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ORIGINAL ARTICLE

Perineural Dexamethasone Versus Dexmedetomidine as Adjuncts to Single-Injection Peripheral Nerve and Fascial-Plane Blocks in Adults: A Systematic Review and Meta-Analysis

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ABSTRACT

Background: Dexamethasone and dexmedetomidine are commonly used perineural adjuncts, but their comparative effects may differ across blocks, operations, doses, and local anesthetics.

Objective: To compare perineural dexamethasone with perineural dexmedetomidine for analgesic duration, block characteristics, analgesic consumption, pain, rebound pain, and adverse events in adults receiving single-injection peripheral nerve or fascial-plane blocks for surgery.

Methods: PubMed and Scopus were searched from inception to 1 August 2026, and ClinicalTrials.gov was searched for ongoing or unpublished trials. Direct randomized or quasi-randomized head-to-head trials in adults were eligible. The primary outcome was duration of analgesia or time to first rescue analgesia. Risk of bias was assessed with RoB 2 and certainty with GRADE. Mean differences (MDs), standardized mean differences (SMDs), and risk ratios (RRs) were synthesized using DerSimonian-Laird random-effects models when outcomes were compatible.

Results: The search identified 440 records; 357 unique records were screened and 40 unique studies were provisionally included. Twenty-three studies (1,465 participants) contributed to the primary meta-analysis. Dexmedetomidine did not clearly prolong analgesia compared with dexamethasone (MD 19.6 minutes, 95% CI -34.7 to 74.0; I^2=97.6%; prediction interval -231.8 to 271.1). Results were similarly inconclusive after excluding high-risk studies. Analgesic consumption, sensory-

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block duration, and motor-block duration also showed no clear difference and substantial heterogeneity. Two small studies suggested more bradycardia with dexmedetomidine (RR 4.15, 95% CI 1.41 to 12.20). Certainty was very low for all key outcomes.

Conclusions: Current evidence does not establish a consistent overall advantage of perineural dexmedetomidine or dexamethasone for analgesic duration. Apparent subgroup differences are exploratory and likely confounded. Sparse safety reporting and very low certainty preclude strong clinical recommendations.

KEYWORDS

• Dexamethasone • Dexmedetomidine • Peripheral Nerve Block • Fascial-Plane Block • Postoperative Analgesia • Meta-Analysis

INTRODUCTION

Single-injection peripheral nerve and fascial-plane blocks can reduce acute postoperative pain and systemic opioid exposure, but their duration is limited by local-anesthetic pharmacology. Perineural adjuncts are used to extend analgesia, improve block quality, or reduce rescue medication requirements. Both dexamethasone and dexmedetomidine have been evaluated in randomized head-to-head trials across brachial plexus, truncal, and abdominal-wall blocks.[1-4]

The agents have different pharmacologic profiles and adverse-effect concerns. Comparative trial results have varied, and the direction and size of effect may depend on block location, local anesthetic, dose, operation, and outcome definition.[1-8] A direct comparative synthesis is therefore more clinically useful than separate comparisons with placebo.

This systematic review evaluated direct randomized comparisons of perineural dexamethasone and perineural dexmedetomidine in adults undergoing surgery. The primary objective was to compare analgesic duration or time to first rescue analgesia. Secondary objectives were to compare sensory and motor-block duration, postoperative analgesic consumption, pain, rebound pain, and adverse events.

METHODS

Protocol and reporting

The review methods were specified before quantitative synthesis and are reported according to PRISMA 2020 principles.[9] The protocol was not prospectively registered. Screening, extraction, risk-of-bias assessment, and synthesis were completed by one reviewer; this protocol deviation and its implications were documented.

Eligibility criteria

Randomized or quasi-randomized head-to-head trials enrolling adults aged 18 years or older who underwent surgery with a single-injection peripheral nerve or fascial-plane block were eligible. Comparisons were perineural dexamethasone versus perineural dexmedetomidine, each administered with local anesthetic.

We excluded continuous catheters, neuraxial techniques, intravenous-only adjunct administration, pediatric-only populations, dental or chronic-pain procedures, observational studies, and combined-adjunct interventions without standalone comparison groups.

