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HEAD AND NECK

Post-thyroidectomy bilateral cervical plexus block relieves pain: a systematic review

Carlos Betancourt[1,2] · **Alvaro Sanabria**[1,2,3]

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Abstract

Purpose To assess the effectiveness of bilateral superficial cervical plexus block (BSCPB) in treating post-thyroidectomy pain.

Methods MEDLINE, Embase, Google Scholar, LILACS, and the Cochrane Central Register of Controlled Trials, were extensively searched. The search period extended from 1968 until December 2022. Randomized controlled trials comparing BSCPB to placebo, no block in patients with thyroidectomy for benign or malignant thyroid disease were included. Outcomes were pain in the first 24 h after surgery. Analgesic rescue, period before the first rescue dosage, and 24-h opioid usage were secondary outcomes. The RoB 2 instrument was used to evaluate the risk of bias.

Results 34 of 354 studies were eligible. There were 2,519 patients. BSCPB reduced the intensity of pain postoperatively [SMD: − 1.17 (95% CI: − 1.54 to − 0.81)] and in the first 24 h [− 0.62 (95%: 0.91 to 0.33)]. A considerable delay for the first opioid dose, rescue analgesics, and postoperative opioid usage was also found.

Conclusion BSCPB's 24-h analgesic efficacy minimizes the requirement for rescue analgesia, postoperative opioid intake, and rescue analgesia start time. The choice of anesthetic and different application methods might affect its effectiveness.

Keywords Thyroid carcinoma · Thyroidectomy · Blocking · Pain · Analgesia

Introduction

Thyroidectomy are among the most frequently conducted procedures for benign or malignant pathologies [1]. Although considered a mild to moderately painful procedure, thyroidectomy can cause severe discomfort in patients, particularly within the first 24 h after surgery [2]. Inadequate pain management increases stress hormone levels and the incidence of postoperative complications [3]. Therefore, postoperative pain management is essential for the efficacy of the procedure.

Opioids and non-steroid anti-inflammatory drugs (NSAID) are typically used to treat postoperative pain. However, systemic opioid use is associated with adverse effects such as nausea, vomiting, urinary retention, apnea, and respiratory depression [4]. In a similar fashion, NSAID may not provide effective pain relief and may increase the risk of postoperative hemorrhage [5]. Therefore, additional postoperative pain management strategies are required and have become a topic of contemporary research.

Regional anesthesia techniques are a straightforward, safe, and effective postoperative analgesia technique. One of the most studied is bilateral superficial cervical plexus block (BSCPB). The cervical plexus superficial branches are sensory and supply the skin and subcutaneous tissues of the neck. These rami have a well-established location and can be readily located at certain anatomic landmarks, allowing their block to be carried out.

Numerous studies have evaluated the effectiveness of BSCPB in reducing and managing post-thyroidectomy pain [6, 7] and the effectiveness of this technique in reducing

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✉ Alvaro Sanabria
alvarosanabria@gmail.com

[1] Head and Neck Service, Hospital Alma Mater, Medellín, Colombia

[2] CEXCA, Centro de Excelencia en Enfermedades de Cabeza y Cuello, Medellín, Colombia

[3] Department of Surgery, School of Medicine, Universidad de Antioquia, Cra. 51d #62-29, Medellín, Colombia

pain levels and its usefulness in managing postoperative pain remain controversial and are still the subject of debate. Warschkow et al., [7] and Mayhew et al., [6] published their meta-analysis in an attempt to answer this query. They discovered that BSCPB is an effective analgesic during the first 24 h after thyroid surgery. However, many new Randomized Controlled Trials (RCT) have been conducted and published evaluating this topic and specific concerns regarding the blocking technique and medication have arisen. The research question was: in RCTs (S) evaluating patients undergoing partial or total open thyrodiectomy (P), does routine use of BSCPB (I) compared to no use/placebo (C) decrease postoperative pain and the use of rescue analgesics (O)?

We decided to conduct an updated systematic review to assess the efficacy of BSCPB in managing post-thyroidectomy pain and to answer some specific concerns regarding the use of type and quantity of anesthetic, time of blocking, number of infiltration points and addition of other interventions.

Methods

This review was designed in accordance with the Cochrane Collaboration's recommendations and is reported according to the PRISMA 2023 recommendations [8, 9]. Prior to this, the protocol was registered in the Open Science Framework registry (https://doi.org/10.17605/OSF.IO/DPXUT).

Eligibility criteria

Studies

Only RCTs comparing cervical sensory plexus block to no block, placebo block, or block plus surgical wound infiltration were included in this review.

