The Egyptian Journal of Hospital Medicine (October 2023) Vol. 93, Page 7433- 7438

Effect of Pericapsular Nerve Group (PENG) Block for Perioperative Analgesia in Geriatric Patients with Hip Fractures

Samuel H. Daniel, Paula M. Elkomos, Lydia E. Zakhary
Department of anesthesia and intensive care medicine, Faculty of medicine, Ain shams university, Cairo, Egypt.
Corresponding author: Lydia E. Zakhary, **email:** Lydia_zakhary@med.asu.edu.eg
Mobile: +201222555128

ABSTRACT

Background: The occurrence of hip fracture is a prevalent orthopedic emergency among older individuals, and it is linked to substantial morbidity and death. Surgical reduction and fixation are considered the primary therapeutic approach for the majority of patients. It is crucial to provide perioperative analgesia that is effective in reducing the need for opioids and the associated side effects, including delirium, in this specific group of patients**.**

Objective: Our research focused on investigating the ultrasound-guided approach for blocking the articular nerve branches to the hip, namely[1] the PENG (PEricapsular Nerve Group) block, which may provide a successful implementation and approach in individuals with hip fracture.

Methods and patients: The experiment comprised a cohort of sixteen elderly patients, all of whom were above the age of sixty-five and classified as ASA II or III. These patients suffered from hip fractures and were scheduled to have hip surgery. All patients had postoperative PENG block after the administration of spinal anesthetic for hip surgery.

Results: postoperative pain assessment both at rest and with movement using visual analogue score (VAS) for twenty-four hours demonstrated a statistically significant decline compared to preoperative pain.

Conclusion : PENG block provided significant post-operative analgesia after hip surgery.

Keywords : Elderly, Hip fractures, Pain, Regional anethesia , PENG block, VAS scale.

INTRODUCTION

Fractures of the hip are a frequent orthopedic emergency in the elderly and are the most common cause of disability and death [1]. In most cases, fixation and surgical reduction is the best choice for patients [2]. It is important to provide perioperative analgesia that is effective in reducing the need for opioids and mitigating associated side effects, including delirium, in this particular group of patients [3,4].

Regional analgesic approaches, which involve the fascia iliaca block (FIB), femoral nerve (FN) block and 3-in-1 FN block, are widely used procedures for pain management. These techniques are particularly favored owing to their ability to minimize the need of opioids and reduce the associated adverse outcomes [5-7]. The analgesic effect size resulting from these blocks is found to be only modest, as indicated in the literature. Additionally, existing research reveals that the obturator nerve (ON) is not well treated by these blocks [8].

Previous anatomical investigations have indicated that the innervation of the anterior hip capsule includes the FN, the ON and the auxiliary obturator nerve (AON). The anterior capsule of the hip joint has a high density of innervation, indicating that targeting these nerves would be a primary approach for achieving analgesia in the hip region. Anatomical research conducted recently by **Short *et al*. [(9)]** confirmed the role of these 3 major nerves in the innervation of the anterior hip, but also discovered a larger function for the AON and FN than had been previously documented. This research also identified the relevant landmarks for those branches. The high articular branches originating from the FN and the accessory obturator nerve (AON) exhibit a continuous presence in the anatomical region situated between the anterior inferior iliac spine (AIIS) and the iliopubic eminence (IPE). In contrast, the ON is positioned in close proximity to the inferomedial aspect of the acetabulum [10].

In this research, we will examine the use of an ultrasound-guided approach for the blocking of articular branches to the hip, specifically focusing on the PENG block and its successful implementation in individuals diagnosed with hip fracture.

PATIENTS AND METHODS

Design of study: This was observational prospective one arm clinical trial that studied the PENG block effect in the postoperative pain management following surgery of hip fracture. This research was registered at ClinicalTrials.gov with the registration number: NCT05941221. Sixteen elderly patients admitted to our institution due to hip fracture were included in our analysis.

