Pericapsular Nerve Group Block versus Local Infiltration in Direct Anterior Total Hip Arthroplasty: Evaluation in the Immediate Postoperative Period

Bloqueio pericapsular do quadril versus infiltração local em artroplastia total de quadril por via anterior direta: Avaliação no pós-operatório imediato

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Abstract

Objective To compare the pericapsular nerve group (PENG) block and local infiltration analgesia (LIA) regarding pain control, opioid consumption, adverse effects, and quadriceps function in the immediate postoperative period following total hip arthroplasty (THA) performed through a direct anterior approach.

Methods This prospective, randomized, comparative clinical study included 110 patients undergoing THA, allocated into the PENG (n = 55) and LIA (n = 55) groups. During the first 24 postoperative hours, pain was assessed using the visual analog scale (VAS), the need for rescue analgesia with morphine sulfate was recorded, quadriceps strength was evaluated using the Medical Research Council scale, and the occurrence of nausea, vomiting, and postural hypotension was assessed.

Results There were no statistically significant differences between the groups regarding pain intensity at rest or opioid consumption. Quadriceps strength was significantly lower in the PENG group compared with LIA (3.42 vs. 4.04; $p < 0.001$). The incidence of adverse effects was similar between the techniques.

Conclusion Both PENG block and LIA provided equivalent analgesia in the immediate postoperative period following direct anterior THA, with no differences in opioid consumption or adverse effects. However, PENG block was associated with a greater reduction in quadriceps strength during the first hours after surgery.

Keywords
- anesthesia, local
- arthroplasty, replacement, hip
- nerve block
- postoperative pain

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Resumo

Objetivo Comparar o bloqueio pericapsular do quadril (PENG, do inglês *pericapsular nerve group*) e a infiltração local analgésica (ILA) quanto ao controle da dor, consumo de opioides, efeitos adversos e função do quadríceps no pós-operatório imediato da artroplastia total do quadril (ATQ) realizada por acesso anterior direta.

Métodos Estudo clínico prospectivo randomizado, comparativo, incluindo 110 pacientes submetidos à ATQ, distribuídos nos grupos PENG (n = 55) e ILA (n = 55). Foram avaliadas, nas primeiras 24 horas pós-operatórias, a dor pela escala visual analógica (EVA), a necessidade de analgesia de resgate com sulfato de morfina, a força do quadríceps pela escala Medical Research Council e a ocorrência de náusea, vômito e hipotensão postural.

Resultados Não houve diferenças estatisticamente significativas entre os grupos quanto à intensidade da dor em repouso ou ao consumo de opioides. A força do quadríceps foi significativamente menor no grupo PENG em comparação ao ILA (3,42 vs. 4,04; $p < 0,001$). A incidência de efeitos adversos foi semelhante entre as técnicas.

Conclusão O bloqueio PENG e a ILA apresentaram analgesia equivalente no pós-operatório imediato da ATQ por via anterior direta, sem diferenças no consumo de opioides ou nos efeitos adversos. Entretanto, o bloqueio PENG associou-se a maior redução da força do quadríceps nas primeiras horas após a cirurgia.

Palavras-chave

- anestesia local
- artroplastia de quadril
- bloqueio nervoso
- dor pós-operatória

Introduction

Total hip arthroplasty (THA) through the direct anterior approach has been increasingly adopted because it is associated with less tissue trauma, faster functional recovery, and shorter hospital stays compared with conventional approaches, such as the posterior or direct lateral approach.[1,2] Despite these advantages, pain control in the immediate postoperative period remains a relevant clinical challenge. Severe pain during this period may limit early mobilization, increase opioid requirements, and increase the risk of complications (e.g., nausea, vomiting, delirium, prolonged hospitalization).[3,4]

Effective analgesic strategies during the first 24 hours are essential to facilitate early rehabilitation, reduce hospital length of stay and costs, as well as to improve the patient experience.[5–7] Among the available options, the pericapsular nerve group (PENG) block, described by Girón-Arango et al.[8] in 2018, has been investigated as a regional anesthesia technique aimed at providing analgesia to the anterior hip capsule while preserving quadriceps motor function.[8,9] At the same time, local infiltration analgesia (LIA) remains widely used because of its simplicity, safety, and clinical efficacy, although outcomes vary across different protocols and populations.[10] Studies have emphasized that the use of PENG block, LIA, or a combination of both may be important for adequate patient recovery.[11,12]

The present study aims to compare these two approaches in terms of pain, opioid use, adverse effects, and muscle function during the first 24 hours after surgery. Clarifying the effectiveness of each technique may contribute to the standardization of evidence-based anesthetic protocols, with potential benefits for quality of care and hospital efficiency.

