

ORIGINAL RESEARCH

Comparison of Analgesic Effect between Erector Spinae Plane Block and Transversus Abdominis Plane Block for Pain Management following Caesarean Section: A Systematic Review and Meta-analysis

Parada Jiwanggana^{✉*}, Feni Venawati*, Arifah Mabruroh Prilia*

Article Info :

Submitted :

27-08-2024

Accepted :

19-10-2026

Published :

31-10-2026

[https://doi.org/10.20961/](https://doi.org/10.20961/sojaV6i2.92742)

[sojaV6i2.92742](https://doi.org/10.20961/sojaV6i2.92742)

Authors' affiliations:

*Budi Rahayu Regional
Hospital, Magelang City,
Indonesia

✉Correspondence:

jiwanggana@gmail.com

ABSTRACT

Background: The erector spinae plane (ESP) block and the transversus abdominis plane (TAP) block are used for postoperative analgesia after caesarean section, but direct comparisons remain limited. We compared their analgesic effects.

Methods: The protocol was registered in PROSPERO (CRD42024579323). PubMed, ScienceDirect and Google Scholar were searched up to June 2024 for randomized trials comparing ESP with TAP block after caesarean section. Outcomes were block duration (primary), visual analogue scale (VAS) pain at 24 hours, and satisfaction. Medians were converted to means and standard deviations (SD) with explicit rules for zero or missing SDs; leave-one-out and SD-handling sensitivity analyses were performed.

Results: Four trials (194 women) were included. All favored ESP block for duration, but the pooled difference was imprecise and heterogeneous (mean difference [MD] 11.75 hours; 95% CI -1.24 to 24.75; $I^2 = 99.8\%$) and depended on one trial. VAS did not differ significantly at rest (MD -0.60; 95% CI -1.26 to 0.07) or during movement (MD -0.66; 95% CI -1.34 to 0.02). More women rated satisfaction as excellent with ESP block (odds ratio 3.00; 95% CI 1.33 to 6.77), but not when good satisfaction was included (odds ratio 1.94; 95% CI 0.69 to 5.49).

Conclusion: Evidence is limited and at high risk of bias. ESP block was favored for duration and top satisfaction, but estimates were imprecise and sensitive to SD handling, with no robust difference in pain. Larger blinded trials are needed.

Keywords: Caesarean section; ESP block; TAP block; Pain management.

INTRODUCTION

Pain after caesarean section is frequently severe. It has two components: visceral pain from uterine stimulation and deep somatic pain from nociceptors in the abdominal wound. Adequate control of both is essential for rapid maternal recovery and for the mother's ability to bond with and care for her newborn. Pain is also a major determinant of satisfaction in women undergoing caesarean section.^{1,2}

Several approaches are used for postoperative analgesia after caesarean section under spinal anesthesia, including intrathecal and/or systemic opioids, abdominal wall nerve blocks, and truncal blocks such as the TAP block and the ESP block.^{3,4}

In the ESP block, local anesthetic is deposited in the plane between the transverse process and the erector spinae muscle. The injectate may spread in the paravertebral space over roughly three vertebral levels cranially and caudally, reaching the dorsal and ventral rami, and has been proposed to provide both somatic and visceral analgesia.^{5,6}

The TAP block is widely used as part of multimodal analgesia after caesarean section. By blocking the thoracolumbar nerves (T10–L1), it

provides adequate somatic analgesia of the abdominal wall but little or no visceral analgesia.^{7,8}

A systematic review has assessed the ESP block for analgesia after caesarean section,⁸ but evidence directly comparing ESP block with TAP block remains limited. We therefore performed a systematic review and meta-analysis to compare the analgesic effects of ESP block and TAP block after caesarean section.

METHODS

This systematic review was conducted in accordance with the PRISMA-P guidelines,¹² and the flow of studies is presented following the PRISMA 2020 statement.²⁵ The protocol was registered in PROSPERO (CRD42024579323).²⁴

The research question was formulated with the PICO framework: among women undergoing caesarean section, does ESP block provide better postoperative pain management than TAP block?

PubMed, ScienceDirect and Google Scholar were searched (until June 2024) using the following search terms: (1) Transversus Abdominis Plane Block AND Erector Spinae Plane Block AND Caesarean; and (2) (Transversus

Abdominis Plane Block OR Transverse Abdominis Plane Block OR TAP Block OR Erector Spinae Plane Block OR ESP Block) AND Caesarean. The inclusion criteria were: (1) prospective studies and randomized controlled trials; (2) women who had caesarean sections; and (3) trials with two intervention groups, with the ESP block group as the experimental arm and the TAP block group as the comparator. The reference lists of

retrieved publications were also screened. After duplicates were removed, the titles and abstracts of all retrieved records were screened independently by two reviewers (PJ and APM). Records that met the inclusion criteria were assessed in full text by the same two reviewers, and disagreements were resolved by consensus with a third author (FV) (Figure 1).