Inclusion criteria: Patients with hip fractures, undergoing hip surgery, aging more than sixty years with ASA II and III with unilateral hip fracture (intertrochanteric, femoral neck fracture or subtrochanteric). Patients who had surgical procedures at

Received: 27/03/2023
Accepted: 24/05/2023

our facility, namely hemiarthroplasty or total hip arthroplasty for femoral neck fracture, and proximal femoral nail anti-rotation (PFNA) for intertrochanteric fracture.

Exclusion criteria: Patients who had contraindications for regional blocks and spinal anesthetics such as coagulopathy with an International Normalized Ratio (INR) greater than 1.8 and thrombocytopenia with a platelet count less than 50,000. Additionally, individuals with a known allergy to the medicines employed in the trial were also eliminated.

Study procedure: Patients meeting the inclusion criteria were informed by the side effect, study methods, aim in clear language, written consent was taken in clear written and spoken language, All patients were subjected to recording of baseline SBP, DBP, MAP, SPO_2 and pulse. Spinal anesthesia was performed as follows: After back sterilization with bovidon iodine, 3 cc of lidocaine 20% local anesthetic was injected at the level of L3-L4 spine, then injection of 17 mg bupivacaine 0.5% through a 25 spinal needle. At surgery end, all patients received PENG block through ultrasound (US).

The regional blockade was administered while the patient was in a supine posture. Initially, a curvilinear low-frequency ultrasonic probe with a frequency range of 2-5MHz was positioned in a transverse plane across the AIIS. Subsequently, the probe was adjusted by rotating it counterclockwise at an angle of roughly 45 degrees to align it with the pubic ramus. This perspective included the observation of the IPE, iliopsoas muscle and tendon, femoral artery, and pectineus muscle [11]. A needle with a diameter of 22-gauge and a length of 80 mm was entered using a lateral to medial trajectory in an in-plane manner. The objective was to position the needle tip inside the musculofascial plane, namely between the anterior psoas tendon and the posterior pubic ramus. Using a 20 mL volume of bupivacaine 0.25%, the local anesthetic solution was given in 5 mL increments after negative aspiration, with careful monitoring of fluid distribution in this plane [11].

outcome measurement: To measure the pain relief afforded by PENG block in the postoperative phase, the present study used VAS values (0-10, with 0 denoting no pain and 10 denoting the greatest agony imaginable). Six, nine, twelve, and twenty-four hours after the block was initiated, patients' VAS resting scores were recorded. VAS score with movement was recorded at six hrs, nine hrs. twelve hrs. and twenty-four hours post-operative. blood pressure (BP) monitoring and mean blood pressure (MBP) and heart rate (HR) were recorded at six hrs, nine hrs, twelve hrs and twenty-four hours postoperative. Also, the need for analgesic doses when VAS score was more than 3 with elevated MBP and HR > 20% of the preoperative values was recorded. Moreover, agitation or delirium at six hrs, twelve hrs and twenty-four hrs postoperative were monitored using (RAMZY score) which is a six points scale score where 1 represents fully awake, agitated and 6 represents sleeping irresponsive state.

1	Individuals who are awake may experience a state of agitation, restlessness, or a combination of both.
2	Aware, as well as calm, cooperative, and goal-oriented.
3	Awake but responds orders only
4	Asleep, with a quick awakening elicited by a gentle glabellar touch or a loud aural stimulation.
5	A state of sleep characterized by a slow reaction to either a mild glabellar tap or a loud aural stimulation.
6	Sleeping state; does not react to glabellar touch or loud aural stimuli

Ethical consideration: The necessary approvals were received from the Anesthesia and Intensive Care Department and the Ethics Committee of the Faculty of Medicine, Ain Shams University. This study was conducted in accordance with Helsinki Declaration. Informed permissions were obtained from all patients prior to the commencement of the investigation.