Patients

Only studies recruiting patients with benign or malignant thyroid disease who underwent partial or total open thyroidectomy were considered.

Interventions

The interventions evaluated were the performance of a sensory nerve plexus block (superficial, intermediate, or deep) at any time of the procedure (pre-incision or post-incision), with any medication (anesthetics, NSAIDs) or concentration, with any technique (2 or 3 points), with or without ultrasound guidance, and by any practitioner (surgeon or anesthesiologist). The comparison strategy consisted of the standard technique without a block or the administration of a placebo block with or without local wound infiltration.

Outcomes

The primary outcome was the evaluation of postoperative pain during the first 24 h, as measured by a 0–10 point visual analogue scale (VAS). To homogenize the primary outcome variable, studies in which the scale was measured in a range of less or more than 10 were normalized to this interval. Due to the need to report the outcome as mean ± SD, studies in which the outcome was reported in a different format were transformed using the following mathematical procedures: When reported as median and range, range/4 was used to calculate SD; when reported as interquartile range, range/1.35 was used to calculate SD [9]. The software *Engauge Digitizer 12.1 (*https://github.com/markummitchell/engauge*)* was used to impute mean and SD values for studies in which only graphical results were presented. According to the Cochrane manual, for outcomes for which the range was not reported, the maximum value of SD for the respective comparison was used [9].

Need for analgesic rescue in the first 24 h, time to first analgesic rescue dose in minutes, and total opioid analgesic consumption at 24 h were secondary outcomes. As heterogeneity between analgesic drugs and doses was anticipated, a conversion from opioid drugs to equianalgesic doses of 1 mg morphine was devised: 7.5 mg for meperidine; 10 mg for tramadol [10].

Search strategy

The authors independently searched through the MEDLINE, Embase, Google Scholar, LILACS (Latin American literature in health sciences), and Central (Cochrane Central Register of Controlled Trials) databases between 1968 and December 2022. No time or language restrictions were imposed. The search is detailed in Supplementary Table 1.

Initially, the abstracts were evaluated, and those deemed eligible were selected. These were then assessed in full and selected based on the predetermined inclusion criteria. The disagreements were resolved through consensus. Using a 'snowball' strategy, the references of selected studies were examined to identify additional studies. The flow chart was build using ShinyApp for making PRISMA 2020 flow diagrams [11].

Data collection

The authors evaluated the selected studies in full text and independently completed an online form. The differences between the two sets of data were resolved by consensus.

Variables

Characteristics of the patients, type of surgery and anesthetic induction and maintenance process, use of analgesic rescue and its conditions, type of sensitive plexus operated on, timing and technique of the block, anesthetic used, and measured volume and quantity values and outcome were included in the data collection format. In studies with more than two comparison groups, data from each group were utilized in independent comparisons, so no adjustments were required to control for unit of analysis effect.

Risk of bias assessment

Authors independently assessed studies with the RoB 2 instrument for RCTs, [12] which evaluates five domains, rates them in five categories (yes, probably yes, probably no, no, and no information), and defines an overall risk of bias as low, some concerns, or high. Disagreements were resolved through consensus. Publication bias was investigated using a tunnel plot for the outcome with the most studies and the Begg test [13].

Analysis

The analysis was conducted utilizing the Cochrane Collaboration Review Manager (Review Manager (RevMan) [Computer program]) software. The Cochrane Collaboration, 2020, Version 5.4.). As a summary measure, the standardized mean difference (SMD) was used for quantitative variables and the odds ratio (OR) was used for categorical variables using the Mantel and Haenszel random effects method with a 95% confidence interval [9]. The information was displayed using Forrest plots. Clinical heterogeneity was investigated qualitatively, while statistical heterogeneity was investigated using the Higgins I^2 statistic.

Subgroup and sensitivity analyses

Due to the anticipated heterogeneity, subgroup analyses were planned based on the type of control group used (no block versus placebo versus wound infiltration), the type of drug used for the block (Bupivacaine/levobupivacaine versus ropivacaine), the amount of anesthetic and technique variants (number of blocking points, time of blocking). The Chi-square test was utilized for group comparisons. A p value 0.05 was statistically significant. A sensitivity analysis was conducted, excluding outliers from each comparison.

Results

Study characteristics

The initial search found 354 studies, of which 34 RCTs were ultimately included in this review [14–46] Fig. 1.

