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Effect of Peripheral Nerve Block on Post-operative Pain and opioid use compared to Periarticular Multimodal Drug Injection following Total Hip Arthroplasty - A Protocol for Systematic Review and Meta-analysis

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Keywords: analgesic consumption after total hip arthroplasty, analgesic effects of the peng block, managing postoperative pain, analgesic effect, local anesthetic infiltration in total hip arthroplasty, postoperative pain, effect of peripheral nerve block, decreasing analgesic consumption, use of opioid, periarticular multimodal drug injection, effective than peripheral multimodal drug injection, pain level, peripheral multimodal drug injection, opioid consumption, peripheral nerve block, following total hip arthroplasty, opioid, total hip arthroplasty, local anesthetic infiltration

Abstract

INTRODUCTION

This protocol for a systematic review and meta-analysis aims to provide evidence to assess whether Peripheral Nerve Block (PNB) is more effective than Peripheral Multimodal Drug Injection (PMDI) in managing postoperative pain and decreasing analgesic consumption after total hip arthroplasty.

METHOD AND ANALYSIS

A systematic search will be conducted in PubMed, EMBASE, Scopus, DOAJ, Web of Science, the Cochrane Library, and various Trial Registries from their inception up to July 16, 2025. This review will focus on randomized controlled trials (RCTs) that assessed the analgesic effects of the PENG block compared to local anesthetic infiltration in total hip arthroplasty. The primary outcome will be the use of opioids in the first 24 hours following surgery. Secondary outcomes will comprise opioid consumption at 48 hours, pain levels measured by the Visual Analog Scale (VAS) within the first 6 hours, at 24 hours, and at 48 hours, as well as the length of the hospital stay.

ETHICS AND DISSEMINATION

Ethical approval is not applicable. The results shall be published publicly in English.

PROSPERO registration number

CRD420251104847

Troubleshooting

Introduction

1 Total hip arthroplasty (THA) is indeed one of the most effective and successful surgical interventions in orthopedics, consistently providing relief from pain, restoring function, and improving the overall quality of life for patients with advanced degenerative arthritis of the hip(1,2). Addressing postoperative pain is a significant challenge following total hip arthroplasty(3). Periarticular multimodal drug injection (PMDI) was introduced by Kerr and Kohan during total hip arthroplasty (THA) to lower the likelihood of complications linked with traditional pain management techniques. PMDI involves the intraoperative administration of a mixture of analgesics by the operating surgeon—typically local anesthetics like ropivacaine, NSAIDs like ketorolac, and epinephrine(4). Ranawat et. al. also suggested addition of steroid like methylprednisolone acetate, opioid like morphine sulfate and antibiotic like cefuroxime to the infiltration cocktail(5). They describe administering injections into the tissues surrounding the acetabular rim, with particular attention to the joint capsule when present, as well as the exposed gluteal and adductor muscles. An additional injection targets the external rotators, gluteus tendon, and iliotibial band. Periarticular multimodal drug injection (PMDI) during total hip arthroplasty (THA) appears to be a safe and effective method for pain management(6,7). Peripheral nerve block (PNB) involves injecting local anesthetics near particular nerves (such as the femoral nerve and lateral femoral cutaneous nerve block, lumbar plexus block, fascia iliaca compartment block, quadratus lumborum block, and pericapsular nerve group block) to inhibit nociceptive transmission. This procedure is typically carried out by an anesthesiologist either preoperatively or postoperatively under ultrasound guidance(8–11). PMDI provides localized, multi-mechanistic pain relief with minimal systemic involvement and does not impair motor function, thereby supporting early mobilization. PNB, while providing effective analgesia, may be associated with motor blockade, increasing the risk of falls and delaying mobilization(12). PNB also requires specialized expertise and equipment, making it more resource-intensive. On average, PNB can add approximately 30 minutes to operating room (OR) time. In contrast, PMDI can be administered in less than one minute intraoperatively, causing minimal disruption to surgical workflow(5,13). If PMDI can provide equivalent pain relief with significantly less application time and resource use, it could serve as a more practical and efficient option in busy surgical centers with high case turnover(12,13).

