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RESEARCH ARTICLE (ORIGINAL)

Management of acute postoperative pain in hiparthroplasty: Analgesic efficacy of peripheral nerve blocks

Gestão da dor aguda pós-operatório na artroplastia da anca: Eficácia analgésica dos bloqueios de nervo periférico

Tratamiento del dolor posoperatorio agudo en la artroplastia de cadera: Eficacia analgésica de los bloqueos nerviosos periféricos

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Abstract
Background: Locoregional analgesia is a recommended method for treating postoperative pain.
Objective: To compare the analgesic efficacy of femoral nerve block (FNB) combined with lateral femoral cutaneous nerve block (LFCNB); pericapsular nerve group (PENG) block combined with LFCNB; and fascia iliaca compartment block (FICB) alone in patients undergoing primary hip arthroplasty.
Methodology: Analytical-correlational and retrospective study with a total of 994 patients. The non-probability convenience sample was obtained from January 1, 2013, to October 15, 2023. Ethical principles were safeguarded. Descriptive and inferential analysis was carried out using the Python Programming Language software (Version 3.12).
Results: Most patients reported no pain at rest (82.7%) and mild movement-evoked pain (55.2%). Rescue analgesia with opioids was low (7.8%). The group of patients undergoing PENG block+LFCNB had a lower degree of sensory block than those undergoing FNB+LFCNB (p = 0.036).
Conclusion: These different techniques have similar analgesic efficacy. The results suggest that PENG block+LFCNB can provide effective analgesia with fewer adverse effects.

Keywords: arthroplasty, replacement, hip; acute pain; nerve block; analgesia; nursing

Resumo
Enquadramento: A analgesia loco-regional é um método recomendado no tratamento da dor do pós-operatório.
Objetivo: Comparar a eficácia do bloqueio de nervo femoral (BNF) e cutâneo lateral da coxa (CLC); bloqueio do grupo nervoso pericapsular (PENG) e CLC e bloqueio da fáscia ilíaca em doentes submetidos a artroplastia primaria da anca.
Metodologia: Estudo analítico-correlacional e retrospetivo, num total de 994 doentes, obtida uma amostra não probabilística por conveniência, de 1 janeiro a 15 outubro de 2023. Foram salvaguardados os princípios éticos. Realizou-se análise descritiva e inferencial com recurso ao programa *Python Programming Language* (versão 3.12).
Resultados: A maioria dos doentes referiu ausência de dor em repouso (82,7%) e dor ligeira em movimento (55,2%). A analgesia de resgate com opioides foi reduzida (7,8%). O grupo de doentes submetidos ao PENG+CLC é aquele que apresenta menor grau de bloqueio sensitivo comparando com o BNF+CLC (p = 0,036).
Conclusão: A eficácia analgésica é semelhante nas diferentes técnicas. Os resultados sugerem que o PENG+CLC pode resultar numa analgesia eficaz com menos efeitos adversos.

Palavras-chave: artroplastia de quadril; dor aguda; bloqueio nervoso; analgesia; enfermagem

Resumen
Marco contextual: La analgesia locorregional es un método recomendado para tratar el dolor posoperatorio.
Objetivo: Comparar la eficacia del bloqueo del nervio femoral (BNF) y el bloqueo cutáneo lateral del muslo (CLC); el bloqueo del grupo nervioso pericapsular (PENG) y el bloqueo del CLC y la fascia ilíaca en pacientes sometidos a artroplastia primaria de cadera.
Metodología: Estudio analítico-correlacional y retrospectivo de un total de 994 pacientes, obtenidos a partir de una muestra de conveniencia no probabilística, desde el 1 de enero hasta el 15 de octubre de 2023. Se respetaron los principios éticos. Se realizó un análisis descriptivo e inferencial mediante el programa *Python Programming Language* (versão 3.12).
Resultados: La mayoría de los pacientes indicaron ausencia de dolor en reposo (82,7%) y dolor leve en movimiento (55,2%). La analgesia de rescate con opiáceos fue baja (7,8%). El grupo de pacientes sometidos a PENG+CLC presentó el menor grado de bloqueo sensitivo en comparación con BNF+CLC (p = 0,036).
Conclusión: La eficacia analgésica es similar en las distintas técnicas. Los resultados sugieren que PENG+CLC puede dar lugar a una analgesia eficaz con menos efectos adversos.