Methods

This prospective, randomized, comparative clinical study was conducted between May and December 2025 at a referral orthopedic hospital. A total of 110 patients undergoing THA through the direct anterior approach were evaluated. Participants were randomly allocated in a 1:1 ratio to two groups: PENG (n = 55) and LIA (n = 55). Randomization was performed using a computer-generated random sequence.

The analysis was restricted to the first 24 postoperative hours. The variables collected included age, sex, Body Mass Index (BMI), American Society of Anesthesiologists (ASA) classification,[13] degree of osteoarthritis according to the Tönnis classification,[14] pain intensity assessed using the Visual Analog Scale (VAS),[15] quadriceps muscle strength 6 hours after the surgical procedure assessed using the Medical Research Council (MRC) scale,[16] need for rescue analgesia with morphine sulfate, and the occurrence of nausea, vomiting, and postural hypotension.

Patients aged 18 to 100 years with a clinical and radiographic diagnosis of hip osteoarthritis, classified as ASA I to III, and scheduled for elective surgery were included. The exclusion criteria were peripheral neuropathy of the lower limbs, chronic opioid use, a diagnosis of dementia or decompensated psychiatric disorders, bilateral surgery or revision arthroplasty, coagulopathy, allergy to local anesthetics, active infection, refusal to participate, or failure to provide written informed consent.

A LIA procedure was performed by the surgeon at the end of the surgery, before closure of the tensor fasciae latae, using 20 mL of 0.75% ropivacaine, with 1 mL of ketorolac tromethamine at 30 mg/mL, and 1 mL of epinephrine at 1 mg/mL, administered to the periarticular muscle groups and

Table 1 Preoperative baseline characteristics according to nerve block group in patients undergoing THA

Features	PENG ($n = 55$)	LIA ($n = 55$)	*p*-value
Age	65.0 (58.0–73.0)	63.0 (56.0–73.0)	0.611¥
Gender			
Female	23 (46.9)	26 (53.1)	0.701*
Male	32 (52.5)	29 (47.5)	
BMI (kg/m^2)	25.6 (24.1–28.7)	27.2 (24.9–30.7)	0.086¥
ASA			
Risk 1	15 (53.6)	13 (46.4)	0.333**
Risk 2	38 (51.4)	36 (48.6)	
Risk 3	2 (25.0)	6 (75.0)	
Osteoarthritis grade			
Grade 1	0 (0.0)	2 (100.0)	0.341**
Grade 2	15 (48.4)	16 (51.6)	
Grade 3	40 (51.9)	37 (48.1)	

Abbreviations: ASA, American Society of Anesthesiologists; BMI, body mass index; LIA, local infiltration analgesia; PENG, pericapsular nerve group; THA, total hip arthroplasty.
Notes: *Fisher's exact test; **Pearson's Chi-squared test; ¥Mann-Whitney U test. Data were presented as median (P25–P75) and absolute number (%).

subcutaneous tissue, according to the technique described by Kerr and Kohan.[10]

The PENG block, in turn, was performed before closure of the joint capsule, with the patient in the supine position. Using anatomical landmarks, including the anteroinferior iliac spine and the pubic ramus, a 22-gauge needle was advanced medially between the psoas tendon and the iliac ramus, where 20 mL of 0.5% ropivacaine was injected. The procedure was performed without ultrasound guidance, following a landmark-based technique adapted from the original description by Girón-Arango et al.[8]

The study was conducted in accordance with Resolution No. 466/2012 of the Brazilian National Health Council. All patients provided written informed consent, in accordance with the ethical principles of beneficence, nonmaleficence, justice, and autonomy. The study was approved by a Research Ethics Committee within the Brazilian National Ethics Committee (CEP/CONEP, in Portuguese 'Comitê de Ética e Pesquisa / Comissão Nacional de Ética em Pesquisa') system, under the CAAE number 75628123.7.0000.5342.

Statistical analyses were performed using the IBM SPSS Statistics for Windows (IBM Corp.) software, version 24.0. Fisher's exact test and Pearson's chi-squared test were used to compare categorical variables between groups. Because the numerical variables did not meet the assumption of normality, as assessed using the Kolmogorov-Smirnov test, between-group comparisons of numerical variables were performed using the nonparametric Mann-Whitney U test. The significance level was set at 5%.