A study conducted by Wadhawan et al. indicated that patients in the nerve block group experienced significantly lower postoperative pain scores at various time intervals compared to those in the infiltration group. Additionally, the need for rescue analgesia was reduced in the nerve block group(14). Conversely, other studies (Kuchalik J., Yang R.) reported that the infiltration group had significantly lower postoperative pain scores and required less rescue analgesia(15,16). Therefore, a systematic review and meta-analysis is essential to consolidate the existing evidence, directly compare these treatment methods, and inform clinical decision-making based on their effectiveness, safety, and practical considerations. A network meta-analysis conducted by Jiménez-Almonte et al. in 2015 revealed no significant differences in pain levels or opioid usage between the two groups—peripheral nerve blockade and Local Infiltration Analgesia(17). However, since there were no randomized controlled trials (RCTs) directly comparing these two groups at that time, a network (indirect) meta-analysis was employed. Over the past decade however, several RCTs have been conducted that directly compare the two groups, making it worthwhile to re-evaluate the findings using the new body of evidence.

Method and Analysis

2 STUDY REGISTRATION

We have documented this protocol in the International Prospective Register of Systematic Reviews (CRD420251104847). This study was developed in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses Protocols (PRISMA-P) guidelines. The PRISMA-P checklist can be found in Annexure I. Ethical approval does not apply in this case.

CRITERIA FOR CONSIDERING STUDIES FOR THIS REVIEW

TYPES OF STUDIES

Randomized controlled trials (RCTs) directly comparing the two groups: Peripheral Nerve Block (PNB) and Periarticular Multimodal Drug Injection (PMDI).

TYPES OF PARTICIPANTS

Adults (≥18 years) undergoing elective primary total hip arthroplasty for non-infective arthropathy.

TYPES OF INTERVENTION STUDIED

Experimental intervention: Peripheral nerve block (PNB) techniques including femoral and lateral femoral cutaneous nerve block (FNB/LFCNB), lumbar plexus block (LPB), fascia iliaca compartment block (FICB), quadratus lumborum block (QLB) or pericapsular nerve group block (PENG).

Comparator Intervention: Periarticular multimodal drug injection (PMDI) administered intraoperatively.

SEARCH STRATEGY

Two independent authors will conduct a systematic search across four databases: PubMed, EMBASE, Web of Science, Scopus and the Cochrane Library, utilizing the following search terms: “peripheral nerve block”, “local anesthetic infiltration”, “local infiltration analgesia”, “periarticular injection”, “periarticular infiltration”, “total hip arthroplasty”, and “randomized controlled trials.” Additionally Cochrane Central Register of Controlled Trials (CENTRAL), clinicaltrials.gov, WHO ICTRP(WHO-International Clinical Trial Registry Platform), CTRI (Clinical Trial Registry- India), CRiS (Clinical Research Information Service), Chi-CTR (Chinese Clinical Trial Register) were also searched with the same search terms. The time frame for the search will go from the inception of these databases up until July 16, 2025. The search strategy for all databases has been detailed in Annexure II.

INCLUSION AND EXCLUSION CRITERIA

Inclusion Criteria: 1. Study Type: Randomised Controlled Trials 2. Participants: Patient who underwent elective primary Total Hip Arthroplasty. 3. Interventions: Peripheral Nerve Blocks (PNB) 4. Comparator: Periarticular Multimodal Drug Injection. 5. Primary outcome: Opioid use in the first 24 hours after surgery. Secondary outcomes: Opioid use in 48 hours, Pain scores in Visual analog Scale (VAS) within the first 6 hours, at 24 hours and at 48 hours and Length of Hospital stay. Pain outcomes in the included studies were reported using either the Visual Analog Scale (VAS) or the Numeric Rating Scale (NRS). For consistency, only studies employing a 0–10 scale, where 0 indicates no pain and 10 represents the worst imaginable pain, were included in the analysis. Research that fails to satisfy the criteria outlined earlier will be excluded, encompassing the following types of studies: retrospective studies, systematic reviews and meta-analyses, narrative reviews, conference abstracts, case reports, commentaries, letters, perspective pieces, insights, correspondences, and editorials. Additionally, to enhance the quality of the studies included, poor quality, unavailable full texts, or that have been published multiple times will also be excluded.

SELECTION OF STUDIES

To begin with, two independent writers will assess the titles and abstracts of the studies that were initially identified. Next, the full texts of potentially relevant studies will be examined for inclusion. If we come across a study that has incomplete information during the selection process, we will reach out to the authors for more details to establish whether the study meets the inclusion criteria. Any disagreements will be resolved through discussion with a third author.

DATA EXTRACTION AND MANAGEMENT

Data will be extracted using a standardized form including study characteristics (design, setting, funding, etc.), participant demographics, intervention and comparator details, outcome measures and results. Two independent authors will perform data extraction and any disagreements will be resolved by discussion with a third author.