Statistical Analysis

The research utilized Power Analysis and Sample Size Software (PASS 15) (Version 15.0.10) to calculate the required sample size. The data underwent collection, revision, coding, and entry into the Statistical Package for Social Science (IBM SPSS) version 23. The research provided quantitative data that followed a parametric distribution using measures such as, standard deviations (SD), ranges and average. For data that did not follow a parametric distribution, the research used measures such as inter-quartile range (IQR) and median. In addition, the presentation of qualitative factors included the use of percentage and numerical values. The comparison of two paired groups with a parametric distribution and quantitative data was conducted using the Paired t-test. On the other hand, the comparison of two paired groups with quantitative data and a non-parametric distribution was performed using the Wilcoxon Rank test. A ninety-five% confidence interval was established with a five % margin of error. The p-value was deemed statistically significant at a level of ≤ 0.05.

RESULTS

Sixteen patients were included in our research, no statistical variance between them regarding demographic data (Table 1).

Table (1): HR, and demographic data of the studied patients

		No. = Sixteen
Age (Years)	Average ± SD	73.06 ± 9.1
Sex	Females Males	9 (56.2%) 7 (43.8%)
ASA	II III	9 (56.2%) 7 (43.8%)
Preop diagnosis	Subtrochanteric fracture Intertrochanteric fracture Fr neck femur	3 (18.8%) 3 (18.8%) 10 (62.5%)
Surgical procedure	Bipolar Total hip PFN	8 (50.0%) 5 (31.2%) 3 (18.8%)
HR (per minute)	Mean ± SD	13.75 ± 5

visual analogue scale for pain was assessed at rest at the preoperative period, after six hrs, nine hrs, twelve, hrs and twenty -four hrs. highly significant variance in pain score was noticed at all times compared to preoperative period (Table 2).

Table (2): Follow up for VAS at rest among the studied patients

VAS at rest		**No. = Sixteen**	**Diff. from preop. Mean ± SD 95%CI**	**Test value**	**P-value**
Preoperative	Mean ± SD	5.19 ± 0.91	-	-	-
Six hours	Mean ± SD	4.06 ± 0.85	-1.13 ± 0.96	-3.166	0.002
Nine hours	Mean ± SD	3.81 ± 1.05	-1.38 ± 0.96	-3.236	0.001
Twelve hours	Mean ± SD	3.31 ± 1.14	-1.88 ± 1.09	-3.462	0.001
Twenty-four hours	Mean ± SD	2.75 ± 0.86	-2.44 ± 0.89	-3.563	0.000

*: P-value of Wilcoxon Rank test in comparison with preoperative

VAS was assessed with movement at the same examination times. Also, findings showed lower pain scores at all times compared to baseline level which was statistically significant at nine, twelve, and twenty-four hours (Figure 1 and table 3).

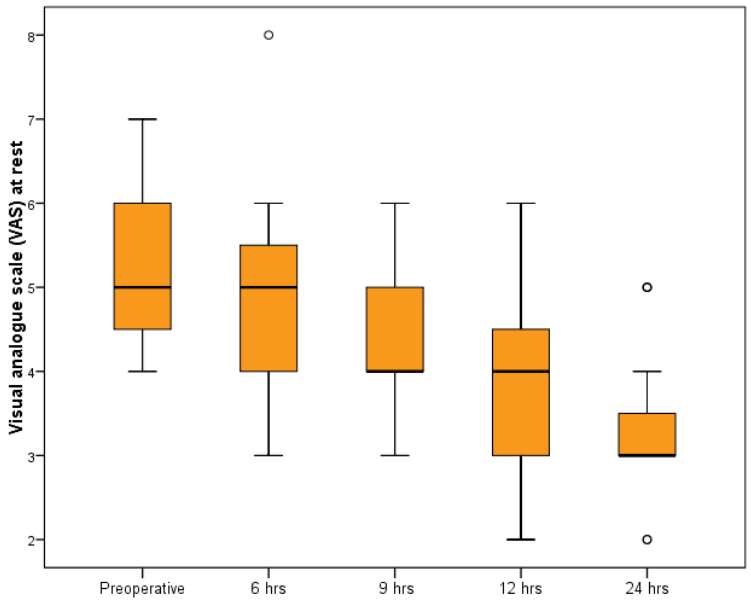

Figure (1): Follow up for VAS at movement between the studied patients.

Table (3): Follow up for VAS at movement between the studied patients.