Palabras clave: artroplastia de cadera; dolor agudo; bloqueo nervioso; analgesia; enfermería

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Introduction

Hip replacement surgeries are usually performed in case of degenerative disease. Regardless of the type of surgical technique used in primary total hip arthroplasty (THA), hip surgery causes significant acute postoperative pain (APOP). APOP has emerged as a cause of morbidity and mortality associated with surgical procedures. Poorly controlled APOP is associated with impaired physical function and quality of life, slowed recovery, prolonged opioid use, and increased cost of care (Gan, 2017). In addition, the presence and intensity of acute pain during or after surgery is a predictive risk factor for the development of chronic pain (Gan, 2017).

Despite evidence-based clinical guidelines, the treatment of APOP remains inadequate (Joshi et al., 2019). Possible reasons for the failure to address acute pain include: the set of published guidelines are general in nature; conventional guidelines predominantly review single-analgesic interventions compared to placebo; and, in addition, they usually pool together different surgical procedures, failing to consider that they have variable pain characteristics, such as the nature of the pain (somatic or visceral), site, intensity, and duration (Joshi et al., 2019).

The recognition of these limitations led to the creation of the Procedure Specific Postoperative Pain Management (PROSPECT) working group, which provides healthcare professionals with practical and evidence-based recommendations to facilitate clinical decision-making across all stages of the perioperative period on a surgical procedure-specific basis (Joshi et al., 2019).

Efficient structural organization in pain management is widely recognized as a fundamental aspect of patient care. Thus, it is important to strengthen nurses' intervention in postoperative care and in Acute Pain Units (APUs), particularly in pain assessment, surveillance, teaching, and implementation of APOP protocols (Rawal, 2016).

The recent increase in the use of locoregional analgesia techniques to manage APOP in Portugal and the scarcity of published studies justify the relevance of this study. This study expects to increase nurses' knowledge of the nursing care needs of people in pain, particularly those resulting from postoperative assessment (pain intensity, systemic adverse effects, and use of rescue analgesia with opioids). The general aim of this study is to compare the efficacy of femoral nerve block (FNB) combined with lateral femoral cutaneous nerve block (LFCNB), pericapsular nerve group (PENG) block combined with LFCNB, and fascia iliaca compartment block (FICB) alone in patients undergoing THA.

Background

Osteoarthritis is one of the leading causes of pain and functional disability, with a higher prevalence among older people due to its degenerative nature. The number of people affected globally increased by 48% between 1990 and 2019 (Hunter et al., 2020). Joint replacement surgery is the recommended intervention to restore physical function and relieve pain in affected joints in people with joint pain or limitations in performing activities of daily living after undergoing conservative treatment or other previous surgical treatments (Direção-Geral da Saúde [DGS], 2012).

Regardless of the type of surgical technique used in THA, these surgeries cause significant APOP, which can lead to poor control and additional complications. Given that this condition is more prevalent among older people, conventional systemic analgesia is not always the ideal analgesic method due to the adverse effects associated with the use of opioids in the postoperative period, namely nausea, vomiting, constipation, and others (Girón-Arango et al., 2018; Ying et al., 2023).

A recent review confirmed that APOP remains common, with around 20% of patients experiencing severe pain in the first 24 hours after surgery, a figure that has remained largely unchanged over the last 30 years (Small & Laycock, 2020). Data from the UK Perioperative Quality Improvement Program 2021-2023 confirms that it remains a significant problem, with 37% of patients reporting moderate pain and 18% reporting severe pain at the surgical site within 24 hours of surgery (Royal College of Anaesthetists, 2023).

FNB and FICB are analgesic techniques used to control APOP in hip surgery. More recently, Girón-Arango et al. (2018) described the PENG block, which anesthetizes the femoral, obturator, and accessory obturator nerves. By preserving the motor components of quadriceps muscle strength, this technique can result in better preservation of motor function. In a single-center double-blinded randomized comparative trial, Lin et al. (2021) compared the analgesic efficacy of PENG block and FNB. The results showed that the group of patients who received a PENG block for APOP management experienced less pain in the first 4 hours after surgery, with no differences detected in either group after 24 hours. Quadriceps strength was better preserved in patients who received a PENG block. It was not possible to assess differences in opioid consumption.