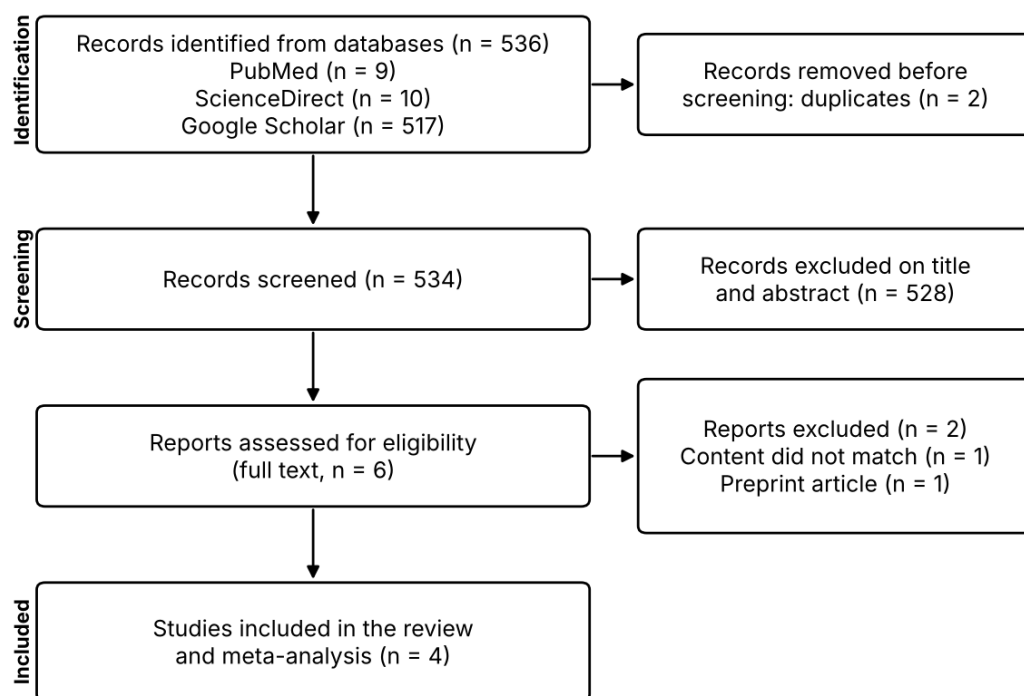


Figure 1. Flow chart for literature selection

Outcomes

The primary outcome was block duration, defined as the time from block performance to the first request for rescue analgesia, as reported by each trial (Table

2). Secondary outcomes were VAS pain scores (0–10 scale) at rest and during movement at 24 hours after surgery, and patient satisfaction. Movement was

defined as coughing, extending the lower limbs, sitting or walking. Patient satisfaction was assessed on three- or four-point ordinal scales in the included trials (Table 2). We pooled the proportion of women giving the highest rating (excellent or completely satisfied) and, in a second analysis, the proportion rating their satisfaction as good or better.

Data extraction

Means, SDs, standard errors, 95% confidence intervals (CI), numbers of events and total numbers of participants were extracted from the text, tables or, when not otherwise available, figures of the original studies.

Risk of bias assessment

The reviewers independently assessed the randomized trials with the Cochrane risk-of-bias tool¹⁰ in the following domains: random sequence generation, allocation concealment, blinding of participants and personnel, blinding of outcome assessment, incomplete outcome data, selective reporting and other bias.

Each domain was rated as low, unclear or high risk of bias. RevMan version 5.4⁹ was used for the risk-of-bias assessment.

Statistical analysis

A meta-analysis was performed for each outcome reported by at least two trials. Mean differences (MD) with 95% CI were calculated for continuous outcomes and odds ratios (OR) with 95% CI for dichotomous outcomes (a correction of 0.5 was added to studies with zero cells), using inverse-variance weighting. Heterogeneity was assessed with Cochran's Q test, the I^2 statistic and τ^2 ;^{13,23} a DerSimonian–Laird random-effects model was used when I^2 exceeded 50%, and a fixed-effect model otherwise. The calculations were implemented in a script following these standard methods, and all data entered are listed in Table 3 so that the analysis can be reproduced.

Trials that reported medians with interquartile ranges were converted to means and SDs with the method of Wan et al.,²⁶ which extends the approach of Hozo et al.¹¹ to medians with interquartile ranges. VAS values reported on a 0–100 mm scale (Malawat et al.) were divided by 10. When a converted or reported SD was zero (identical quartiles, or a reported SD of 0.00), the SD was replaced by the SD of the other arm of the same trial. When the SD was not reported for either arm (block duration in Malawat et al.), it was imputed as the mean of the valid SDs of the other

trials.¹³ A trial that reported VAS only graphically without SDs (Balata et al.) could not be pooled for that outcome and is described narratively.

Sensitivity analyses comprised: (1) leave-one-out analysis, omitting each trial in turn; (2) keeping zero SDs as reported (VAS); (3) replacing zero or missing SDs with the largest valid SD and, for block duration, with twice the largest valid SD; (4) excluding trials with imputed SDs (block duration); and (5) two definitions of a satisfied patient. Because only four trials were available, subgroup analysis, meta-regression and funnel plots were not feasible, and potential sources of heterogeneity were explored qualitatively (Tables 1–2 and Discussion)

RESULT

Four randomized controlled trials^{14–17} were included from the 536 records identified (Figure 1). A total of 194 women were analyzed (97 in each of the ESP and TAP groups); the 12 women in the control arm of Balata et al. were not analyzed.