There was a total of 2519 patients, with 1318 assigned to the block group and 1,201 to the control group. Seven

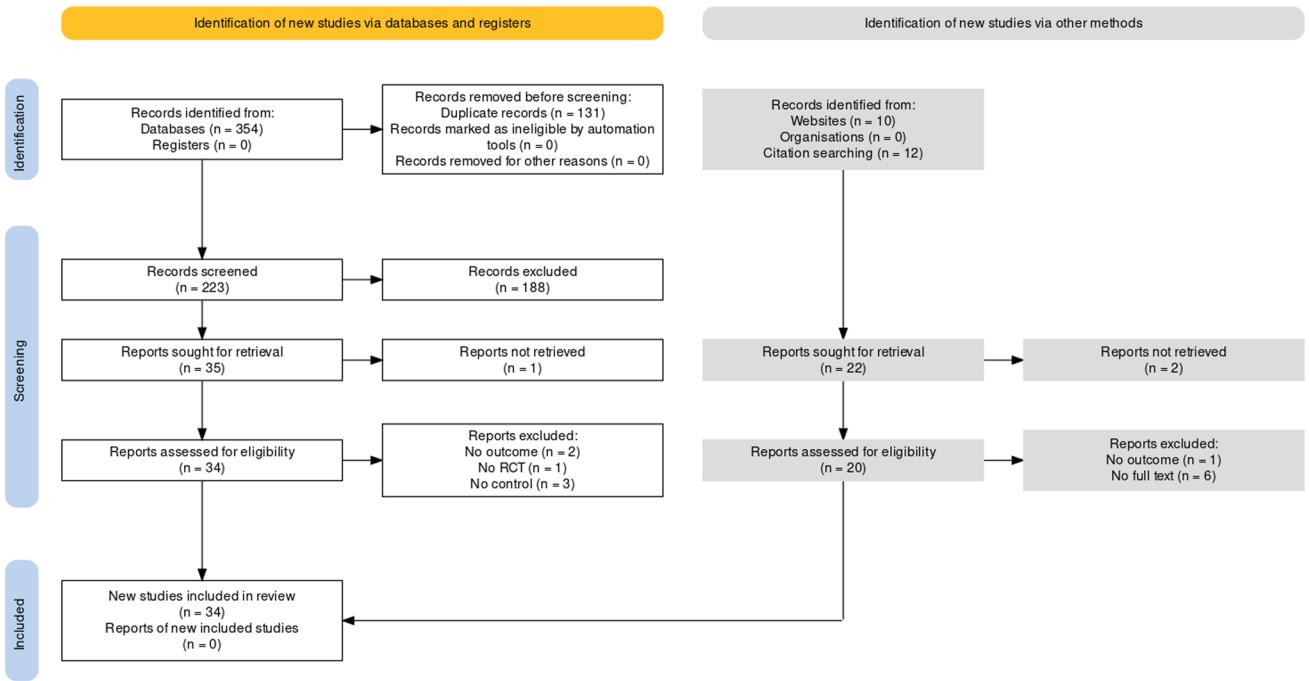

Fig. 1 PRISMA flow diagram

studies [17, 21, 30, 31, 36, 39, 46] included only patients undergoing total thyroidectomy. Twenty studies reported in detail the use of premedication [4, 17–21, 26, 26, 27, 29, 31–36, 38, 39, 42, 43, 45, 46], most using midazolam. Many studies used a combination of propofol and an opioid for induction [14, 15, 17–22, 24–28, 30–34, 34–36, 38, 39, 42, 43, 45, 47]. Eight studies used Total Intravenous Anesthesia (TIVA) alone [14, 17, 18, 20, 23, 34, 39, 41]. Nineteen studies used opioids as analgesia in maintenance of anesthesia [14, 15, 17, 19–22, 25, 26, 28, 30–33, 35, 36, 41, 46, 47, 49]; six studies used PCA pump for analgesic rescue [16, 26, 29, 30, 33, 46] and 16 studies used a combination of NSAIDs + opioids for postoperative analgesia [9, 10, 15, 17, 18, 20, 24, 25, 27–31, 33, 34, 39–41].

Characteristics of interventions and outcomes

Most investigations employed two comparison groups [15, 21, 24, 25, 27–29, 34–47]. Two studies also blocked the deep plexus associated to superficial blocking [14, 20]. Six studies [3, 9, 17, 21, 22, 29, 33, 36] employed two blocking points and four studies [21, 25, 27, 47] administered the BSCPB postoperatively. The control group in four investigations was wound infiltration [16, 27, 40, 42].