In a systematic review and meta-analysis to compare outcomes of PENG block versus FICB in patients undergoing THA, Ying et el. (2023) found no differences in pain intensity scores within 24 hours of surgery. However, the overall consumption of analgesics over 24 hours was significantly lower in patients with PENG block. The limited data available showed no differences in adverse effects related to opioid use, such as nausea and vomiting, in either group. The researchers concluded that the quality of the evidence suggests that the PENG block may result in better analgesia than FICB. Data on motor activity and associated complications were scarce to draw conclusions.

In 2021, the PROSPECT group published a set of recommendations for APOP management after THA, suggesting that FICB or local infiltration analgesia are recommended, especially if there are contraindications to basic analgesics and/or in patients with high expected postoperative pain. FNB (risk of increasing the degree of motor block), lumbar plexus block, and gabapentinoid

administration are not recommended as the adverse effects outweigh the benefits (Anger et al., 2021). Surgical and anesthetic techniques appear to have a minor impact on APOP, although spinal anesthesia is recommended due to its association with better postoperative outcomes compared to general anesthesia. However, studies into its benefits on APOP remain inconclusive, so its choice should be based on criteria other than pain (Anger et al., 2021).

Research question

What is the level of pain intensity of patients undergoing THA with peripheral nerve block techniques? What are the adverse effects of using peripheral nerve block techniques in patients undergoing THA? How is the rescue analgesia with opioids used? Are there any differences in pain intensity in patients undergoing THA depending on the type of block used (FNB+LFCNB, PENG block+LFCNB, and FICB)? Are there any differences in the adverse effects of patients undergoing THA depending on the type of block used (FNB+LFCNB, PENG block+LFCNB, and FICB)?

Methodology

This was a retrospective, correlational-analytical study. Participants included patients followed in the APU of a hospital in northern Portugal who underwent THA and peripheral nerve block techniques to manage APOP between January 1, 2013, and October 15, 2023. They were selected using a non-probability convenience sampling technique. Inclusion criteria were as follows: age over 18 years; both sexes; surgery under spinal anesthesia; patients without neurocognitive alterations; and no incomplete records. Data were obtained in Microsoft Excel format from a database of APU clinical records, which is managed by the anesthesiology department. This database was used to collect data for this study. Data extracted included: age (age groups); gender (female/male); intensity of pain at rest and movement-evoked pain (Verbal Descriptor Scale: 0 - *no pain*; 1 - *mild pain*; 2 - *moderate pain*; 3 - *severe pain*; 4 - u*nbearable pain*); motor block levels (Bromage Scale: M1 - *no block*; M2 - *slight decrease in muscle strength*; M3 - *significant decrease in muscle strength*; M4 - *complete block*); levels of sensory block (Levels adopted by the team: S1 - *no paresthesia*; S2 - *paresthesia in a small area*; S3 - *paresthesia in the whole limb*); use of rescue analgesia (*yes*/*no*); presence of systemic adverse effects (*yes*/*no*); and peripheral nerve block technique used (FNB+LFCNB, PENG block+LFCNB, and FICB). The data collected are from the APU nurses' assessment during the first 24 hours after surgery, except for sociodemographic data and identification of the regional analgesia technique, which are from the initial records of the entire team. These data were extracted in October 2023 by the first author of this article, after authorization from the anesthesiology department. The reliability of the process is ensured by the size of the sample, the detailed description of the data collection procedure, and the confirmation of the process by a second researcher (second author of the article). The study was carried out in accordance with current scientific evidence and received a favorable opinion No. 169/2023 from the Board of Directors and the Ethics Committee of the hospital where it was conducted.

Data were exported and analyzed using Python Programming Language (version 3.12). Absolute and relative frequencies were used for statistical description. The discrete and non-continuous nature of the categorical and ordinal variables used in this study, as well as the assumptions underlying the normality tests, mean that it is not appropriate or relevant to apply normality tests. Therefore, the non-parametric Mann-Whitney *U*-test (*U*) was used to determine any statistically significant differences between the groups. This test was chosen for its ability to compare independent groups when the data do not follow a normal distribution. It was preceded by the Chi-square test to check for differences among all groups. A significance level of $p < 0.05$ was used for all analyses.