All trials performed ultrasound-guided, bilateral, single-shot TAP and ESP blocks under spinal anesthesia (Table 1). TAP

blocks used a posterior approach between the costal margin and the iliac crest. ESP blocks were performed at the thoracic level (T9 in Boules et al. and Malawat et al., T9–T10 in Reddy et al. and T10 in Balata et al.). Local anesthetics were bupivacaine 0.25% (15–20 ml per side) or ropivacaine 0.2% (0.2 ml/kg in Malawat et al.; 20 ml in Reddy et al.). Dexmedetomidine 25 mcg was added in one trial (Reddy et al.). Adrenaline was not reported in any of the trials.

Most studies had a high risk of bias, mainly because participants were not blinded (performance bias) (Figure 2). Balata et al. had three domains at high risk: blinding of participants, blinding of outcome assessment and incomplete outcome data (SDs of VAS at rest and during movement were not reported).¹⁷ Boules et al. and Reddy et al. had a high risk of bias for participant blinding.^{14,16} Malawat et al. had two domains at high risk: selective reporting (SD of block duration not reported) and insufficient outcome data (30 participants per group were enrolled whereas 53 per group were required by the sample size calculation).¹⁵

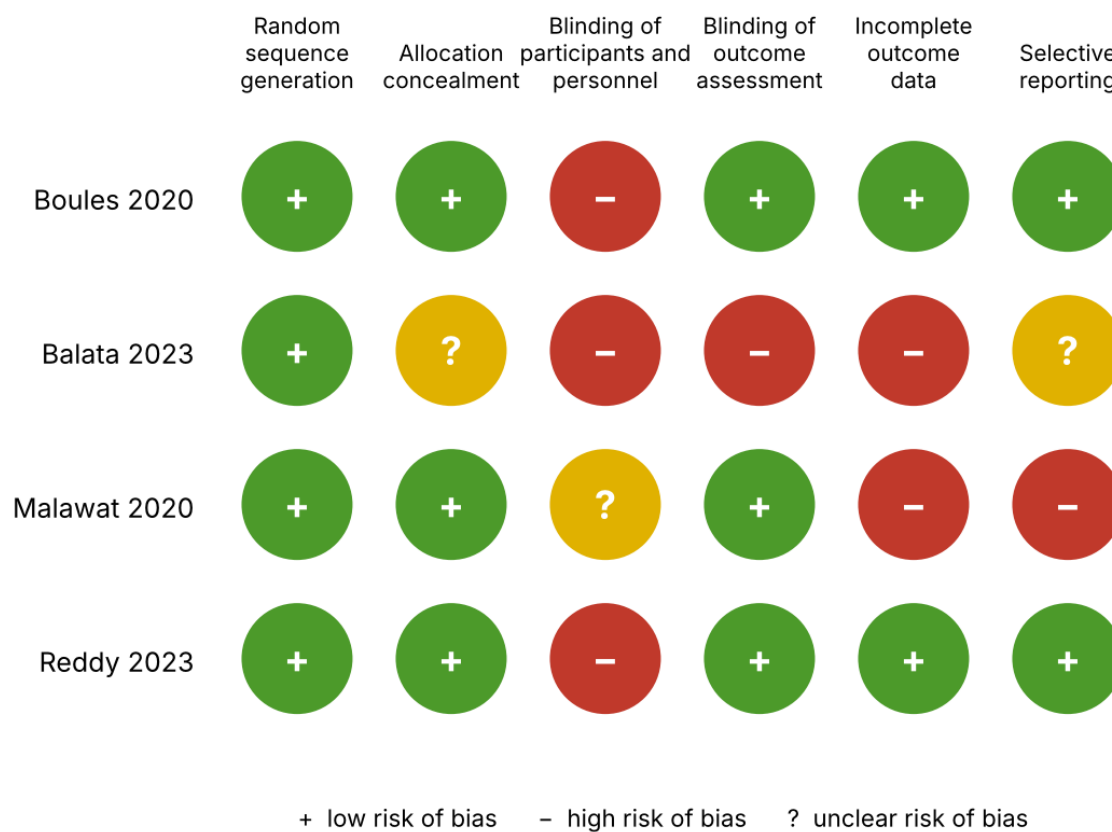


Figure 2. Risk of bias summary for the included studies

Table 1. Characteristics of the included studies

Reference	Group (n)	TAP block technique	Local anesthetic for TAP block	ESP block technique	Local anesthetic for ESP block	Anesthetic strategy	Postoperative analgesia	Primary outcome
Boules et al. (2020) ¹⁴	TAP block (30), ESP block (30)	US-guided, bilateral single shot, posterior approach (costal margin and iliac crest)	20 ml per side of 0.25% bupivacaine	US-guided, bilateral single shot, T9 transverse process approach	20 ml per side of 0.25% bupivacaine	Spinal anesthesia	IV paracetamol 1 g every 8 hours, IV ketorolac 30 mg every 12 hours, tramadol PCA (20 mg bolus, 10-minute lockout, 50 mg/hour limit)	Duration of the block
Balata et al. (2023) ¹⁷	Control (12), TAP block (12), ESP block (12)	US-guided, bilateral single shot, posterior approach (subcostal margin and iliac crest)	15 ml of 0.25% bupivacaine	US-guided, bilateral single shot, T10 level, 3 cm lateral to the spinous process	15 ml of 0.25% bupivacaine	Spinal anesthesia	IV pethidine as rescue	Postoperative pain score
Malawat et al. (2020) ¹⁵	TAP block (30), ESP block (30)	US-guided, bilateral single shot, posterior approach (costal margin and iliac crest)	0.2 ml/kg of 0.2% ropivacaine	US-guided, bilateral single shot, T9 transverse process approach	0.2 ml/kg of 0.2% ropivacaine	Spinal anesthesia	IV diclofenac 75 mg when VAS $\geq$ 40 mm	Time to rescue analgesia
Reddy et al. (2023) ¹⁶	TAP block (25), ESP block (25)	US-guided, bilateral single shot, posterior approach (iliac crest and costal margin)	20 ml of 0.2% ropivacaine with 25 mcg dexmedetomidine	US-guided, bilateral single shot, T9–T10 transverse process approach	20 ml of 0.2% ropivacaine with 25 mcg dexmedetomidine	Spinal anesthesia	Scheduled IV acetaminophen; tramadol PCA (20 ml syringe, 12.5 mg/ml)	Total tramadol consumption