The most common anesthetic concentration was 0.25% bupivacaine, followed by 0.5%. Only four studies employed different concentration [17, 21, 39, 42]. The average infiltration volume was 21.5 ± 5.2 ml, while the average anesthetic dose was 82.1 ± 41.8 mg. The quartile division yielded 50 mg as the limit of the 25% quartile and 100 mg as the limit of the 75% quartile.

Four studies made use of ultrasonography to guide the BSCPB placement [29, 32, 36, 45]. Eleven of the 34 studies used a saline placebo as a control [19, 21–24, 26, 27, 33, 35, 37, 44].

The most frequently evaluated outcome was pain with a VAS, followed by total postoperative analgesic consumption [1, 14, 16, 18–20, 23, 26–30, 32–34, 36, 38, 38, 41–44, 46] in addition to the need for rescue analgesia [17, 18, 20–22, 24, 25, 30–32, 37, 39, 44] Table 1.

Risk of bias assessment

All studies were RCTs. 50% of the trials were categorized as RoB with some concerns [14, 15, 19, 20, 25, 28, 29, 34–37, 39, 41, 43–45, 47] The domain with the most weaknesses was deviations from intended interventions, due to the possibility that intervention applicators knew the type of intervention used in patients who did not receive placebo, [15–18, 20, 25, 28–32, 34, 36, 37, 39, 41, 43, 45, 46] Fig. 2 and Supplementary Fig. 1.

There was no evidence of publication bias for the VAS outcome with the most studies (postoperative and 24 h). Supplementary Fig. 2.

Outcomes

Postoperative pain

The postoperative pain assessments were administered at varying intervals. 23 studies assessed pain in the immediate postoperative period, [14–22, 24, 29, 30, 32–34, 36, 37, 41, 43–47, 57] including 12 at 4 h, [16–18, 20, 22, 24, 26, 30, 32, 33, 37, 45] 18 at 6 h, [14, 16, 19–21, 26, 29, 30, 34, 36, 41, 43–47] 9 at 8 h, [16–18, 22, 24, 26, 32, 33, 37, 43] 21 at 12 h, [2, 14, 16–22, 24, 29–34, 36, 37, 41, 44–46, 60] and 24 at 24 h [14, 16–22, 24, 26, 29–34, 36, 37, 41, 43–47].

Immediate postoperative and 24-h periods with 1550 and 1550 patients, respectively, were the comparisons with the highest number of patients. In all time periods described, the BSCPB had a statistically significant effect on pain control, which decreased over time, from an SMD of − 1.17 (95% CI: − 1.54 to − 0.81) in the immediate postoperative period to − 0.62 (95% CI: 0.91 to 0.33) at 24 h. Figure 3 and Supplementary Fig. 3. All comparisons exhibited statistically significant heterogeneity.

Subgroup analysis revealed that the bupivacaine group experienced less postoperative pain than the ropivacaine group (SMD − 063 vs − 1.41, $p = 0.05$). Figure 4 and Supplementary Fig. 4. This difference was maintained at 12 and 24 h. In the immediate postoperative period, the three-point injection group had a greater effect than the two-point injection group (− 1.46 vs 0.63, $p = 0.02$), and this difference was maintained at 12 and 24 h, Supplementary Fig. 4. In relation to the moment of the block, there were no differences between the groups. Regarding the amount of analgesic, at 12 h, the < 25% percentile group had a greater effect than the other groups (SMD − 0.41 (95% CI − 0.71 to − 0.10), and at 24 h, the < 25% percentile group and the 25–75% percentile group maintained this superior effect. The subgroup analysis based on the use or non-use of ultrasound guidance revealed no distinctions in its effect.

No differences were found between the methods when comparing BSCPB to BSCPB plus wound infiltration. (SMD 0.47 (95% CI 0.11–0.83). Supplementary Fig. 5.

Because the studies by Hassan et al. [32] and Woldergerima et al. [44] provided unusual results in terms of the magnitude of the impact on VAS, a sensitivity analysis

Table 1 Characteristics of included studies in the systematic review comparing BSCPB with no block in thyroidectomy