Results

A total of 110 patients with hip osteoarthritis were evaluated and equally allocated according to the predefined randomization scheme: 1. PENG block (n = 55); and 2. LIA (n = 55). There were no statistically significant differences between the groups in preoperative baseline characteristics (►**Table 1**).

There were no statistically significant differences between the groups in VAS pain scores at rest ($p = 0.228$) or in the total amount of morphine sulfate administered during the first 24 postoperative hours ($p = 0.615$). In contrast, quadriceps muscle strength on the operated side differed significantly between the groups. Patients who received the PENG block had lower quadriceps strength than those who received LIA 6 hours after surgery (3.42 vs. 4.04; $p < 0.001$), as shown in ►**Table 2**.

Regarding postoperative complications, nausea occurred in 8 patients in the PENG group, and no patients experienced vomiting. In the LIA group, nausea also occurred in 8 patients, while 3 experienced vomiting. Neither outcome differed significantly between the groups. Postural hypotension occurred in 9 patients in the PENG group and 7 in the LIA group ($p = 0.788$), as shown in ►**Table 3**.

Discussion

In the present study, the PENG block and LIA showed similar efficacy in controlling pain during the first 24 hours after THA performed through the direct anterior approach. No statistically significant differences were observed between the groups in pain scores at rest or morphine sulfate consumption during the immediate postoperative period. In contrast, a significant reduction in quadriceps strength was observed in the PENG group compared with the LIA group.

The comparable analgesic efficacy observed between the techniques is consistent with recent evidence in the

Table 2 Postoperative morphine consumption, pain, and muscle strength according to nerve block group in patients undergoing THA

Features	PENG (n = 55)	LIA (n = 55)	*p*-value*
Morphine (mg)	0.65 (1.88)	0.89 (3.33)	0.615
Pain (NRS)	3.0 (0.0–5.0)	2.0 (0.0–4.0)	0.228
Quadriceps strength (MRC)	3.42 (0.99)	4.04 (0.61)	$\leq$ 0.001

Abbreviations: LIA, Local infiltration analgesia; MRC, Medical Research Council; NRS, numeric rating scale; PENG, pericapsular nerve group; THA, total hip arthroplasty.**Notes:** *Mann-Whitney U test. Data were presented as presented as median (P25–P75) and mean (standard deviation).

literature. Randomized clinical trials and systematic reviews have shown that, although effective, the PENG block does not consistently provide superior pain control or reduce opioid consumption compared with LIA during the first 24 hours after THA.[17–19] In a meta-analysis of andomized clinical trials, Bravo et al.[18] reported similar outcomes with PENG and LIA in terms of analgesia, opioid requirements, and the incidence of adverse effects, supporting the view that both strategies have comparable efficacy.

The same randomized clinical trial comparing the PENG block with periarticular anesthetic infiltration in patients undergoing THA found no clinically relevant differences between the techniques in postoperative pain scores or opioid consumption, although periarticular infiltration resulted in slightly lower static and dynamic pain scores at some time points during the immediate postoperative period. These findings corroborate the results of the present study and support LIA as an effective and broadly applicable alternative for pain control in the immediate postoperative period.[18]

The main distinguishing finding of this study was the lower quadriceps strength observed in the PENG group. Although this block was initially described as a predominantly sensory technique, a case report indicates that some degree of motor impairment may occur, particularly during the first hours after the procedure.[8,9] In response to this report, Girón-Arango and Peng[19] suggested that the occurrence of motor deficits may be related to variations in technique, injection volume, or injection site, emphasizing that this effect does not necessarily represent an inherent characteristic of PENG block when performed according to the original technique.[19]

The anatomical proximity of the injection site to the femoral nerve and its motor branches may explain this effect, particularly when greater spread of the local anesthetic occurs. This issue is of particular clinical relevance in the context of the direct anterior approach, which is frequently associated with enhanced recovery protocols where preservation of muscle function is essential for early mobilization and adequate rehabilitation. More recent evidence indicates that the PENG block may result in quadriceps weakness in 25 to 45% of cases. Although medial spread allows coverage of the articular branches of the femoral, obturator, and accessory obturator nerves, concomitant spread to the femoral nerve within the iliac fossa compartment may lead to quadriceps weakness.[20]