Information sources and search strategy

PubMed and Scopus were searched from inception to 1 August 2026. ClinicalTrials.gov was searched for ongoing and unpublished trials. Search concepts combined controlled vocabulary and free-text terms for dexamethasone, dexmedetomidine, peripheral nerve or fascial-plane blocks, and randomized trials. Complete database-specific searches should be included in Supplementary Appendix 1 before submission.

Selection and data collection

Records were deduplicated using DOI, PMID, registry identifier, and exact normalized title. One reviewer screened titles and abstracts, assessed full texts, linked multiple reports from the same trial, and extracted study characteristics and outcomes using a structured form. Values were extracted in the form reported. Medians were not converted to means post hoc. Study authors were not contacted during this draft stage.

Outcomes

The primary outcome was duration of analgesia or time to first rescue analgesia, converted to minutes when compatible. Secondary outcomes included 24-hour analgesic consumption, sensory-block duration, motor-block duration, pain scores, rebound pain, and adverse events. When multiple measures were reported, the most direct prespecified measure of analgesic duration was prioritized.

Risk of bias and certainty

Risk of bias for the primary outcome was assessed using the five RoB 2 domains.[10] Overall judgments were low risk, some concerns, or high risk. Certainty was assessed using GRADE across risk of bias, inconsistency, indirectness, imprecision, and publication bias.[11]

Statistical analysis

Compatible continuous outcomes measured in the same units were expressed as MDs. Analgesic consumption reported using different drugs or units was expressed as Hedges-adjusted SMD. Dichotomous adverse events were expressed as RRs.

Random-effects models used the DerSimonian-Laird estimator[12] and normal 95% confidence intervals. Heterogeneity was summarized with I^2 and tau^2, and a prediction interval was calculated for the primary outcome. Sensitivity analysis excluded studies at high risk of bias. Subgroups by block region, local anesthetic, and adjunct dose were exploratory, non-randomized across-study comparisons.

RESULTS

Study selection

The searches identified 91 PubMed records, 340 Scopus records, and nine ClinicalTrials.gov records (440 total). After 83 duplicates were removed, 357 unique records were screened. We excluded 308 records during title-and-abstract screening and sought 49 reports.

Three reports remained awaiting full text, one was excluded after full-text assessment, and four registrations were ongoing or unpublished. Forty-one provisionally eligible reports represented 40 unique studies because one probable duplicate report pair was linked as a single study. The study-selection process is shown in Figure 1.

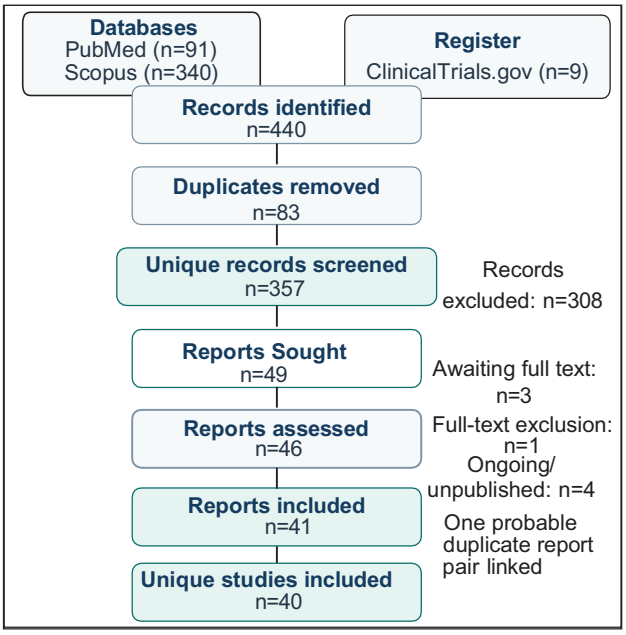


Figure 1: PRISMA 2020 flow diagram.[9] Forty-one eligible reports represented 40 unique studies because one probable duplicate publication pair was linked as a single study.