RISK OF BIAS ASSESSMENT

Two independent authors shall perform risk of bias assessment using 'Revised Cochrane risk-of-bias tool for randomized trials (RoB 2)'. The risk of bias will be rated as 'low', 'high' or 'some concern' according to estimated results in 5 domain: (i) Risk of bias arising from randomisation process, (ii) Risk of bias due to deviations from the intended interventions, (iii) Missing outcome data, (iv) Risk of bias in measurement of the outcome and (v) Risk of bias in selection of reported result. Disagreements shall be resolved by discussion with a third author.

STATISTICAL ANALYSIS

Mean differences (MD) and risk ratios (RR) along with their corresponding 95% confidence intervals (CI) will be utilized for continuous and dichotomous variables, respectively. The degree of statistical heterogeneity will be assessed using the I2 test. A fixed-effect model will be employed when I2 is less than 50%. Conversely, the random-effect model will be adopted when I2 exceeds 50%. A p-value of less than 0.05 indicates statistical significance. If I2 exceeds 50%, additional subgroup analysis or meta-regression will be conducted to investigate the cause of heterogeneity based on various potential factors.

PUBLICATION BIAS

Egger's test will be employed to evaluate potential publication bias through funnel plots, which are scatterplots displaying each study's effect size on the x-axis against its standard error on the y-axis. A symmetrical inverted funnel, with smaller studies positioned at the top and more studies filling the bottom, suggests that there is no publication bias. Conversely, a skewed funnel indicates the presence of publication bias, and a 'trim and fill' method will additionally be applied to rectify the asymmetry of the funnel plot by 1) eliminating the smaller studies responsible for the asymmetry, 2) using the adjusted funnel plot to determine the true funnel center, and 3) reinserting the omitted studies around the funnel center.

EVIDENCE QUALITY ASSESSMENT

The Grading of Recommendations Assessment, Development and Evaluation (GRADE) methodology will be utilized to evaluate the quality of evidence for the aggregated results and will produce a 'Summary of findings' table. The GRADE methodology will categorize the quality of evidence into four categories:

High: Strong confidence that the true effect is close to the estimated effect.
Moderate: Reasonable confidence in the estimated effect; the true effect is likely close but may differ substantially.
Low: Limited confidence in the estimated effect; the true effect may be substantially different.
Very Low: Very little confidence in the estimated effect; the true effect is likely to differ significantly.

Detailed information is available in Cochrane Handbook (https://training.cochrane.org)

Discussion

3 Despite the growing body of evidence comparing the impact of peripheral nerve block (PNB) and periarticular multimodal drug injection (PMDI) on postoperative pain management after total hip arthroplasty (THA), a thorough meta-analysis that consolidates the existing data has yet to be conducted. This study intends to outline a protocol to assess whether PNB offers superior postoperative pain relief compared to PMDI in patients undergoing THA. Several challenges may arise during the execution of this meta-analysis. First, significant variability across the studies included—due to differences in types of local anesthetics, techniques for PNB, definitions of primary outcomes, combinations of drugs, regional healthcare standards, patient characteristics, and durations of follow-up—may influence the reliability of the aggregated findings. Second, there may be a limited number of randomized controlled trials (RCTs) that specifically compare PNB and PMDI. To address the effects of heterogeneity, a meta-regression analysis will be conducted to identify possible sources. Future research should focus on including participants with similar baseline characteristics, such as healthcare environments, demographic factors, and follow-up intervals. Furthermore, the GRADE approach will be utilized to evaluate the quality of evidence concerning the primary outcomes. This protocol has been registered with PROSPERO and has been developed following PRISMA-P guidelines.

Exploratory data analysis can be performed when unexpected trends or variations in results are identified. For example, there might be discrepancies in the types of analgesics utilized across the studies included. To standardize the consumption of analgesics, data will be adjusted to morphine-equivalent doses using established conversion methods outlined in previous research (e.g., 1 mg of intravenous morphine equates to 10 mg of intravenous tramadol, 10 mcg of intravenous fentanyl, 1 mcg of intravenous sufentanil, 10 mg of intravenous pethidine, and 1.5 mg of oral oxycodone) **(18,19)**. For studies that present data as medians with ranges, the values will be transformed into means and standard deviations employing suitable statistical techniques(20).

Strengths and Limitations

4 This protocol has been registered in PROSPERO and created in accordance with the PRISMA-P guidelines. Two independent reviewers will carry out the database search, select studies, extract data, and evaluate the risk of bias. Significant heterogeneity may be present among the studies included, stemming from variations in local anesthetic types, anesthetic techniques, definitions of primary outcomes, drug combinations, and other elements. To address this issue, meta-regression will be undertaken to investigate potential sources of heterogeneity. Furthermore, the GRADE methodology will be utilized to evaluate the quality of evidence for the primary outcomes.