Regarding adverse effects, no statistically significant differences were observed between the groups in the occurrence of nausea, vomiting, or postural hypotension. These findings are consistent with other recent studies showing no consistent advantage of one technique over the other with respect to the incidence of clinical complications during the immediate postoperative period, when both are used as part of multimodal analgesic strategies.[17,21]

Several limitations should be considered when interpreting the results. These include the lack of pain assessment during mobilization, measurement of muscle strength at a single time point, and the use of a subjective clinical scale to assess quadriceps strength without objective instrumental methods. Nevertheless, the adequate sample size, homogeneity of the groups, and direct comparison between the two strategies lend consistency to the presented findings.

In summary, the results of this study indicate that the PENG block and LIA provide equivalent analgesia during the

Table 3 Postoperative complications according to nerve block group in patients undergoing THA

Features	PENG (n = 55)	LIA (n = 55)	*p*-value*
Postural hypotension	9 (16.4)	7 (12.7)	0.788
Nausea	8 (14.5)	8 (14.5)	1.000
Vomiting	0 (0.0)	3 (5.5)	0.243

Abbreviations: LIA, local infiltration analgesia; PENG, pericapsular nerve group; THA, total hip arthroplasty.
Note: *Fisher's exact test. Data were presented as absolute number (%).

immediate postoperative period following THA through the direct anterior approach. However, the association between PENG block and a greater reduction in quadriceps strength suggests that LIA may represent a more functionally favorable alternative during this early period. These findings may contribute to clinical decision-making when selecting an analgesic strategy, particularly in settings in which early mobilization and preservation of muscle function are priorities.

Conclusion

During the immediate postoperative period following THA through the direct anterior approach, the PENG block and LIA showed similar efficacy in pain control and the need for rescue opioid analgesia during the first 24 hours. However, PENG block was associated with a greater reduction in quadriceps strength when compared with LIA. These findings suggest that, in the context of early recovery, LIA may represent a more functionally favorable alternative, providing adequate analgesia without significant motor impairment.

Data Availability

Data will be available upon request to the corresponding author.

Authors' Contributions

Each author contributed individually and significantly to the development of the present article. BDR: conceptualization and supervision; HED: investigation, writing – original draft, and writing – review and editing; investigation; MVR: formal analysis and supervision; EMUL: formal analysis; MDB: methodology and formal analysis; and NNS: investigation.

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Conflict of Interests

The authors have no conflict of interests to declare.