Table 2. Block level, outcome definitions, form of reported data and satisfaction scales of the included studies

Study	ESP block level; local anesthetic; adjuvant	Definition of block duration	Form of reported data	Satisfaction scale and counts
Boules et al. ¹⁴	T9; 20 ml per side of 0.25% bupivacaine; no adjuvant	Interval between block performance and first request for analgesia	Median (IQR): duration ESP 12 (10–14) h, TAP 8 (8–8) h; VAS at 24 h at rest ESP 6 (6–6), TAP 6 (6–7); after cough ESP 7 (7–7), TAP 7 (7–8)	3-point (poor/good/excellent): ESP 3/10/17, TAP 6/16/8 (n = 30 each)
Balata et al. ¹⁷	T10, 3 cm lateral to the spinous process; 15 ml of 0.25% bupivacaine; no adjuvant	Time to first analgesic request (hours)	Duration: mean $\pm$ SD, ESP 23.37 $\pm$ 0.65 h, TAP 13.18 $\pm$ 0.86 h (n = 12 each). VAS shown only in figures; no SD reported	4-point (completely dissatisfied to completely satisfied): ESP satisfied 1, completely satisfied 11; TAP 6 and 6 (n = 12 each)
Malawat et al. ¹⁵	T9; 0.2 ml/kg per side of 0.2% ropivacaine; no adjuvant	Time to first rescue analgesia (diclofenac 75 mg when VAS $\geq$ 40 mm)	Duration: mean ESP 43.53 h, TAP 12.07 h; SD not reported (survival curve only). VAS (0–100 mm) at 24 h: rest ESP 18.33 $\pm$ 3.79, TAP 29.67 $\pm$ 5.56; movement ESP 20.00 $\pm$ 0.00, TAP 32.00 $\pm$ 4.07	Not reported
Reddy et al. ¹⁶	T9–T10; 20 ml of 0.2% ropivacaine with dexmedetomidine 25 mcg	Time required for first demand of analgesia (minutes)	Median (IQR) in minutes: ESP 270 (225–405), TAP 210 (135–315). VAS at 24 h: medians (IQR) in a table	3-point (excellent/good/poor): ESP 5/17/3, TAP 4/16/5 (n = 25 each)

Table 3. Data entered in the meta-analysis (mean $\pm$ SD (n) unless stated)

Outcome	Study	ESP block	TAP block	Source and handling
Block duration (h)	Boules	12.00 $\pm$ 3.11 (30)	8.00 $\pm$ 3.11* (30)	Medians (IQR) 12 (10–14) and 8 (8–8) converted; *SD of 0 replaced by the ESP SD
	Balata	23.37 $\pm$ 0.65 (12)	13.18 $\pm$ 0.86 (12)	Reported mean $\pm$ SD
	Malawat	43.53 $\pm$ 1.87† (30)	12.07 $\pm$ 1.87† (30)	†SD not reported; imputed as the mean of the valid SDs of the other trials
	Reddy	5.00 $\pm$ 2.36 (25)	3.67 $\pm$ 2.36 (25)	Medians (IQR) 270 (225–405) and 210 (135–315) minutes converted
VAS at rest, 24 h (0–10)	Boules	6.00 $\pm$ 0.78* (30)	6.33 $\pm$ 0.78 (30)	Medians (IQR) 6 (6–6) and 6 (6–7) converted; *SD of 0 replaced by the TAP SD
	Malawat	1.83 $\pm$ 0.38 (30)	2.97 $\pm$ 0.56 (30)	Reported mean $\pm$ SD on a 0–100 mm scale, divided by 10
	Reddy	2.50 $\pm$ 1.18 (25)	2.67 $\pm$ 1.57 (25)	Medians (IQR) 3 (1.5–3) and 2 (2–4) converted
	Balata	Not pooled	Not pooled	Figure only, no SD (ESP lower, P < 0.001 at 24 h)
VAS during movement, 24 h (0–10)	Boules	7.00 $\pm$ 0.78* (30)	7.33 $\pm$ 0.78 (30)	Medians (IQR) after cough 7 (7–7) and 7 (7–8) converted; *SD of 0 replaced by the TAP SD
	Malawat	2.00 $\pm$ 0.41* (30)	3.20 $\pm$ 0.41 (30)	Reported 20.00 $\pm$ 0.00 and 32.00 $\pm$ 4.07 mm, divided by 10; *SD of 0.00 replaced by the TAP SD
	Reddy	2.67 $\pm$ 0.79 (25)	3.00 $\pm$ 1.57 (25)	Medians (IQR) 3 (2–3) and 3 (2–4) converted
	Balata	Not pooled	Not pooled	Figure only, no SD (ESP lower, P < 0.001 at 24 h)

Outcome	Study	ESP block	TAP block	Source and handling
Satisfaction: highest rating (events/n)	Boules	17/30	8/30	Excellent
	Balata	11/12	6/12	Completely satisfied
	Reddy	5/25	4/25	Excellent
Satisfaction: good or better (events/n)	Boules	27/30	24/30	Good or excellent
	Balata	12/12	12/12	Satisfied or completely satisfied
	Reddy	22/25	20/25	Good or excellent

IQR, interquartile range; SD, standard deviation; VAS, visual analogue scale. Means and SDs were converted from medians and interquartile ranges with the method of Wan et al.