Author Contributions

5 **Conception and design:** Dr. Soutrik Kundu (guarantor); **Data Collection:** Dr. Soutrik Kundu, Prof. Hyuck Min Kwon, Prof. Tae Hyung Kim; **Data analysis:** Dr. Soutrik Kundu, Prof. Hyuck Min Kwon, Prof. Tae Hyung Kim, Prof. Kwan Kyu Park; **Drafting the manuscript:** Dr. Soutrik Kundu, Prof. Hyuck Min Kwon, Prof. Tae Hyung Kim; **Critical revision of the manuscript:** Prof. Kwan Kyu Park, Prof. Yong Seon Choi, Prof. Boral Lee; **Statistical Analysis:** Ms. Hye Jung Shin; **Study supervision:** Prof. Kwan Kyu Park, Prof. Yong Seon Choi

Funding Source

6 This review has received no external funding, is not affiliated with or supported by any academic institution, and is being undertaken independently by the authors in their own time.

Annexure I

7 **PRISMA-P (Preferred Reporting Items for Systematic review and Meta-Analysis Protocols) 2015 checklist: recommended items to address in a systematic review protocol***

	A	B	C	D
	Section and topic	**Item No**	**Checklist item**	**Reported on page number**
	ADMINISTRATIVE			

	A	B	C	D
	INFORMATION			
	Title:			
	Identification	1a	Identify the report as a protocol of a systematic review	Page 1
	Update	1b	If the protocol is for an update of a previous systematic review, identify as such	NA
	Registration	2	If registered, provide the name of the registry (such as PROSPERO) and registration number	Page 1
	Authors:			
	Contact	3a	Provide name, institutional affiliation, e-mail address of all protocol authors; provide physical mailing address of corresponding author	Page 1
	Contributions	3b	Describe contributions of protocol authors and identify the guarantor of the review	Page 7
	Amendments	4	If the protocol represents an amendment of a previously completed or published protocol, identify as such and list changes; otherwise, state plan for documenting important protocol amendments	NA
	Support:			
	Sources	5a	Indicate sources of financial or other support for the review	Page 7
	Sponsor	5b	Provide name for the review funder and/or sponsor	Page 7
	Role of sponsor or funder	5c	Describe roles of funder(s), sponsor(s), and/or institution(s), if any, in developing the protocol	Page 7
	INTRODUCTION			

	A	B	C	D
	Rationale	6	Describe the rationale for the review in the context of what is already known	Page 3
	Objectives	7	Provide an explicit statement of the question(s) the review will address with reference to participants, interventions, comparators, and outcomes (PICO)	Page 4
	METHODS			
	Eligibility criteria	8	Specify the study characteristics (such as PICO, study design, setting, time frame) and report characteristics (such as years considered, language, publication status) to be used as criteria for eligibility for the review	Page 4
	Information sources	9	Describe all intended information sources (such as electronic databases, contact with study authors, trial registers or other grey literature sources) with planned dates of coverage	Page 4
	Search strategy	10	Present draft of search strategy to be used for at least one electronic database, including planned limits, such that it could be repeated	Page 4
	Study records:			
	Data management	11a	Describe the mechanism(s) that will be used to manage records and data throughout the review	Page 5
	Selection process	11b	State the process that will be used for selecting studies (such as two independent reviewers) through each phase of the review (that is, screening, eligibility and inclusion in meta-analysis)	Page 4
	Data collection process	11c	Describe planned method of extracting data from reports (such as piloting forms, done independently, in duplicate), any processes for obtaining and confirming data from investigators	Page 5
	Data items	12	List and define all variables for which data will be sought (such as PICO items, funding sources), any pre-planned data assumptions and simplifications	Page 4
	Outcomes and	13	List and define all outcomes for which data will be sought, including prioritization of main and additional outcomes, with rationale	Page 4

	A	B	C	D
	prioritization			
	Risk of bias in individual studies	14	Describe anticipated methods for assessing risk of bias of individual studies, including whether this will be done at the outcome or study level, or both; state how this information will be used in data synthesis	Page 5
	Data synthesis	15a	Describe criteria under which study data will be quantitatively synthesised	Page 5
		15b	If data are appropriate for quantitative synthesis, describe planned summary measures, methods of handling data and methods of combining data from studies, including any planned exploration of consistency (such as I2, Kendall's τ)	Page 5
		15c	Describe any proposed additional analyses (such as sensitivity or subgroup analyses, meta-regression)	Page 5
		15d	If quantitative synthesis is not appropriate, describe the type of summary planned	Page 6
	Meta-bias(es)	16	Specify any planned assessment of meta-bias(es) (such as publication bias across studies, selective reporting within studies)	Page 5
	Confidence in cumulative evidence	17	Describe how the strength of the body of evidence will be assessed (such as GRADE)	Page 6