References

1 Barrett WP, Turner SE, Leopold JP. Prospective randomized study of direct anterior vs postero-lateral approach for total hip arthroplasty. J Arthroplasty 2013;28(09):1634–1638. Doi: 10.1016/j.arth.2013.01.034
2 Taunton MJ, Trousdale RT, Sierra RJ, Kaufman K, Pagnano MW. John Charnley Award: randomized clinical trial of direct anterior and miniposterior approach total hip arthroplasty: which provides better functional recovery? Clin Orthop Relat Res 2018;476(02):216–229. Doi: 10.1007/s11999.0000000000000112
3 Memtsoudis SG, Cozowicz C, Bekeris J, et al. Anaesthetic care of patients undergoing primary hip and knee arthroplasty: consensus recommendations from the International Consensus on Anaesthesia-Related Outcomes after Surgery group (ICAROS) based on a systematic review and meta-analysis. Br J Anaesth 2019;123(03):269–287. Doi: 10.1016/j.bja.2019.05.042
4 Apfelbaum JL, Chen C, Mehta SS, Gan TJ. Postoperative pain experience: results from a national survey suggest postoperative pain continues to be undermanaged. Anesth Analg 2003;97(02):534–540. Doi: 10.1213/01.ANE.0000068822.10113.9E
5 Kehlet H. Fast-track hip and knee arthroplasty. Lancet 2013;381(9878):1600–1602. Doi: 10.1016/S0140-6736(13)61003-X
6 Wainwright TW, Immins T, Middleton RG. Enhanced recovery after surgery (ERAS) and its applicability for major spine surgery. Best Pract Res Clin Anaesthesiol 2016;30(01):91–102. Doi: 10.1016/j.bpa.2015.11.001
7 Soffin EM, YaDeau JT. Enhanced recovery after surgery for primary hip and knee arthroplasty: a review of the evidence. Br J Anaesth 2016;117(Suppl 3):iii62–iii72. Doi: 10.1093/bja/aew362
8 Girón-Arango L, Peng PWH, Chin KJ, Brull R, Perlas A. Pericapsular Nerve Group (PENG) Block for Hip Fracture. Reg Anesth Pain Med 2018;43(08):859–863. Doi: 10.1097/AAP.0000000000000847
9 Yu HC, Moser JJ, Chu AY, Montgomery SH, Brown N, Endersby RVW. Inadvertent quadriceps weakness following the pericapsular nerve group (PENG) block. Reg Anesth Pain Med 2019;44(05):611–613. Doi: 10.1136/rapm-2018-100354
10 Kerr DR, Kohan L. Local infiltration analgesia: a technique for the control of acute postoperative pain following knee and hip surgery: a case study of 325 patients. Acta Orthop 2008;79(02):174–183. Doi: 10.1080/17453670710014950
11 Anger M, Valovska T, Beloeil H, et al; PROSPECT Working Group* and the European Society of Regional Anaesthesia and Pain Therapy. PROSPECT guideline for total hip arthroplasty: a systematic review and procedure-specific postoperative pain management recommendations. Anaesthesia 2021;76(08):1082–1097. Doi: 10.1111/anae.15498
12 Zhang Q, Chen Y, Li Y, et al. Enhanced recovery after surgery in patients after hip and knee arthroplasty: a systematic review and meta-analysis. Postgrad Med J 2024;100(1181):159–173. Doi: 10.1093/postmj/qgad125
13 American Society of Anesthesiologists. American Society of Anesthesiologists Statement on ASA Physical Status Classification System. Anesthesiol Open 2026;1(01):e0002. Doi: 10.1097/ao9.0000000000000002
14 Tönnis D. Congenital dysplasia and dislocation of the hip in children and adults. Berlin: Springer-Verlag; 1987
15 Hawker GA, Mian S, Kendzerska T, French M. Measures of adult pain: Visual Analog Scale for Pain (VAS Pain), Numeric Rating Scale for Pain (NRS Pain), McGill Pain Questionnaire (MPQ), Short-Form McGill Pain Questionnaire (SF-MPQ), Chronic Pain Grade Scale (CPGS), Short Form-36 Bodily Pain Scale (SF-36 BPS), and Measure of Intermittent and Constant Osteoarthritis Pain (ICOAP). Arthritis Care Res (Hoboken) 2011;63(Suppl 11):S240–S252. Doi: 10.1002/acr.20543
16 Parte superior do formulárioParte inferior do formulárioMedical Research Council. Aids to the examination of the peripheral nervous system. Memorandum No. 45 (superseding War Memorandum No. 7). London: Her Majesty's Stationery Office; 1976
17 Chen J, Loke RWK, Wong EY, Tan BWL. Efficacy of pericapsular nerve group block (PENG) compared to local infiltration analgesia (LIA) after total hip arthroplasty: a systematic review and meta-analysis of randomized controlled trials. Musculoskelet Surg 2026;110(01):29–39. Doi: 10.1007/s12306-025-00915-8
18 Bravo D, Aliste J, Layera S, et al. Randomized clinical trial comparing pericapsular nerve group (PENG) block and periarticular local anesthetic infiltration for total hip arthroplasty. Reg Anesth Pain Med 2023;48(10):489–494. Doi: 10.1136/rapm-2023-104332
19 Arango LG, Peng P. Reply to Dr Yu *et al*: Inadvertent quadriceps weakness following the pericapsular nerve group (PENG) block. Reg Anesth Pain Med 2019;44(05):613–614. Doi: 10.1136/rapm-2018-100263

20 Yeoh SR, Chou Y, Chan SM, Hou JD, Lin JA. Pericapsular nerve group block and iliopsoas plane block: a scoping review of quadriceps weakness after two proclaimed motor-sparing hip blocks. Healthcare (Basel) 2022;10(08):1565. Doi: 10.3390/healthcare10081565 Erratum in: Healthcare (Basel) 2022;10 (8):1804 10.3390/healthcare10091804

21 Ye S, Wang L, Wang Q, Li Q, Alqwbani M, Kang P. Comparison between Ultrasound-Guided Pericapsular Nerve Group Block and Local Infiltration Analgesia for Postoperative Analgesia after Total Hip Arthroplasty: A Prospective Randomized Controlled Trial. Orthop Surg 2023;15(07):1839–1846. Doi: 10.1111/os.13777