Results

This study included the records of 994 patients, mostly women (53.0%) aged between 60 and 79 years (60.2%). The most common technique was FNB+LFCNB (77.5%), followed by PENG block+LFCNB (14.4%) and FICB (8.1%). At 24 hours, the nurses prescribed re-evaluations to 12.7% of patients, mainly due to the presence of moderate to severe pain or adverse effects.

Regarding pain at rest, most patients (82.7%) reported experiencing no pain. Regarding movement-evoked pain, 55.2% of patients experienced mild pain and 17.6% experienced at least moderate pain (Table 1).

Table 1

Characterization of the intensity of pain at rest and movement-evoked pain in the first 24 hours (n = 994)

	Pain at rest		Movement-evoked pain	
	n	%	*n*	%
No pain	822	82.7	270	27.2
Mild pain	148	14.9	549	55.2
Moderate pain	21	2.1	156	15.7
Severe pain	3	0.3	18	1.8
Unbearable pain	0	0.0	1	0.1

Note. *n* = Frequency; % = Percentage.

Most patients reported no adverse effects associated with the nerve block techniques when assessed in the first 24 hours after THA. Of the few adverse effects, the most frequent was sensory block with paresthesia in a small area (13%), followed by motor block with a slight decrease in muscle strength (4.9%). The most common systemic adverse effects were nausea and vomiting (3.5%; Table 2).

Table 2

Characterization of adverse effects in the first 24 hours (n = 994)

Adverse effects		*n*	%
Motor block	M1 - no block	945	95.1
	M2 - slight decrease in muscle strength	49	4.9
	M3 - significant decrease in muscle strength	0	0.0
	M4 - complete block	0	0.0
Sensory block	S1 - no paresthesia	864	86.9
	S2 - paresthesia in a small area	129	13.0
	S3 - paresthesia in the whole limb	1	0.1
Systemic effects	No effects	955	96.1
	Nausea/vomiting	35	3.5
	Hypotension	2	0.2
	Dizziness	1	0.1
	Other	1	0.1

Note. *n* = Frequency; % = Percentage.

Rescue analgesia with opioids was used in a small percentage of patients (7.8%).

Table 3 shows the results of the distribution of patients according to the different levels of pain, depending on the nerve block techniques used.

Table 3

Intensity of pain at rest (R) and movement-evoked pain (M), according to the peripheral nerve block techniques (n = 994)

Pain intensity		FNB+LFCNB[1] (*n* = 770)		PENG block+LFCNB[2] (*n* = 143)		FICB[3] (*n* = 81)	
		n	%	*n*	%	*n*	%
Pain at rest	R0 - no pain	641	83.2	112	78.3	69	85.2
	R1 - mild pain	110	14.3	28	19.6	10	12.3
	R2 - moderate pain	16	2.1	3	2.1	2	2.5
	R3 - severe pain	3	0.4	0	0.0	0	0.0
	R4 - unbearable pain	0	0.0	0	0.0	0	0.0
Movement-evoked pain	M0 - no pain	213	27.7	41	28.7	16	19.8
	M1 - mild pain	419	54.4	74	51.7	56	69.1
	M2 - moderate pain	123	16.0	25	17.5	8	9.9
	M3 - severe pain	14	1.8	3	2.1	1	1.2
	M4 - unbearable pain	1	0.1	0	0.0	0	0.0

Note. n = Frequency; % = Percentage; [1] FNB+LFCNB = Femoral nerve block + lateral femoral cutaneous nerve block; [2] PENG block+LFCNB = Pericapsular nerve group block + lateral femoral cutaneous nerve block; [3] FICB = Fascia iliaca compartment block.

In response to the question "Are there any differences in pain intensity in patients undergoing THA depending on the type of block used?", the Chi-square test did not reveal any statistically significant differences (at rest χ^2 = 3.999746; p = 0.676; movement-evoked χ^2 = 7.65138; p = 0.468). Even so, based on these results, the Mann-Whitney *U*-test was carried out, which also revealed no statistically significant differences between the intensity of pain at rest and movement-evoked pain and the peripheral nerve block techniques used (Table 4).