*** It is strongly recommended that this checklist be read in conjunction with the PRISMA-P Explanation and Elaboration (cite when available) for important clarification on the items. Amendments to a review protocol should be tracked and dated. The copyright for PRISMA-P (including checklist) is held by the PRISMA-P Group and is distributed under a Creative Commons Attribution Licence 4.0.**

From: Shamseer L, Moher D, Clarke M, Ghersi D, Liberati A, Petticrew M, Shekelle P, Stewart L, PRISMA-P Group. Preferred reporting items for systematic review and meta-analysis protocols (PRISMA-P) 2015: elaboration and explanation. BMJ. 2015 Jan 2;349(jan02 1):g7647.

Annexure II

8 **Search strategies**

PubMed

#1 peripheral nerve block [Title/Abstract]
#2 nerve block [Title/Abstract]
#3 #1 OR #2
#4 local infiltration analgesia [Title/Abstract]
#5 local anesthetic infiltration [Title/Abstract]
#6 local infiltration anesthesia [Title/Abstract]
#7 periarticular infiltration [Title/Abstract]
#8 periarticular injection [Title/Abstract]
#9 #4 OR #5 OR #6 OR #7 OR #8
#10 randomized controlled trial [Title/Abstract]
#11 randomized controlled study [Title/Abstract]
#12 controlled clinical trial [Title/Abstract]
#13 clinical study [Title/Abstract]
#14 #10 OR #11 OR #12 OR #13
#15 #3 AND #9 AND #114

EMBASE

#1 ‘peripheral nerve block’:ti,ab,kw OR nerve block’:ti,ab,kw
#2 ‘local infiltration analgesia’:ti,ab,kw OR ‘local anesthetic infiltration’:ti,ab,kw OR ‘local infiltration anesthesia’:ti,ab,kw OR ‘periarticular infiltration’:ti,ab,kw OR ‘periarticular injection’:ti,ab,kw
#3 ‘randomized controlled trial’/exp OR ‘randomized controlled trial’:ti,ab,kw OR ‘randomized controlled study’:ti,ab,kw OR ‘controlled clinical trial’:ti,ab,kw OR ‘clinical study’:ti,ab,kw
#4 #1 AND #2 AND #3

Cochrane Library

#1 (peripheral nerve block):ti,ab,kw
#2 (nerve block):ti,ab,kw
#3 #1 OR#2
#4 (local infiltration analgesia):ti,ab,kw
#5 (local anesthetic infiltration):ti,ab,kw
#6 (local infiltration anesthesia):ti,ab,kw
#7 (periarticular infiltration):ti,ab,kw
#8 (periarticular injection):ti,ab,kw
#9 #4 OR #5 OR #6 OR #7 OR #8

#10 (randomized controlled trial):ti,ab,kw
#11 (randomized controlled study):ti,ab,kw
#12 (controlled clinical trial):ti,ab,kw
#13 (clinical study):ti,ab,kw
#14 #10 OR #11 OR #12 OR #13
#13 #3 AND #9 AND #14

Web of Science

#1 peripheral nerve block (Topic) OR nerve block (Topic)
#2 local infiltration analgesia (Topic) OR local anesthetic infiltration (Topic) OR local infiltration anesthesia (Topic) OR periarticular infiltration (Topic) periarticular injection
#3 randomized controlled trial (Topic) OR randomized controlled study (Topic) OR controlled clinical trial (Topic) OR clinical study (Topic)
#4 #1 AND #2 AND #3

Scopus

#1 ‘peripheral nerve block’:ti,ab,kw OR nerve block’:ti,ab,kw
#2 ‘local infiltration analgesia’:ti,ab,kw OR ‘local anesthetic infiltration’:ti,ab,kw OR ‘local infiltration anesthesia’:ti,ab,kw OR ‘periarticular infiltration’:ti,ab,kw OR ‘periarticular injection’:ti,ab,kw
#3 ‘randomized controlled trial’/exp OR ‘randomized controlled trial’:ti,ab,kw OR ‘randomized controlled study’:ti,ab,kw OR ‘controlled clinical trial’:ti,ab,kw OR ‘clinical study’:ti,ab,kw
#4 #1 AND #2 AND #3

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