Block duration

Block duration was the primary outcome in two trials.^{14,15} All four trials reported a longer duration with ESP block (differences of 4.0 hours in Boules et al., 10.2 in Balata et al., 1.3 in Reddy et al. and 31.5 in Malawat et al.; Table 3). The reported mean durations ranged from 5.0 to 43.5 hours for ESP block and from 3.7 to 13.2 hours for TAP block.^{14–17} The pooled difference was MD = 11.75 hours (95% CI –1.24 to 24.75; random-effects model), with extreme heterogeneity ($I^2 = 99.8\%$; $\tau^2 = 175.3$; Q test $P < 0.001$), so the pooled estimate should be interpreted with great caution (Table 4). Omitting Malawat et al. reduced the pooled difference to 5.20 hours (95% CI –0.88 to 11.28), whereas omitting any of the other trials left it between 12.3 and 15.2 hours; I^2 stayed above 98% in every leave-one-out analysis. When the missing SD of Malawat et al. was replaced by the largest valid SD,

the difference was 11.74 hours (95% CI 1.29 to 22.19), and with twice that value 11.57 hours (95% CI 4.13 to 19.01).

Postoperative pain score at rest and during movement

Three trials contributed to the pooled analysis of VAS at 24 hours;^{14–16} Balata et al. reported VAS only in figures without SDs and could not be pooled, but reported lower scores with ESP block at 24 hours both at rest and during movement ($P < 0.001$).¹⁷ At rest, the pooled difference was MD = –0.60 (95% CI –1.26 to 0.07; $I^2 = 87\%$; random-effects model). During movement it was MD = –0.66 (95% CI –1.34 to 0.02; $I^2 = 89\%$). Neither difference was statistically significant, and results were similar when zero SDs were kept as reported (–0.59 and –0.65). Omitting Malawat et al. removed most of the heterogeneity ($I^2 = 0\%$) and reduced both differences to about –0.3 (Table 4). Replacing zero SDs with the largest valid

SD gave a borderline significant difference during movement (MD = -0.64; 95% CI -1.23 to -0.05).

Patient satisfaction

Three trials reported satisfaction (Malawat et al. did not).^{14,16,17} A higher proportion of women rated their satisfaction as excellent or completely satisfied with ESP block (OR = 3.00; 95% CI 1.33 to 6.77; I² =

21%; fixed-effect model). When women rating their satisfaction as good or better were counted, the difference was smaller and not statistically significant (OR = 1.94; 95% CI 0.69 to 5.49; I² = 0%). The highest-rating result was sensitive to the omission of Boules et al. (OR = 3.09; 95% CI 0.40 to 23.87; I² = 56%).

Table 4. Primary and sensitivity analyses

Outcome	Analysis	k	Effect (95% CI)	I ²
Block duration (MD, hours)	Primary: all trials, missing/zero SD imputed	4	11.75 (-1.24 to 24.75)	99.8%
	Omit Boules et al.	3	14.33 (-1.61 to 30.28)	99.9%
	Omit Balata et al.	3	12.27 (-8.87 to 33.41)	99.9%
	Omit Reddy et al.	3	15.22 (-0.45 to 30.90)	99.9%
	Omit Malawat et al.	3	5.20 (-0.88 to 11.28)	98.9%
	Malawat SD = largest valid SD (3.11 h)	4	11.74 (1.29 to 22.19)	99.7%
	Malawat SD = twice the largest valid SD (6.23 h)	4	11.57 (4.13 to 19.01)	99.2%
	Boules TAP SD = mean of the other TAP SDs (1.61 h)	4	11.75 (-0.92 to 24.42)	99.9%
	Excluding trials with imputed SD (Balata, Reddy only)	2	5.78 (-2.90 to 14.46)	99.3%
VAS at rest, 24 h (MD, points)	Primary: Boules, Malawat, Reddy	3	-0.60 (-1.26 to 0.07)	87%
	Omit Boules et al.	2	-0.72 (-1.66 to 0.22)	82%
	Omit Malawat et al.	2	-0.30 (-0.65 to 0.05)	0%
	Omit Reddy et al.	2	-0.75 (-1.53 to 0.03)	91%
	Zero SDs kept as reported	3	-0.59 (-1.25 to 0.06)	90%
	Zero SDs replaced by the largest valid SD (1.57)	3	-0.61 (-1.30 to 0.07)	80%
VAS during movement, 24 h (MD, points)	Primary: Boules, Malawat, Reddy	3	-0.66 (-1.34 to 0.02)	89%
	Omit Boules et al.	2	-0.83 (-1.67 to 0.01)	82%
	Omit Malawat et al.	2	-0.33 (-0.68 to 0.01)	0%
	Omit Reddy et al.	2	-0.78 (-1.63 to 0.07)	93%
	Zero SDs kept as reported	3	-0.65 (-1.35 to 0.05)	94%
	Zero SDs replaced by the largest valid SD (1.57)	3	-0.64 (-1.23 to -0.05)	62%