Selection stage	n
Records identified	440
Duplicates removed	83
Unique records screened	357
Title/abstract exclusions	308
Reports sought	49
Awaiting full text	3
Full-text exclusions	1
Ongoing/unpublished	4
Provisionally included reports	41
Unique provisionally included studies	40

Study characteristics

The 40 included studies evaluated a clinically diverse set of brachial plexus, truncal, abdominal-wall, lower-limb, cervical plexus, scalp, and other blocks.[1-8,13-44] Local anesthetics included ropivacaine, bupivacaine, levobupivacaine, lidocaine-containing mixtures, and other combinations. Dexamethasone was generally administered as a fixed dose, commonly 4-10 mg; dexmedetomidine was administered as fixed microgram or weight-based doses.

One study still lacked complete numeric data for the primary outcome, although a sensory-duration result was available from its abstract. Detailed study characteristics and source links are provided in the separate reporting tables.

Risk of bias

One study was judged at low risk of bias, 27 had some concerns, and 12 were at high risk. Common limitations were incomplete reporting of sequence generation or allocation concealment and absence of an accessible prospective protocol or statistical analysis plan. All judgments were provisional and completed by one reviewer. The domain-level judgments are summarized in Figure 3.

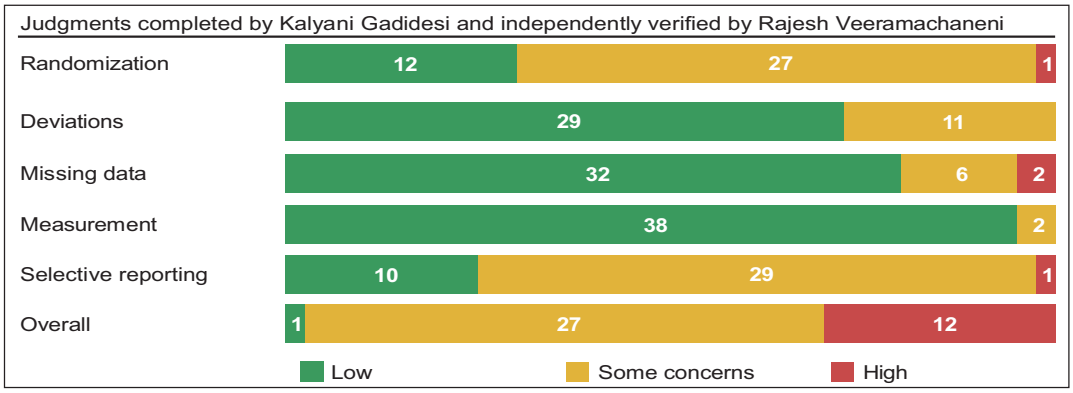


Figure 3: RoB 2 summary for the primary outcome.[10] Judgments were completed by one reviewer and require independent verification before submission.

Primary outcome

Twenty-three studies with 1,465 participants supplied compatible means, standard deviations, and sample sizes.[1-5,7,13,17-19,21,24,26-27,29,32-38,43] The random-effects pooled MD was 19.6 minutes (95% CI -34.7 to 74.0), with extreme heterogeneity (I^2=97.6%; tau^2=15,687.7). The 95% prediction interval ranged from -231.8 to 271.1 minutes, indicating that future settings could plausibly favor either adjunct. The primary meta-analysis is shown in Figure 2.