Table 4

Comparison between pain intensity and peripheral nerve block techniques

Nerve block techniques	Pain at rest		Movement-evoked pain	
	Mann-Whitney *U*-test (*U*)	*p*	Mann-Whitney *U*-test (*U*)	*p*
(FNB+LFCNB) + (PENG block+LFCNB)	52449.0	0.172	54855.0	0.939
(FNB+LFCNB) + (FICB)	31777.5	0.662	30696.0	0.795
(PENG block+LFCNB) + (FICB)	6176.0	0.228	5725.5	0.873

Note. p = Significance level; $p < 0.05$; FNB+LFCNB = Femoral nerve block + lateral femoral cutaneous nerve block; PENG block+LFCNB = Pericapsular nerve group block + lateral femoral cutaneous nerve block; FICB = Fascia iliaca compartment block.

No differences were found in the adverse effects of patients undergoing THA depending on the type of block (FNB+LFCNB; PENG block+LFCNB, and FICB), except for the degree of sensory block between two groups. PENG block+LFCNB had the lowest degree of sensory block (Table 5).

Motor block was similar in the three techniques, but PENG block also caused less motor block (97.9%) than FICB (92.6%), with a difference close to the threshold of significance (U = 5484.0; p = 0.052).

Table 5

Degree of sensory block and mean pain scores according to the peripheral nerve block techniques (n = 994)

		FNB+LFCNB[1] (*n* = 769)		PENG block+LFCNB[2] (*n* = 143)		FICB[3] (*n* = 81)	
		n	%	*n*	%	*n*	%
Sensory block	S1 - no paresthesia	662	86.1	132	92.3	70	86.4
	S2 - paresthesia in a small area	107	13.9	11	7.7	11	13.6
Mean pain scores		1.139142		1.076923		1.135802	

Note. *n* = Frequency; % = Percentage; [1] FNB+LFCNB = Femoral nerve block + lateral femoral cutaneous nerve block; [2] PENG block+LFCNB = Pericapsular nerve group block + lateral femoral cutaneous nerve block; [3] FICB = Fascia iliaca compartment block.

In response to the question "Are there any differences in the adverse effects of patients undergoing THA depending on the type of block used?", the Chi-square test was initially carried out to check for differences between all groups, but it did not reveal any statistically significant differences ($\chi^2 = 4.156659$; $p = 0.125$). Even so, based on these results, the Mann-Whitney *U*-test was performed, which revealed a statistically significant difference between FNB+LFCNB and PENG block+LFCNB ($p = 0.041$; Table 6).

Table 6

Comparison between the degree of sensory block and the peripheral nerve block techniques

Nerve block techniques	Mann-Whitney *U*-test (*U*)	*p*
(FNB+LFCNB) + (PENG block+LFCNB)	58404.5	* 0.041
(FNB+LFCNB) + (FICB)	31248.5	0.934
(PENG block+LFCNB) + (FICB)	5450.5	0.156

Note. *p* = Significance level; * $p < 0.05$; FNB+LFCNB = Femoral nerve block + lateral femoral cutaneous nerve block; PENG block+LFCNB = Pericapsular nerve group block + lateral femoral cutaneous nerve block; FICB = Fascia iliaca compartment block.

Discussion

The use of surgical site-specific regional techniques has proven effective as part of multimodal analgesia for APOP. These findings reflect an evaluation conducted over a 10-year period by APU nurses at a hospital in northern Portugal. The evaluation was performed during the first 24 hours after THA and aimed to compare the analgesic efficacy of three different peripheral nerve block techniques. The most frequently used peripheral nerve block technique was FNB+LFCNB (77.5%), followed by PENG block+LFCNB (14.4%) and FICB (8.1%). This result may be explained by the fact that most anesthesiologists incorporated these techniques into their clinical practice at a later point in time. The PENG block is the most recent technique, having only been described in 2018 (Girón-Arango et al., 2018; Martínez Martín et al., 2023; Morrison et al., 2021). The possible bias in the analyses due to the overrepresentation of the FNB technique was mitigated by conducting analyses that excluded data from before 2019, and the same results were confirmed. No statistically significant differences were found in pain intensity when comparing the three techniques used. In a randomized comparative study between PENG block and FNB, Lin et al. (2021) also found no significant differences ($p = 0.53$). The systematic review by Ying et al. (2023) also showed that APOP can be controlled with PENG block or FNB, yet no differences were observed in pain intensity scores at 24 hours.