Author	Year	Country	BSCPB group	Control group	Type of surgery	Prem drug	Induction drug	Anesthesia technique	Anesthesia maintenance drug	Intraoperative analgesia drug	Pop analgesia control	Indication of pop analgesia	Type of pop analgesia
Dieudonne	2001	France	47	40	PT + TT	Mid	Pro + Sul	Inh	Iso + N02	Par + Sul	Rescue dose	VAS > 4	NSAID + Opioid
Aunac	2002	Belgium	13	13	PT + TT	Lorm	Pro + Alf	TIVA	Pro + Alf	Alf	Rescue dose	VAS > 4	NSAID
Negmi	2005	Saudi Arabia	25	25	PT + TT	Mid	Pro + Fen	Inh	Iso + N02	Fen	Rescue dose	VAS > 4	NSAID + Opioid
Eti	2006	Turkey	15	15	PT + TT	Mid	Tio	Inh	Sev + N02	ND	PCA	VAS > 3	Opioid
Herbland	2006	France	74	37	TT	Hid	Pro + Fen	TIVA	Pro	Par + Sul	Rescue dose	VAS > 4	NSAID + Opioid
Moussa	2006	Saudi Arabia	12	12	PT + TT	Mid	Pro + Rem	TIVA	Pro + Rem	ND	Rescue dose	VAS > 3	NSAID + Opioid
Andrieu	2007	France	29	29	PT + TT	Hid	Pro + Sul	Inh	Sev + N02	Sul	Rescue dose	VAS > 4	NSAID
Suh	2009	South Korea	30	30	PT	Zolp	Pro + Rem	TIVA	Pro + Rem	Rem	Rescue dose	VAS > 4	NSAID + Opioid
Kesisoglou	2010	Greece	50	50	TT	Hid	Pro + Sul	Inh	Sev + N02	Sul	Rescue dose	ND	NSAID
Shih	2010	Taiwan	106	56	PT + TT	ND	Pro + Fen	Inh	Des	Fen	Rescue dose	VAS > 4	NSAID
Steffen	2010	Switzerland	82	77	PT + TT	ND	ND	TIVA	Pro + Rem	ND	Rescue dose	RP	NSAID
Cai	2012	China	67	68	PT + TT	ND	Pro + Fen	Inh	Sev + N02	ND	Rescue dose	VAS > 6	NSAID + Opioid
Karthikeyan	2012	India	20	20	PT + TT	Mid + Dia	Pro + Fen	Inh	Iso + N02	Fen	PCA	VAS > 3	Opioid
Egan	2013	UK	29	29	PT + TT + PaT	ND	Pro + Alf	Inh	Iso	Par + Fen	Rescue dose	RP	NSAID + Opioid
Dostbil	2014	Turkey	30	30	PT + TT	Mid	Pro + Fen	Inh	Sev + N02	ND	Rescue dose	VAS > 4	NSAID + Opioid
Gurkan	2015	Turkey	25	24	PT + TT	Mid	Tio + Fen	Inh	Des + N02	Par + Lor	PCA	RP	NSAID + Opioid
Çanakçı	2015	Turkey	75	75	PT + TT	ND	Pro + Fen	Inh	Sev	Fen	Rescue dose	VAS > 5	NSAID + Opioid
Kılınçkan	2015	Turkey	19	20	TT	ND	Pro + Fen	Inh	Sev	Fen	PCA	RP	NSAID + Opioid
Barua	2016	India	25	25	TT	Mid	Pro + Fen	Inh	Sev	Fen	Rescue dose	VAS > 4	NSAID + Opioid
Hassan	2017	Egypt	46	23	PT + TT	Mid	Pro + Fen	Inh	Iso	Fen	Rescue dose	VAS > 3	Opioid
Ahiskalioglu	2018	Turkey	20	20	PT + TT	Mid	Pro	Inh	Sev + N02	Fen	PCA	VAS > 4	NSAID + Opioid
Aweke	2018	Ethiopia	33	33	PT + TT	Mid + Fen	Pro + Thio	TIVA	ND	Dic + Tram	Rescue dose	ND	NSAID + Opioid
Kannan	2018	India	25	25	PT + TT	Dia	Pro	Inh	Sev + N02	Fen	Rescue dose	VAS > 4	NSAID

Table 1 (continued)

