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Efficacy of erector spinae plane block for post-nephrectomy pain management: a trial-sequential meta-analysis

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ADMINISTRATIVE INFORMATION

Support - None.

Review Stage at time of this submission - Preliminary searches.

Conflicts of interest - None declared.

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Amendments - This protocol was registered with the International Platform of Registered Systematic Review and Meta-Analysis Protocols (INPLASY) on 11 January 2025 and was last updated on 11 January 2025.

INTRODUCTION

Review question / Objective Is use of erector spinae plane block beneficial for post-nephrectomy pain management: a trial-sequential meta-analysis.

Condition being studied Postoperative pain management following nephrectomy remains challenging, with inadequate control potentially leading to complications, delayed recovery, and chronic pain development. Traditional pain management strategies, including systemic opioids and epidural analgesia, have limitations such as respiratory depression, nausea, and hemodynamic instability. The erector spinae plane (ESP) block, first described in 2016, has emerged as a promising regional anesthetic technique providing thoracolumbar analgesia through local anesthetic injection between the erector spinae muscle and transverse process. While several randomized controlled trials (RCTs) have investigated ESP block's efficacy for post-nephrectomy pain, their results have been inconsistent, and individual studies often lack statistical power due to small sample sizes. Previous systematic reviews have not performed trial sequential analysis to determine if the evidence is conclusive, nor comprehensively evaluated the quality of evidence. Therefore, we conducted this systematic review and trial sequential meta-analysis to assess the efficacy of ESP block for post-nephrectomy pain control, providing clinicians with robust evidence for decision-making in perioperative pain management.

METHODS

Search strategy The search strategy for this meta-analysis will utilize major electronic databases including MEDLINE, Embase, Cochrane CENTRAL, and Google Scholar from their inception to January 12, 2025 with a combination of search terms organized into population (nephrectomy-related terms: "nephrectomy," "kidney surgery," "renal surgery," "partial nephrectomy," "radical nephrectomy"), intervention (ESP block-related

terms: "erector spinae plane block," "ESP block," "ESPB," "erector spinae block," "paraspinal block"), and outcome components (pain management-related terms: "pain," "analgesia," "pain control," "postoperative pain"), supplemented by methodological filters for randomized controlled trials, without language restrictions, and enhanced by additional methods including reference list screening and citation tracking to ensure comprehensive coverage of all relevant evidence. Duplicate records were identified and removed using EndNote X9. Two independent reviewers will meticulously assess study eligibility, first screening titles and abstracts, followed by a detailed evaluation of full-text articles. Any discrepancies will be resolved through discussion or consultation with a third reviewer.

Participant or population Patient population consists of adult patients undergoing open or laparoscopic nephrectomy.

Intervention The intervention focuses on erector spinae plane (ESP) block as a perioperative pain management technique.

Comparator The control group includes conventional pain management methods, such as intravenous opioids or local anesthetic infiltration.

Study designs to be included Only randomized controlled trials are included.

Eligibility criteria Based on the PICO framework, the population consists of adult patients undergoing open or laparoscopic nephrectomy (Population). The intervention focuses on erector spinae plane (ESP) block as a perioperative pain management technique (Intervention). The control group includes conventional pain management methods, such as intravenous opioids or local anesthetic infiltration (Control). Outcomes of interest include postoperative opioid consumption, pain intensity scores measured by visual analog or numeric rating scales, opioid-related side effects, and other recovery characteristics (Outcomes).

Information sources The search strategy for this meta-analysis will utilize major electronic databases including MEDLINE, Embase, Cochrane CENTRAL, and Google Scholar from their inception to January 12, 2025.

Main outcome(s) The primary outcome was 24-hour postoperative morphine consumption, with all opioid medications converted to morphine equivalents.

Additional outcome(s) Secondary outcomes included pain severity assessed using either visual analog scale (VAS) or numeric rating scale (NRS) scores at multiple postoperative time points (2, 6, 12, and 24 hours). When pain scores were not available at these exact time points, we used data from the nearest available time point within a predefined window (±1 hour for the 2 and 6-hour assessments, ±2 hours for the 12-hour assessment, and ±4 hours for the 24-hour assessment). Additional secondary outcomes encompassed opioid-related adverse effects (including postoperative nausea and vomiting, pruritus, and respiratory depression), requirement for rescue analgesia (defined as any additional analgesic medication administered beyond the standard postoperative regimen), and recovery characteristics such as time to first ambulation, length of hospital stay, and patient satisfaction scores.

Quality assessment / Risk of bias analysis To evaluate the risk of bias, the revised Cochrane Risk of Bias tool (RoB 2.0) for randomized trials was utilized. Two reviewers independently assessed five critical domains: (1) the randomization process, (2) deviations from intended interventions, (3) missing outcome data, (4) outcome measurement, and (5) selection of the reported result. Each domain was classified as "low risk," "some concerns," or "high risk" based on predefined signaling questions. The overall risk of bias for each trial was rated as "low risk" if all domains were judged as low risk, "some concerns" if at least one domain raised concerns without being high risk, and "high risk" if one or more domains were deemed high risk or if multiple domains raised concerns. Any disagreements were resolved through discussions with a third reviewer to ensure consistency and reliability in the assessments.

Strategy of data synthesis Statistical analyses were conducted using Review Manager (RevMan, version 5.4, The Cochrane Collaboration, Copenhagen, Denmark). For continuous outcomes, mean differences (MD) or standardized mean differences (SMD) with 95% confidence intervals (CI) were calculated. For dichotomous outcomes, risk ratios (RR) with 95% CI were determined. A random-effects model was used to account for anticipated clinical heterogeneity. Heterogeneity was evaluated using I^2 statistics, where thresholds of 25%, 50%, and 75% indicated low, moderate, and high heterogeneity, respectively. Publication bias was assessed through funnel plots and Egger's test if 10 or more studies were available. Trial sequential analysis (TSA) was used to

estimate the required information size and assess the conclusiveness of evidence. TSA utilized two-sided tests with a 5% type I error and 80% power, while accounting for heterogeneity observed in the included trials.

Subgroup analysis Subgroup analyses examined variations based on nephrectomy type and local anesthetic protocols.

Sensitivity analysis Sensitivity analysis is conducted using a leave-one-out approach, where one study is excluded at a time to assess the robustness of the overall findings.

Country(ies) involved Taiwan.

Keywords opioid, erector spinae plane block, nephrectomy, pain, meta-analysis.

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