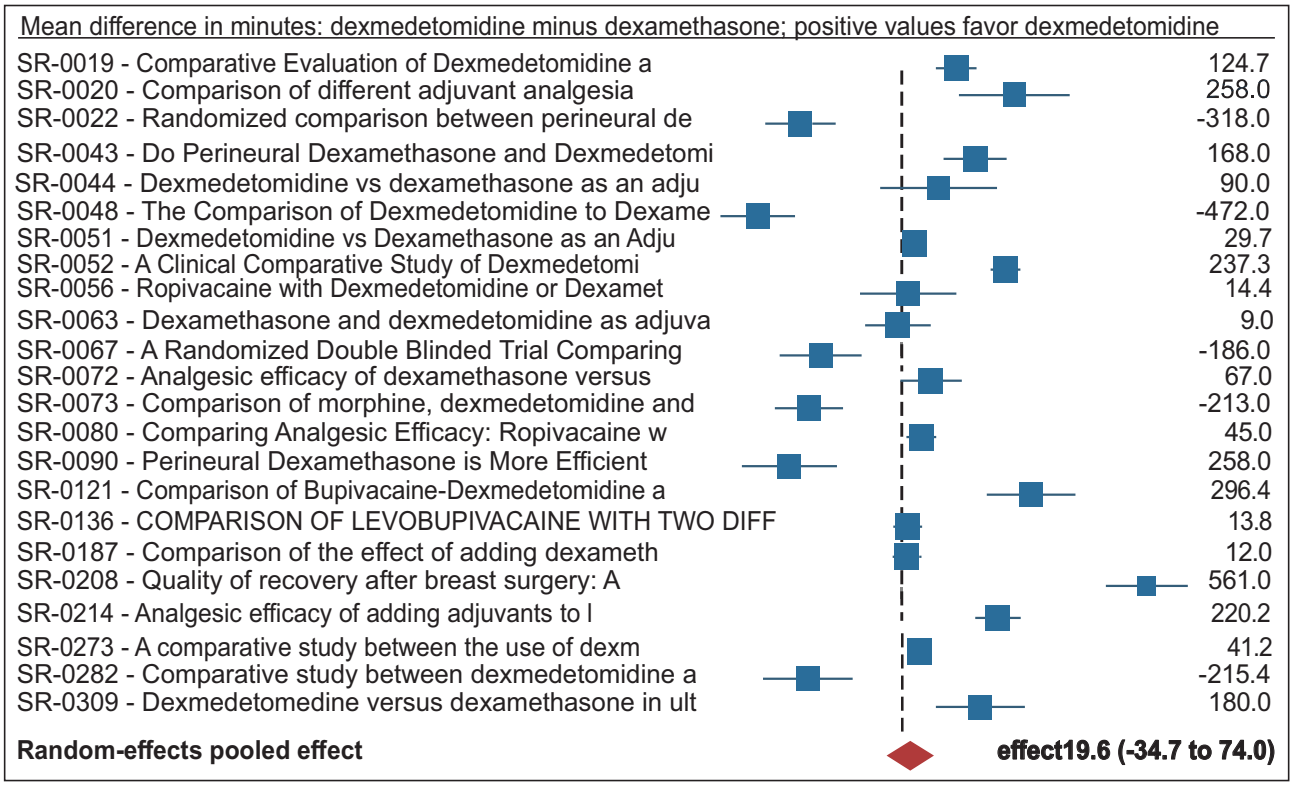


Figure 2: Random-effects meta-analysis of duration of analgesia/time to first rescue analgesia. Effects are mean differences in minutes calculated as dexmedetomidine minus dexamethasone; positive values favor dexmedetomidine. Study labels show first author, publication year, and the corresponding manuscript reference number.

After high-risk studies were excluded, 16 studies remained. The pooled MD was -2.2 minutes (95% CI -84.9 to 80.4; I^2=96.4%), which did not materially change the inference.

Exploratory subgroup analyses

Block region	Studies	MD, minutes	95% CI	I^2
Brachial plexus	8	-118.3	-316.1 to 79.5	98.9%
Thoracic/truncal	6	169.3	61.0 to 277.5	88.1%
Transversus abdominis plane	5	39.0	30.7 to 47.3	0%
Lower limb/other	4	57.6	-122.6 to 237.8	95.2%

Thoracic/truncal and transversus abdominis plane subgroup estimates appeared to favor dexmedetomidine, whereas brachial plexus and lower-limb/other estimates were inconclusive. These analyses were not based on randomized subgroup allocation and were confounded by surgery, block technique, local anesthetic, and dose. They should not be interpreted as proof of treatment-effect modification.

Secondary outcomes

Outcome	Studies	Effect	95% CI	I^2
24-hour analgesic consumption	8	SMD -0.46	-1.14 to 0.23	92.5%
Sensory-block duration	10	MD 16.7 min	-112.7 to 146.2	98.9%
Motor-block duration	7	MD -33.5 min	-184.4 to 117.4	99.0%
Bradycardia	2	RR 4.15	1.41 to 12.20	0%

Analgesic consumption, sensory-block duration, and motor-block duration showed no clear difference, and heterogeneity was substantial to extreme. Bradycardia was more frequent with dexmedetomidine in two small studies, but this estimate was based on sparse events and selective adverse-event reporting. Pain and rebound-pain outcomes were insufficiently consistent for reliable pooling.

