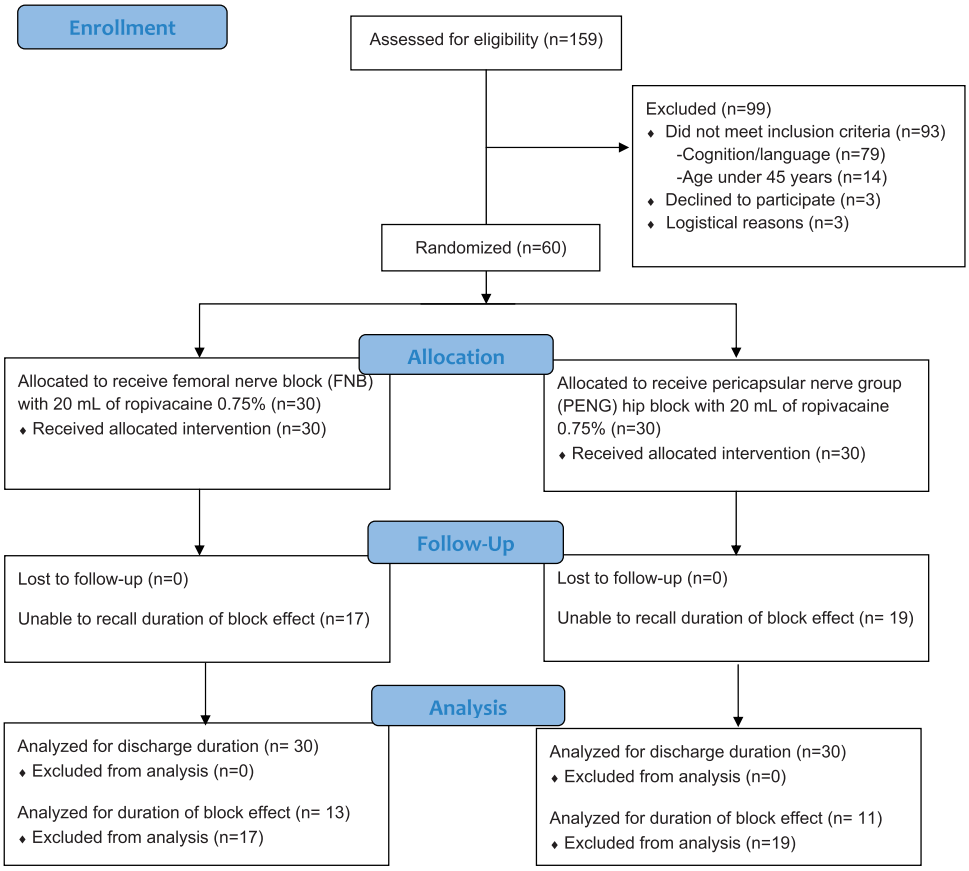

Figure 1. Flow diagram of patient recruitment.

Table 1. Patient and preoperative characteristics.

	Femoral nerve block (n = 30)	PENG (n = 30)	p-value
Age in years, mean (±SD)[a]	79.7 (±11.5)	77.2 (±11.6)	0.39
Sex, n (%)[a]			
Male	7 (23)	14 (47)	0.10
Female	23 (77)	16 (53)	
Weight in kg, mean (±SD)[b]	65.0 (±15.7)	65.6 (±17.8)	0.89
Preoperative pain score (NRS), median (range)[c]	8 (3–10)	9 (2–10)	0.25

[a]Fisher's exact test.
[b]Student's t-test.
[c]Mann–Whitney U-test.
SD: standard deviation, PENG: pericapsular nerve group block, NRS: numeric rating scale.

Table 2. Postoperative outcomes.

	Femoral nerve block (n = 30)	PENG (n = 30)	p-value
Duration of block in hours:minutes, median (range)	15:35 (4:08–30:45)[a]	22:50 (6:00–32:00)[b]	N/A*
Discharge ready (postoperative day), median (range)[c]	4 (2–15)	3 (1–14)	0.02

*Because of the amount of unavailable data, no p-value could be calculated.
[a]Reported for 13 patients who were able to recall the time that the block effect ended.
[b]Reported for 11 patients who were able to recall the time that the block effect ended.
[c]Mann–Whitney U-test.
N/A: not applicable, PENG: pericapsular nerve group block.

was used instead of the time to discharge in this study because the main limiting factor in transferring patients is often a lack of rehabilitation beds. Furthermore, the criterion of 'fit for discharge' has previously been used in other randomized controlled trials in similar circumstances.[12]

This is the first instance, to our knowledge, that the duration of the PENG block has been reported. The duration of both blocks, as reported by patients, was consistent with the short-term analgesic effect noted by the pain score reductions. Although the anesthetists performing the blocks had more experience placing the FNB than the PENG block, the efficacy of the PENG block was longer, demonstrating its general applicability.

Limitations

This randomized comparative trial was powered to detect a difference in the primary outcome of pain score reduction and was conducted in a relatively small number of patients. This study was therefore not adequately powered to detect other outcomes. Only patients who could accurately recall the duration of the regional technique were included in the report; therefore, a large number of patients who were unable to recall the duration of the regional block effect were excluded from the analysis, possibly introducing a recall bias. However, despite the small number of participants, the trends were quite striking. We also chose to define block duration as a self-reported outcome, instead of using the first analgesic use post-surgery. This is because of the frail and geriatric population included in this study, and these patients often did not request analgesia for prolonged periods of time.

Future directions

A high quality, larger, randomized controlled trial for hip fracture surgery would add to the current understanding of the applicability of the PENG block.

Conclusion

This analysis of a double-blinded, randomized comparative trial indicates that the PENG block results in a reduced time to readiness for discharge and a longer duration of efficacy of the regional anesthetic than those of the FNB. The PENG block should be considered for hip fracture surgery patients to reduce perioperative pain and improve recovery.

Declaration of conflicting interest

The authors declare no competing interests.

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