In the first 24 hours after THA, most patients reported no pain at rest (82.7%), while 55.2% reported mild movement-evoked pain. These results are similar to those of other studies that found a predominance of mild pain in the first 24 hours after THA (Lin et al., 2021; Martínez Martín et al., 2023). In another systematic review comparing PENG block and FNB, the authors concluded that there were no differences in pain at rest and movement-evoked pain at 24 hours after surgery (Andrade et al., 2023).

It should be noted that 17.6% of patients reported experiencing moderate to unbearable movement-evoked pain. In accordance with international recommendations (Anger et al., 2021; Girón-Arango et al., 2018; Rawal, 2016), analgesic techniques should be combined with systemic analgesia as a multimodal approach for better management of acute pain.

Rescue analgesia was administered whenever requested by the patient and/or suggested by the nurses after an assessment of moderate to unbearable pain. Rescue analgesic regimes include the use of opioids (tramad-

ol and morphine). In this study, rescue analgesia was administered to a small percentage of patients (7.8%), confirming the limited use of opioids. A small percentage of patients (3.55) also experienced nausea and vomiting. This finding reinforces the evidence that peripheral blocks play an important role in reducing opioid consumption and, consequently, in reducing the risks associated with systemic analgesia, particularly postoperative nausea and vomiting (Andrade et al., 2023; Anger et al., 2021; Girón-Arango et al., 2018; Morrison et al., 2021; Pascarella et al., 2021). The majority of patients did not report or present any adverse effects associated with the use of nerve blocks with local anesthetics. These results are similar to those described by Morrison et al. (2021). The most frequent adverse effect was sensory block with paresthesia in a small area (13%), followed by motor block with a slight decrease in muscle strength (4.9%). Regarding the association between sensory block and the peripheral nerve block techniques used, a statistically significant difference was found between the FNB+LFCNB and the PENG block+LFCNB groups ($p = 0.041$), with patients undergoing PENG block+LFCNB having a lower degree of sensory block. No studies were found to explain this finding. However, from an anatomical point of view, this finding may be explained by the fact that the PENG block is a selective technique for the articular branches of the femoral, obturator, and accessory obturator nerves, without covering the cutaneous and muscular innervation of the femoral and lateral cutaneous nerves. In this study, the motor block was similar in the three techniques. A larger number of observations may demonstrate a better preservation of motor function with PENG block, as described by Girón-Arango et al. (2018). Studies have shown that the use of these block techniques improves analgesic quality and reduces opioid consumption, length of hospital stay, and short- and long-term complications, such as thromboembolism and chronic pain (Lin et al., 2021; Pascarella et al., 2021). The literature review showed that the studies compared a maximum of two techniques and some had limitations in the number of participants. The results of this study may help to increase information about specific surgical procedures. However, this study had some limitations, including the fact that it did not allow conclusions to be drawn about the best analgesic strategy for patients undergoing THA beyond 24 hours and the small number of patients in some variables, which may have compromised the validation of the questions posed. Participants were excluded due to incomplete or inaccurate records, a common problem in retrospective studies. Consequently, these results cannot be generalized to other populations.

Conclusion

The assessment conducted by APU nurses in the first 24 hours after a THA, using three peripheral nerve block techniques combined with systemic analgesia, reveals an adequate approach to APOP management. The results show no statistically significant differences in analgesic efficacy when comparing the three nerve block techniques used. However, they suggest that PENG+LFCN is associated with effective analgesia, with a lower degree of sensory block compared to FN+LFCN. Data on the preservation of motor function are scarce to allow for a similar conclusion to be drawn.

This study can be considered as preliminary evidence on specific analgesia for surgical procedures and justifies the need for randomized clinical trials.

Author contributions

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