Outcome	Analysis	k	Effect (95% CI)	I ²
Satisfaction, highest rating (OR)	Primary: Boules, Balata, Reddy	3	3.00 (1.33 to 6.77)	21%
	Omit Boules et al.	2	3.09 (0.40 to 23.87)	56%
	Omit Reddy et al.	2	4.38 (1.64 to 11.72)	0%
	Omit Balata et al.	2	2.51 (1.05 to 5.97)	16%
Satisfaction, good or better (OR)	All three trials	3	1.94 (0.69 to 5.49)	0%
	Omit Boules et al.	2	1.69 (0.40 to 7.21)	0%
	Omit Reddy et al.	2	2.04 (0.50 to 8.24)	0%
	Omit Balata et al.	2	2.04 (0.70 to 5.98)	0%

MD, mean difference; OR, odds ratio; k, number of trials. Random-effects model when I² > 50%, otherwise fixed-effect model.

DISCUSSION

In this meta-analysis of four small randomized trials, all trials reported a longer block duration with ESP block than with TAP block, but the pooled difference was imprecise, extremely heterogeneous and not robust to the handling of missing standard deviations. Pain scores at 24 hours did not differ significantly at rest or during movement, and a higher proportion of women rated their satisfaction as excellent with ESP block, a finding that depended on how satisfaction was dichotomized. All findings must be interpreted in light of the high risk of bias and the small samples.

The reported durations of ESP block (5.0–43.5 hours) were longer than those of TAP block (3.7–13.2 hours).^{14–17} Elsayy et al. likewise found a considerably longer duration of analgesia with ESP

block than with TAP block in patients undergoing abdominoplasty under general anesthesia.¹⁸ Krishna et al. and Ghamry et al. reported analgesic durations of about ten and six hours, respectively, with thoracic-level ESP block.^{19,20} Moore et al. suggest that the clinical duration of a block is a safer indirect measure of analgesia, because few studies report the time to first analgesic request.²¹

The I² of 99.8% for block duration indicates that practically all of the variability reflects differences between trials rather than chance. Several clinical and methodological factors may explain it. First, the local anesthetic differed in type, concentration and volume: bupivacaine 0.25% in 15–20 ml (Boules et al., Balata et al.), weight-based ropivacaine 0.2% at 0.2 ml/kg (Malawat et al.) and ropivacaine 0.2% in 20 ml (Reddy et al.), and volume influences cranio-caudal spread. Second,

Reddy et al. added dexmedetomidine 25 mcg to both blocks, which prolongs block duration and may shift the absolute durations in both arms. Third, the ESP block was performed at different levels and with different techniques (T9, T9–T10, T10), which may change the extent of spread. Fourth, block duration was not operationalized uniformly: Malawat et al. used the first rescue dose triggered by VAS ≥ 40 mm; Boules et al. and Reddy et al. gave scheduled intravenous paracetamol (and ketorolac in Boules et al.) together with tramadol PCA, which can mask the time to first request; and Balata et al. used intravenous pethidine as rescue. In particular, the median duration of exactly 8 hours (IQR 8–8) with TAP block in Boules et al. coincides with the 8-hour paracetamol interval and may reflect truncation by scheduled dosing. Fifth, the reported durations differed greatly in magnitude, from a median of 4.5 hours with ESP block in Reddy et al. to 12 hours in Boules et al., 23.4 hours in Balata et al. and 43.5 hours in Malawat et al., and background multimodal analgesia and spinal anesthesia were not standardized. Finally, small trials with wide variances and different ways of deriving SDs (Table 3) add further imprecision. With only four trials these explanations could not be

tested formally by subgroup analysis or meta-regression. In leave-one-out analyses I^2 stayed above 98%, but omitting Malawat et al., whose ESP duration was about 3.6 times that of its TAP group and far above the other trials, reduced the pooled difference from 11.8 to 5.2 hours.

Our results also show how strongly pooled estimates depend on the handling of SDs. Medians with identical quartiles (Boules et al.), a reported SD of zero (movement VAS in Malawat et al.) and a missing SD (block duration in Malawat et al.) either give a trial an infinite weight or make it not estimable. Excluding such trials removes the trial with the largest effect and changes the answer: leaving out Malawat et al. gives a difference of 5.2 hours whose 95% CI includes zero, whereas imputing its SD with the mean valid SD gives 11.8 hours (95% CI –1.2 to 24.8), and with the largest or twice the largest valid SD gives 11.7 and 11.6 hours with confidence intervals excluding zero. Statistical significance therefore depends on the SD that is assumed, while the direction of effect (all four trials favor ESP block) and the order of magnitude do not. For VAS, keeping or replacing zero SDs gave similar point estimates, but the heterogeneity fell from 94% to 62% when zero SDs were replaced by the largest valid