VAS at movement		No. = Sixteen	Diff. from preop. Mean ± SD 95%CI	Test value	P-value*
Preoperative	Mean ± SD	5.19 ± 0.91	-	-	-
Six hours	Mean ± SD	4.94 ± 1.18	-0.25 ± 1.24	-0.794	0.427
Nine hours	Mean ± SD	4.38 ± 0.96	-0.81 ± 1.05	-2.506	0.012
Twelve hours	Mean ± SD	3.94 ± 1.29	-1.25 ± 1.24	-3.079	0.002
Twenty-four hours	Mean ± SD	3.31 ± 0.95	-1.88 ± 1.02	-3.449	0.001

*: P-value of Wilcoxon Rank test in comparison with preoperative

SBP was measured and recorded at all examination times, compared to baseline, it was slightly lower at six hours post-operative and at twenty-four hours (Table 4 and figure 2).

Table (4): Follow up for systolic blood pressure (mmHg) among the studied patients

Systolic blood pressure (SBP) (mmHg)		No. = 16	Diff. from preop. Average ± SD 95% CI	Test value	P-value*
Preoperative	Average ±SD	135.62 ± 15.9	-	-	-
Six hours	Average ±SD	122.5 ± 17.32	-13.13 ± 11.38	-4.612	0.000
Nine hours	Average ±SD	130.62 ± 14.82	-5.00 ± 16.33	-1.225	0.240
Twelve hours	Average ±SD	133.13 ± 14.48	-2.50 ± 19.15	-0.522	0.609
Twenty-four hours	Average ±SD	129.38 ± 9.98	-6.25 ± 11.47	-2.179	0.046

When comparing measured DBP at all times, no significant difference was found (Table 5 and figure 2)).

Table (5): Follow up of diastolic blood pressure (DBP) (mmHg) among the studied patients

DBP (mmHg)		No. = 16	Diff. from preop. Average ±SD 95%CI	Test value	P-value*
Preoperative	Mean ± SD	75 ± 8.94	-	-	-
Six hours	Mean ± SD	71.25 ± 8.85	-3.75 ± 7.19	-2.087	0.054
Nine hours	Mean ± SD	76.25 ± 8.85	1.25 ± 8.85	0.565	0.580
Twelve hours	Mean ± SD	76.88 ± 8.73	1.88 ± 8.34	0.899	0.383
Twenty-four hours	Mean ± SD	75.62 ± 6.29	0.63 ± 8.54	0.293	0.774

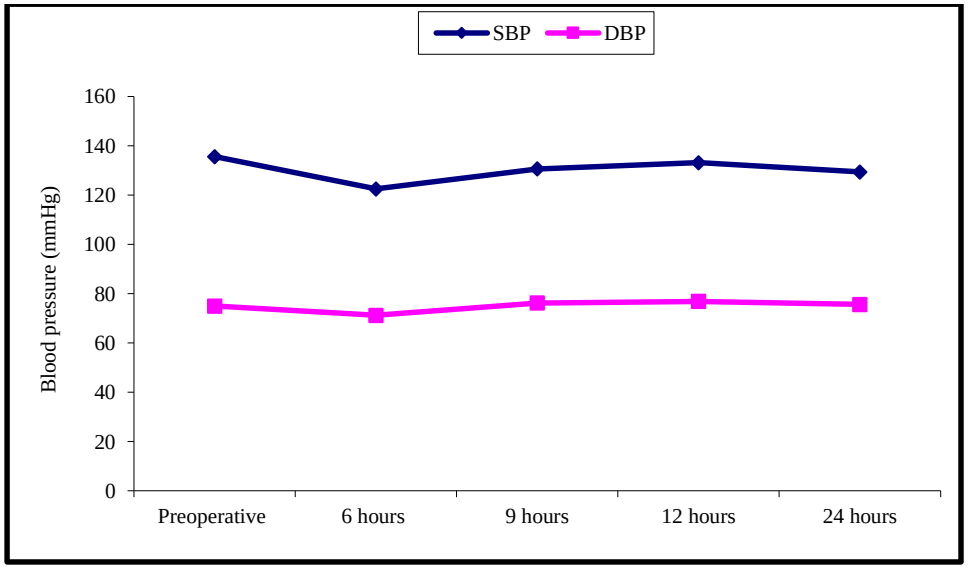

Figure (2): Follow up of systolic and diastolic blood pressures

Sedation assessment was done to all patients at all examination times. Patients showed same or slightly better Ramsy score at all times, which was statistically significant at six, nine and twelve hours postoperative (Table 6).