Author	Year	Country	BSCPB group	Control group	Type of surgery	Prem drug	Induction drug	Anesthesia technique	Anesthesia maintenance drug	Intraoperative analgesia drug	Pop analgesia control	Indication of pop analgesia	Type of pop analgesia
Majdoub	2018	Tunisia	29	31	TT	Hyd	Pro + Rem	Inh	Sev + N02	Par + Tram	Rescue dose	VAS > 4	Opioid
Vasanthageethan	2018	India	29	29	PT + TT	ND	ND	ND	ND	ND	Rescue dose	ND	ND
Arslan	2019	Turkey	78	80	PT + TT	Mid	Pro	Inh	Des	ND	Rescue dose	VAS > 3	NSAID
Goulart	2019	Brazil	50	50	TT	Mid	Pro + Fen	TIVA	Pro + Rem	Ket	Rescue dose	VAS > 3	NSAID + Opioid
Hoh	2019	Malaysia	35	35	PT + TT	ND	ND	ND	ND	Par + Mor	Rescue dose	VAS > 4	NSAID + Opioid
Karakıs	2019	Turkey	23	23	PT + TT	ND	Tio + Fen	TIVA	Rem	Rem	Rescue dose	VAS > 4	NSAID + Opioid
Nagaraj	2019	India	35	35	PT + TT	Mid	Pro	Inh	Sev + N02	ND	Rescue dose	RP	Opioid
Saber	2019	Egypt	40	40	PT + TT	Alp	Pro + Fen	Inh	Iso	Par	Rescue dose	ND	Opioid
Woldegerima	2020	Ethiopia	37	37	PT + TT	ND	ND	ND	ND	ND	Rescue dose	ND	Opioid
Elbahrawy	2021	Egypt	35	35	PT + TT	Mid	Pro + Fen	Inh	Sev	ND	Rescue dose	VAS > 4	NSAID
Ozgun	2022	Turkey	30	30	TT	Mid	Tio + Fen	Inh	Sev + N02	Fen	PCA	VAS > 4	Opioid

Author	Treatment arms	Plexus	Points	Block time	Block drug	Concentration	Anesthetic volume (ml)	Anesthetic quantity (mg)	US use	Associated drug	Control arm	Primary outcome	Secondary outcomes	Time for VAS assessment (h)
Dieudonne	2	S	3	Pos	Bup	0.25%	20	50	No	Epi	Pla	AR	VAS (0–10), TAC	6, 24
Aunac	3	S + D	3	Pre	Rop	0.50%	28	140	No	Clo	Pla	TAC	VAS (0–10), TAC	6, 12, 24
Negmi	2	S	3	Pre	Bup	0.25%	20	50	No	No	Pla	VAS (0–100)	PS	24
Eti	3	S	3	Pre	Bup	0.25%	30	75	No	No	NI	TAC	VAS (0–100), TFA	4, 6, 8, 12, 24
Herbland	3	S	2	Pre	Rop	0.75%	20	150	No	No	NI	AR	VAS (0–10), TFA	4, 8, 12, 24
Moussa	3	S	3	Pre	Bup	0.50%	20	100	No	Epi	NI	AR	VAS (0–10), TAC	4, 8, 12, 24
Andrieu	3	S	3	Pre	Rop	0.48%	20	96	No	Clo	Pla	TAC	VAS (0–10)	6, 12, 24
Suh	3	S + D	3	Pre	Bup	0.25%	18	45	No	No	NI	TAC	VAS (0–10), AR	4, 6, 12, 24
Kesisoglou	2	S	2	Pos	Rop	0.75%	20	150	No	No	Pla	VAS (0–100)	AR	6, 12, 24
Shih	3	S	2	Pre	Bup	0.50%	24	120	No	No	Pla	VAS (0–10)	AR, TFA	4, 8, 12, 24
Steffen	4	S	3	Pre	Bup	0.50%	20	100	No	No	Pla	VAS (0–10)	TAC	24

Table 1 (continued)