SD during movement. We therefore report the analyses with explicit SD rules together with the sensitivity analyses in Table 4. A previous meta-analysis comparing ESP block with other techniques for analgesia after caesarean section found no reduction in postoperative pain scores,⁸ consistent with our finding that pain scores did not differ significantly. In a meta-analysis of ESP block in adults undergoing abdominal, chest or spine surgery, pain scores in the first 24 hours were lower than with sham or no block (mean reduction 1.2 to 2.27), but the authors questioned the clinical significance of this difference.²² In our review all women received spinal anesthesia, and the neuraxial block itself contributes to analgesia in both groups,⁸ which may explain why an additional benefit of ESP over TAP block was small. The pooled differences of 0.6–0.7 points on a 0–10 scale are below the minimal clinically important difference for acute postoperative pain, which is generally taken as about 1 point,²⁷ and should not be regarded as clinically meaningful even if they were statistically significant. A previous study found no difference in patient satisfaction between the groups, most likely because there was no difference in postoperative pain or

complications.⁸ Another study, of abdominoplasty, also found no significant difference in satisfaction between ESP and TAP block, probably because pain management is not the only element that influences satisfaction.¹⁸ In our review, ESP block was associated with a higher proportion of women with the highest satisfaction rating, but not when good satisfaction was counted as satisfied, and this result changed when Boules et al. was omitted. Because satisfaction is a subjective outcome and participants in most trials were not blinded, this finding may be inflated by performance bias. Factors that influence satisfaction beyond pain control need further investigation. This review has several limitations.¹ Only four randomized trials, with 194 analyzed women (12–30 per arm), were included; this limits the power and precision of every pooled estimate (for example, the 95% CI for block duration spans –1.2 to 24.8 hours) and the strength of any clinical conclusion. With so few small trials, random-effects estimates are also unstable and small-study effects and publication bias could not be assessed (no funnel plot was feasible).² Most trials had a high risk of bias, mainly from the lack of participant blinding, which particularly affects subjective outcomes such as pain and

satisfaction.³ Heterogeneity was very high for block duration and for VAS and could not be explored statistically.⁴ Several SDs were missing, zero or had to be converted from medians and interquartile ranges, and the pooled estimates depended on the rules used to handle them; one trial could not be pooled for VAS because no SD was reported.⁵ Pain was assessed only up to 24 hours, and opioid consumption and adverse effects were not analyzed.⁶ Local anesthetic doses and adjuvants differed between trials, and ESP block is a relatively new technique without standardized dosing for obstetric use.⁷ The search covered three databases (including Google Scholar) with a limited set of search terms, so some eligible trials may have been missed. Our findings should therefore be regarded as hypothesis-generating rather than definitive. Future research is required to determine whether ESP block is as effective as other truncal blocks for analgesia in obstetric procedures, and how it compares with neuraxial analgesia. Trials should be adequately blinded, report means and SDs for all outcomes, use standardized definitions of block duration and time to first rescue analgesia, and have sample sizes large enough to detect a clinically important difference.

CONCLUSION

Compared with TAP block, all four trials found a longer block duration with ESP block, and a higher proportion of women rated their satisfaction as excellent. However, the pooled estimates were imprecise, highly heterogeneous and sensitive to the handling of missing standard deviations, and the evidence is limited by few small trials at high risk of bias. No robust difference in pain scores at rest or during movement was found, and the observed differences were below the minimal clinically important difference. Larger, well-designed randomized controlled trials are needed before ESP block can be recommended over TAP block for this indication.

CONFLICT OF INTEREST

The authors declare that they have no conflicts of interest.

REFERENCES

1. McDonnell NJ, Keating ML, Muchatuta NA, Pavy TJ, Paech MJ. Analgesia after caesarean delivery. *Anaesth Intensive Care*. 2009;37(4):539–51. DOI: 10.1177/0310057X0903700418
2. Bakhsha F, Niaki AS, Jafari SY, Yousefi Z, Aryaie M. The effects of diclofenac suppository and

- intravenous acetaminophen and their combination on the severity of postoperative pain in patients undergoing spinal anaesthesia during caesarean section. *J Clin Diagn Res.* 2016;10(7):UC09. DOI: 10.7860/JCDR/2016/15093.8120
3. Baeriswyl M, Kirkham KR, Kern C, Albrecht E. The analgesic efficacy of ultrasound-guided transversus abdominis plane block in adult patients: a meta-analysis. *Anesth Analg.* 2015;121:1640–54. DOI: 10.1213/ANE.0000000000000967
 4. Salaheldin M, Badawy M. Ultrasound-guided erector spinae plane block for postoperative pain management after cesarean delivery. *Teikyo Med J.* 2022;45(01):4337–43.
 5. Bellantonio D, Bolondi G, Cultrera F, Lofrese G, Mongardi L, Gobbi L, et al. Erector spinae plane block for perioperative pain management in neurosurgical lower-thoracic and lumbar spinal fusion: a single-centre prospective randomised controlled trial. *BMC Anesthesiol.* 2023;23(1):187. DOI: 10.1186/s12871-023-02130-z
 6. Ekuariantanto D, Apsari RK. Blok saraf perifer sebagai salah satu suplemen analgesia pascaseksio sesarea. *Jurnal Anestesi Obstetri Indonesia.* 2023;6(3):197–207. DOI: 10.47507/obstetri.v6i3.148
 7. Mankikar G, Sardesai P, Ghodki S. Ultrasound guided transversus abdominis plane block for postoperative analgesia in patients undergoing caesarean delivery. *Indian J Anaesth.* 2016;60(4):253–7. DOI: 10.4103/0019-5049.179451
 8. Junior I, Carvalho V, Brito L. Erector spinae plane block for analgesia after cesarean delivery: a systematic review with meta-analysis. *Braz J Anesthesiol.* 2022;72(4):506–15. DOI: 10.1016/j.bjane.2021.09.015
 9. Review Manager (RevMan) [Computer program]. Version 5.4. The Cochrane Collaboration; 2020.
 10. Higgins JPT, Altman DG, Gøtzsche PC, et al. The Cochrane Collaboration's tool for assessing risk of bias in randomised trials. *BMJ.* 2011;343:d5928. DOI: 10.1136/bmj.d5928
 11. Hozo SP, Djulbegovic B, Hozo I. Estimating the mean and variance from the median, range, and the size of a sample. *BMC Med Res*