Table (6): Follow up for Ramsy sedation score between the studied patients

Ramsy Sedation score		**No. = Sixteen**	**Diff. from preop. Mean ± SD 95%CI**	**Test value**	**P-value***
Preoperative	Mean ± SD	1.81 ± 1.05	-	-	-
Six hours	Mean ± SD	2.25 ± 1.18	0.44 ± 0.63	2.333	0.020
Nine hours	Mean ± SD	2.25 ± 1.29	0.44 ± 0.73	2.111	0.035
Twelve hours	Mean ± SD	2.44 ± 1.21	0.63 ± 0.72	2.673	0.008
Twenty-four hours	Mean ± SD	2.13 ± 1.36	0.31 ± 0.79	1.508	0.132

DISCUSSION

The prevalence of hip illnesses among individuals tends to increase as they go through aging process. Hip surgery, being the primary therapeutic intervention for hip disorders, is often accompanied by substantial perioperative discomfort. The use of optimal perioperative analgesia has the potential to promote the recovery of older patients during the period of perioperative and reduce the incidence of the problem. The selection of opioid analgesics is often approached with caution due to the potential consequences associated with opioid usage, particularly among the older population. These issues have the potential to prolong inpatient stays and delay patient recovery. Methods of modern analgesic and regional anesthesia for perioperative pain control in older patients with hip problems have received more clinical attention in recent years. This change in emphasis is made with the intention of helping speeding up and helping the healing process. For the perioperative pain treatment of hip disorders, the method of optimum regional analgesia is a simple one that is straightforward to execute and provides enough analgesia, while conserving motor function. The PENG block is a novel regional block that provides improved analgesia with a reduced need for opioids, especially in high-risk patients. Ineffective analgesia-caused pain is also associated with an increased risk of agitation and delirium [12].

Several previous research have reported the safety and effectiveness of PENG block as reported by **Lin *et al*** [13]. Numerous case reports, reviews, and case series demonstrated the efficacy of PENG block for perioperative analgesia in hip surgery[14].

In this research, sixteen patients scheduled for surgery of hip under spinal anesthesia were included. All patients received PENG block and at the surgery end pain assessment using VAS was monitored at rest and with movement at selected times for 24 hours post-operative. it was noticed significant analgesia following the PENG block. However, pain monitoring was only done at six, nine, twelve, and twenty-four hours postoperative. hourly recording would have been more precise.

Our research focused on postoperative pain perception by enrolled patients and demonstrated the effect of important analgesics compared to preoperative pain perception. previous research compared the PENG block to other peripheral nerve blocks. There was no important difference in quadriceps strength between the groups as discovered by **Choi and coworkers** **(15)** when they compared the analgesic effects of the PENG block to those of the suprainguinal fascia iliaca compartment block. No significant variations in levels of pain, opioid intake, or quality of recovery scores were observed across groups at any time point in the randomized controlled trial conducted by **Zheng and colleagues** **(16)**, which compared the PENG block with local infiltration and included sixty participants. While, the measurement of motor weakness was not conducted in the current research, two prior randomized controlled trials have shown a reduced occurrence of motor weakness when using the PENG block in comparison with the supragingival FIB technique [17].

LIMITATIONS

Firstly, monitoring BP did not show an important difference. it might have been more beneficial if it was monitored on an hourly basis. Another limitation of our research was that the timing and doses of parenteral analgesics were not recorded.

CONCLUSION

PENG block provided important post-operative analgesia after hip surgery.

Conflict of funding and interest: There was no conflicts of interest. The research did not get any financial support from any funding source.