Certainty of evidence

Outcome	Studies	Effect	Certainty
Duration of analgesia/time to first rescue	23	MD 19.6 min (95% CI -34.7 to 74.0)	Very low
24-hour analgesic consumption	8	SMD -0.46 (95% CI -1.14 to 0.23)	Very low
Sensory-block duration	10	MD 16.7 min (95% CI -112.7 to 146.2)	Very low
Motor-block duration	7	MD -33.5 min (95% CI -184.4 to 117.4)	Very low
Bradycardia	2	RR 4.15 (95% CI 1.41 to 12.20)	Very low

Certainty was very low for every key outcome because of serious risk-of-bias concerns, marked inconsistency, imprecision, and in the analgesic-consumption and adverse-event analyses-additional indirectness or suspected publication bias.

DISCUSSION

Principal findings

Across 23 directly poolable trials, the average difference in analgesic duration between perineural dexmedetomidine and dexamethasone was small and statistically inconclusive. More importantly, the prediction interval was very wide and heterogeneity was extreme. The pooled average therefore does not describe a stable effect expected across clinical settings.

Secondary syntheses were similarly uncertain. No clear advantage was identified for 24-hour analgesic consumption or sensory or motor-block duration. A possible increase in bradycardia with dexmedetomidine is biologically plausible, but the evidence was derived from only two studies with compatible event counts and should be interpreted cautiously.

Interpretation

The inconsistency likely reflects variation in block anatomy, surgery, local anesthetic, adjunct dose, outcome definition, rescue thresholds, and follow-up. Individual head-to-head trials have reported effects in different directions across block types and operations.[1,4-8,17,21,24,29] Exploratory regional patterns may generate hypotheses, particularly for transversus abdominis plane and thoracic/truncal blocks, but cannot establish differential efficacy because treatment was not randomized across these study-level categories.

Clinical selection should not rely on the overall pooled estimate alone. Decisions should consider the specific block and operation, expected analgesic duration, patient comorbidity, hemodynamic vulnerability, institutional experience, and the uncertain safety profile of perineural adjunct administration.[1,2,5,7,8]

Strengths and limitations

Strengths include the direct head-to-head question, searches of two major bibliographic databases and a trial register, explicit linkage of multiple reports, avoidance of post hoc conversion of medians to means, prediction-interval reporting, outcome-specific RoB 2 assessment, sensitivity analysis, and GRADE evaluation.

The most important limitation is that one reviewer completed screening, extraction, and risk-of-bias assessment, increasing the possibility of selection and transcription errors. Several full texts remained unavailable, one included study lacked complete primary numeric data, and some reports contained incomplete methodological descriptions. Searches were limited to PubMed and Scopus, with ClinicalTrials.gov used for trial identification; Embase, CENTRAL, Web of Science, and regional databases were unavailable. Clinical and statistical heterogeneity was extreme, subgroup analyses were exploratory, adverse-event reporting was sparse, and small-study effects could not be evaluated reliably. The protocol was not prospectively registered.

Implications for research

Future trials should prospectively register protocols and analysis plans, use concealed randomization and blinded assessment, standardize definitions of analgesic duration and rebound pain, report complete participant flow, and provide arm-level means with standard deviations or medians with quartiles. Trials should prespecify adverse events-including bradycardia, hypotension, sedation, hyperglycemia, neurologic symptoms, and infection-and report them by randomized group. Dose-ranging studies and adequately powered, block-specific head-to-head trials are needed.

CONCLUSIONS

Very low-certainty evidence does not establish a consistent overall advantage of perineural dexmedetomidine or dexamethasone for prolonging analgesia after single-injection peripheral nerve or fascial-plane block in adults. The pooled estimate was inconclusive and accompanied by extreme heterogeneity and a prediction interval compatible with benefit for either adjunct. Dexmedetomidine may increase bradycardia, but safety evidence is sparse. Block-specific comparative trials with standardized outcomes and rigorous adverse-event reporting are required.

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