Author	Treatment arms	Plexus	Points	Block time	Block drug	Concentration	Anesthetic volume (ml)	Anesthetic quantity (mg)	US use	Associated drug	Control arm	Primary outcome	Secondary outcomes	Time for VAS assessment (h)
Cai	2	S	3	Pre	Rop	0.50%	20	100	No	No	Pla	VAS (0–10)	AR	4, 8, 12, 24
Karthikeyan	3	S	3	Pre	Bup	0.25%	30	75	No	Clo	Pla	TAC	VAS (0–100)	4, 6, 8, 24
Egan	2	S	ND	Pos	Bup	0.50%	10	50	No	Epi	NI	VAS (0–10)	AR	4, 24
Dostbil	2	S	3	Pos	Bup	0.25%	20	50	No	Epi	Pla	TAC	VAS (0-100AR	4, 8, 12, 48
Gurkan	2	S	2	Pre	Bup	0.25%	20	50	Y	No	NI	VAS (0–10)	TAC	6, 12, 24
Çanakçı	2	S	3	Pre	Levobup	0.50%	20	100	No	No	NI	TAC	VAS (0–10)	24
Kılınçkan	3	S	3	Pre	Levobup	0.25%	30	75	No	No	NI	VAS (0–10)	AR, TAC	4,6,12,24
Barua	3	S	3	Pre	Bup	0.25%	10	25	No	No	NI	VAS (0–10)	AR	12, 24
Hassan	3	S	3	Pre	Bup	0.50%	24	120	Y	No	NI	TAC	VAS (0–10),AR, TFA	4, 8, 12, 24
Ahiskalioglu	3	S	2	Pre	Bup	0.25%	20	50	Y	No	Pla	VAS	TAC	4, 8, 12, 24
Aweke	2	S	3	Pre	Bup	0.25%	30	75	No	No	NI	VAS (0–10)	TAC, TFA	6, 12, 24
Kannan	2	S	3	Pre	Bup	0.25%	20	50	No	No	Pla	IAC	VAS (0–10), TFA	4, 6
Majdoub	2	S	2	Pre	Bup	0.25%	20	50	Y	No	NI	TAC	VAS (0–10)	4, 12, 24
Vasanthageethan	2	S	3	Pre	Bup	0.50%	20	100	No	No	Pla	AR	VAS (0–10)	4, 8, 12, 24
Arslan	2	S	ND	Pre	Levobup	0.50%	20	100	No	No	WI	VAS (0–5)	TAC, TFA	24
Goulart	2	S	3	Pre	Rop	0.75%	30	225	No	No	NI	VAS (0–10)	AR	4, 8, 24
Hoh	2	S	3	Pre	Rop	0.50%	12	60	No	No	WI	TFA	VAS (0–10)	4, 12, 24
Karakıs	2	S	3	Pre	Bup	0.25%	20	50	No	No	NI	TAC	VAS (0–10)	6, 12, 24
Nagaraj	2	S	ND	Pre	Bup	0.125%	20	25	No	No	WI	TAC	VAS (0–10), TFA	4, 8, 12, 24
Saber	2	S	3	Pre	Bup	0.25%	30	75	No	No	NI	VAS (0–10)	TAC, TFA	6, 24
Woldegerima	2	S	3	Pre	Bup	0.25%	20	50	No	No	Pla	VAS (0–10)	AR, TAC, TFA	6, 12, 24
Elbahrawy	2	S	3	Pre	Bup	0.25%	25	62.5	Y	Lid	NI	PS	VAS (0–10), AR	4, 6, 12, 24
Ozgun	2	S	3	Pre	Levobup	0.50%	20	100	No	No	NI	TAC	VAS (0–10)	6, 12, 24

TT: Total thyroidectomy, PT: partial thyroidectomy, ND: not described, Y: yes, Mid: Midazolam, Fen: Fentanyl, Dia: Diazepam, Alp: Alprazolam, Hid: Hydroxicine, Pro: propofol, Thio: Thiopental, Rem: remifentanyl, Inh: inhaled, TIVA: total intravenous anesthesia, Sev: sevoflorane, Iso: isoflorane, Par: paracetamol, Tram: tramadol, Ket: ketamine, Mor: morphine, Lor: lornoxicam, Sul: sulfentanyl, Rp: requested by the patient, Mep: meperidine, Nal: nalbuphine, Dip: dipirone, Dic: diclofenac, Prem: premedication

S: superficial, D: Deep, ND: not described, Pre: preincision, Pos: posincision, Bup: bupivacaine, Rop: ropivacaine. Levobup: levobupivacaine, Epi: epinephrine, Clo: clonidine, Lis_: lidocaine, AR: analgesic rescue, TAC: total postoperative analgesic consumption, PS: patient satisfaction, TFA: Time to first analgesic dose