REFERENCES

1. **Brauer C, Coca-Perraillon M, Cutler D, Rosen A (2009):** Incidence and mortality of hip fractures in the United States. JAMA., 302: 1573–1579.
2. **Neuman M, Fleisher L, Even-Shoshan O, Mi L, Silber J (2010):** Nonoperative care for hip fracture in the elderly: the

influence of race, income, and comorbidities. Med Care, 48: 314–320.

3. **Morrison R, Magaziner J, Gilbert M *et al.* (2003):** Relationship between pain and opioid analgesics on the development of delirium following hip fracture. J Gerontol A Biol Sci Med Sci., 58:76–81.
4. **Morrison R, Magaziner J, Mc Laughlin M *et al* (2003):** The impact of post-operative pain on outcomes following hip fracture. Pain, 103: 303–311.
5. **Haines L, Dickman E, Ayvazyan S, Pearl M, Wu S, Rosenblum D *et al.* (2012):** Ultrasound-guided fascia iliaca compartment block for hip fractures in the emergency department. J EmergMed., 43: 692–697.
6. **Unneby A, Svensson O, Gustafson Y, Olofsson B (2017):** Femoral nerve block in a representative sample of elderly people with hip fracture: a randomised controlled trial. Injury, 48: 1542–1549.
7. **Beaudoin F, Haran J, Liebmann O (2013):** A comparison of ultrasound-guided three-in-one femoral nerve block versus parenteral opioids alone for analgesia in emergency department patients with hip fractures: a randomized controlled trial. Acad Emerg Med., 20: 584–591.
8. **Guay J, Parker M, Griffiths R, Kopp S (2017):** Peripheral nerve blocks for hip fractures. Cochrane Database Syst Re., 5: CD001159.
9. **Short AJ, Barnett JJG, Gofeld M *et al.* (2018):** Anatomic study of innervation of the anterior hip capsule: implication for image-guided intervention. Reg Anesth Pain Med., 43: 186–192.
10. **Bhatia A, Hoydonckx Y, Peng P, Cohen S (2018):** Radiofrequency procedures to relieve chronic hip pain. An evidence-based narrative review. Reg Anesth Pain Med., 43: 72–83.
11. **Ying H, Chen L, Yin D, Ye Y, Chen J (2023):** Efficacy of pericapsular nerve group block vs. fascia iliaca compartment block for Hip surgeries: A systematic review and meta-analysis. Front Surg., 10: 1054403. doi: 10.3389/fsurg.2023.1054403.
12. **Abou-Setta A, Beaupre L, Rashiq S, Dryden D, Hamm M, Sadowski C *et al*. (2011):** Comparative effectiveness of pain management interventions for hip fracture: A systematic review. Ann Intern Med., 155: 234–45
13. **D-Yin L, Brigid B, Craig M *et al*. (2022):** The Pericapsular Nerve Group (PENG) block combined with Local Infiltration Analgesia (LIA) compared to placebo and LIA in hip arthroplasty surgery: a multi-center double-blinded randomized-controlled trial BMC Anesthesiol., 22 (1): 252. doi: 10.1186/s12871-022-01787-2.
14. **Yang Y, Zhao X, Dong T, Yang Z, Zhang Q, Zhang Y (2017):** Risk factors for postoperative delirium following hip fracture repair in elderly patients: A systematic review and meta-analysis. Aging Clin Exp Res., 29: 115–26.
15. **Choi Y, Park K, Lee B, Nam W, Kim D (2022):** Pericapsular nerve group (PENG) block versus supra-inguinal fascia iliaca compartment block for total hip arthroplasty: a randomized clinical trial. J Pers Med., 12: 408
16. **Zheng L, Jo Y. Hwang J *et al*. (2022):** Comparison of the analgesic efficacy of periarticular infiltration and pericapsular nerve group block for total hip arthroplasty: a randomized, non-inferiority study. Ann Palliat Med., 11: 1222-1230.
17. **Senthil K, Kumar P, Ramakrishnan L (2021):** Comparison of pericapsular nerve group block versus fascia iliaca compartment block as postoperative pain management in hip fracture surgeries.Anesth Essays Res., 15: 352-356.