- Methodol. 2005;5:13. DOI: 10.1186/1471-2288-5-13
- 2020;36:201–6. DOI: 10.4103/joacp.JOACP_116_19
12. Moher D, Shamseer L, Clarke M, et al. Preferred reporting items for systematic review and meta-analysis protocols (PRISMA-P) 2015 statement. *Syst Rev.* 2015;4:1. DOI: 10.1186/2046-4053-4-1
 13. Higgins JPT, Thomas J, Chandler J, Cumpston M, Li T, Page MJ, Welch VA, editors. *Cochrane Handbook for Systematic Reviews of Interventions* version 6.4 (updated August 2023). Cochrane; 2023. Available from: www.training.cochrane.org/handbook
 14. Boules ML, Goda AS, Abdelhady MA, et al. Comparison of analgesic effect between erector spinae plane block and transversus abdominis plane block after elective cesarean section: a prospective randomized single-blind controlled study. *J Pain Res.* 2020;13:1073–80. DOI: 10.2147/JPR.S253343
 15. Malawat A, Verma K, Jethava D, et al. Erector spinae plane block and transversus abdominis plane block for postoperative analgesia in cesarean section: a prospective randomized comparative study. *J Anaesthesiol Clin Pharmacol.* 2020;36:201–6. DOI: 10.4103/joacp.JOACP_116_19
 16. Reddy KN, Prabhu M, Kanakalakshmi ST, Muhamed S. Randomized comparison between transversus abdominis and erector spinae blocks in cesarean section. *Colomb J Anesthesiol.* 2023;51:e1072. DOI: 10.5554/22562087.e1072
 17. Balata HA, El-Dorgham LT, Ismail HA, Salama MA. Analgesic efficacy of ultrasound-guided erector spinae plane block versus transversus abdominis plane block for post-cesarean delivery pain under spinal anesthesia. *Egypt J Hosp Med.* 2023;91:4265–71.
 18. Elsayy A, Abdelhameed S. Bilateral fascial plane block for post abdominoplasty pain control; erector spinae plane block contrasted with transversus abdominis one. *Al-Azhar Int Med J.* 2021;2(9): Article 5. DOI: 10.21608/aimj.2021.80063.1498
 19. Krishna SN, Chauhan S, Bhoi D, et al. Bilateral erector spinae plane block for acute post-surgical pain in adult cardiac surgical patients: a randomized controlled trial. *J Cardiothorac Vasc Anesth.* 2019;33:368–75.

20. Ghamry M, Amer A. Role of erector spinae plane block versus paravertebral block in pain control after modified radical mastectomy: a prospective randomised trial. *Indian J Anaesth.* 2019;63:1008. DOI: 10.4103/ija.IJA_310_19
21. Moore RA, Mhuirheartaigh RJN, Derry S, et al. Mean analgesic consumption is inappropriate for testing analgesic efficacy in post-operative pain: analysis and alternative suggestion. *Eur J Anaesthesiol.* 2011;28:427–32. DOI: 10.1097/EJA.0b013e328343c569
22. Cai Q, Liu G, Huang L, et al. Effects of erector spinae plane block on postoperative pain and side-effects in adult patients underwent surgery: a systematic review and meta-analysis of randomized controlled trials. *Int J Surg.* 2020;80:107–16. DOI: 10.1016/j.ijssu.2020.05.038
23. Dahlan MS. Pengantar meta analisis disertai aplikasi meta-analisis EpiYudin. Edisi 2. Jakarta: Epidemiologi Indonesia; 2019. p. 23–40, 139–42.
24. Jiwanggana P, Venawati F, Prilia AM. PROSPERO 2024 CRD42024579323 [Internet]. Comparison of analgesic effect between erector spinae plane block and transversus abdominis plane block for pain management following caesarean: a meta-analysis. Available from: https://www.crd.york.ac.uk/prospero/display_record.php?RecordID=579323
25. Page MJ, McKenzie JE, Bossuyt PM, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. *BMJ.* 2021;372:n71. DOI: 10.1136/bmj.n71
26. Wan X, Wang W, Liu J, Tong T. Estimating the sample mean and standard deviation from the sample size, median, range and/or interquartile range. *BMC Med Res Methodol.* 2014;14:135. DOI: 10.1186/1471-2288-14-135
27. Myles PS, Myles DB, Gallagher W, et al. Measuring acute postoperative pain using the visual analog scale: the minimal clinically important difference and patient acceptable symptom state. *Br J Anaesth.* 2017;118(3):424–9. DOI: 10.1093/bja/aew466