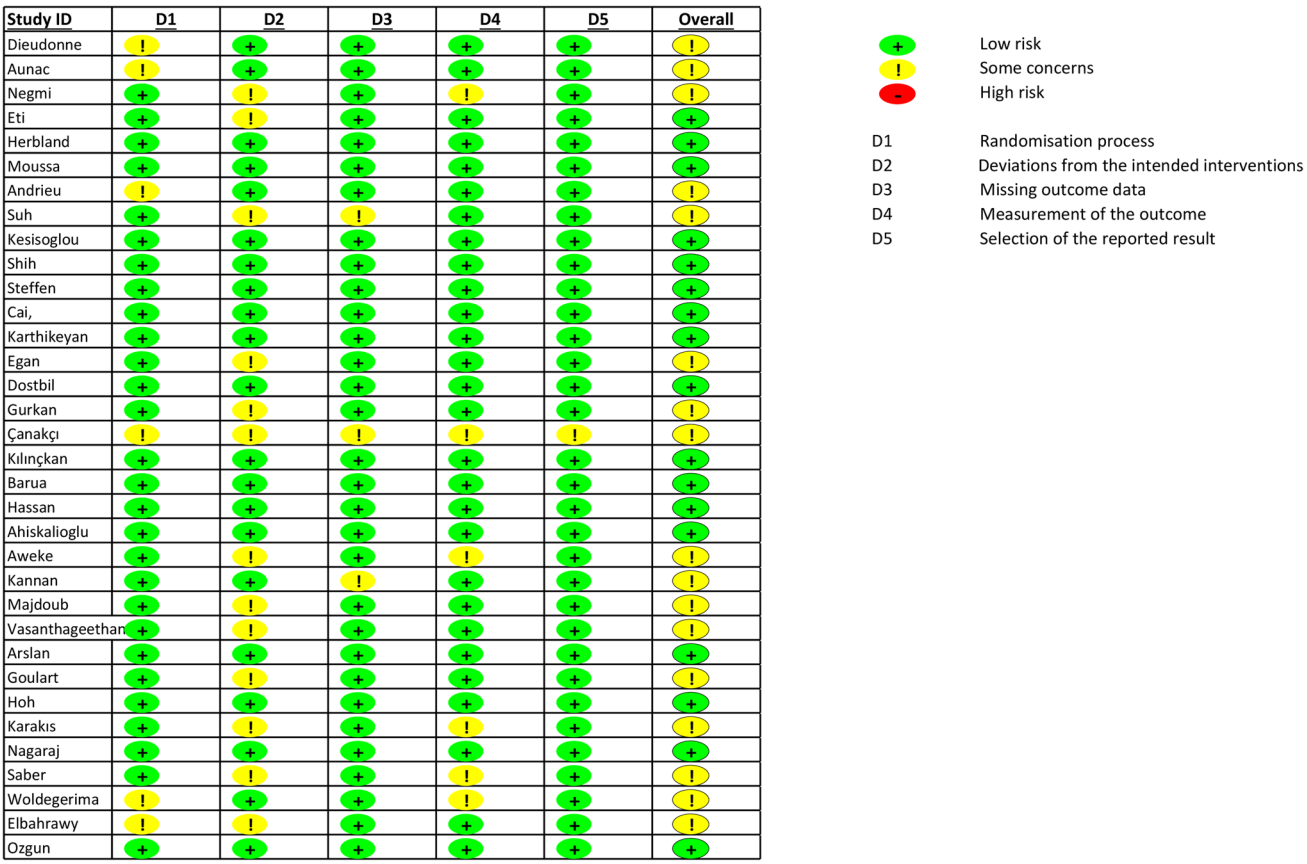

Fig. 2 Risk of bias graph

was carried out excluding them without modifying the direction of the result.

Rescue analgesia

759 patients were evaluated to determine whether they required rescue analgesia [14, 15, 17–23, 28, 30, 31, 33, 36, 39, 41, 43, 45–47]. The OR was 0.24 (95% CI 0.14–0.41) with an I^2 of 74%, lower in the BSCPB group (0.14–0.41). A subgroup analysis revealed that bupivacaine and ropivacaine offer comparable advantages. The three-point technique was more effective (OR 0.21 vs. 0.35, $p < 0.01$)). In terms of timing, the post-incision block was less efficacious than the pre-incision block (OR 0.61 (95% CI 0.24–1.54) vs 0.22 (95% CI 0.13–0.39, $p < 0.01$), Figure 5 and supplementary Fig. 6. Comparing the quantity of anesthetic used by quartiles (< 25%, 25–75%, and > 75%) and the use or non-use of ultrasound guidance revealed no statistically significant differences. Regarding the comparison between BSCPB and BSCPB plus wound infiltration, no significant differences were observed.

Total consumption of analgesics in 24 h

17 studies assessed the total use of opioid analgesics [15–18, 26, 29, 32–34, 36, 38, 41, 43, 44, 46, 47]. In the BSCPB group, the equianalgesic dose of morphine was SMD − 1.04 (95% CI: − 1.41 to − 0.66). Supplementary Fig. 7. The effect of bupivacaine was statistically significantly bigger than that of ropivacaine (− 1.30 vs 0; $p < 0.01$), although there was a smaller number of studies in the ropivacaine arm. The three-point technique had a substantially greater effect (SMD − 1.36 vs − 0.32, p 0.01). Figure 3 Analysis of subgroups by analgesic dose revealed that the maximum dose group (> 75th percentile) had no effect on analgesic consumption. A subgroup analysis by block time and use or non-use of ultrasound guidance revealed no differences in opioid consumption following surgery. Regarding the comparison between BSCPB and BSCPB plus wound infiltration, no significant differences were observed.

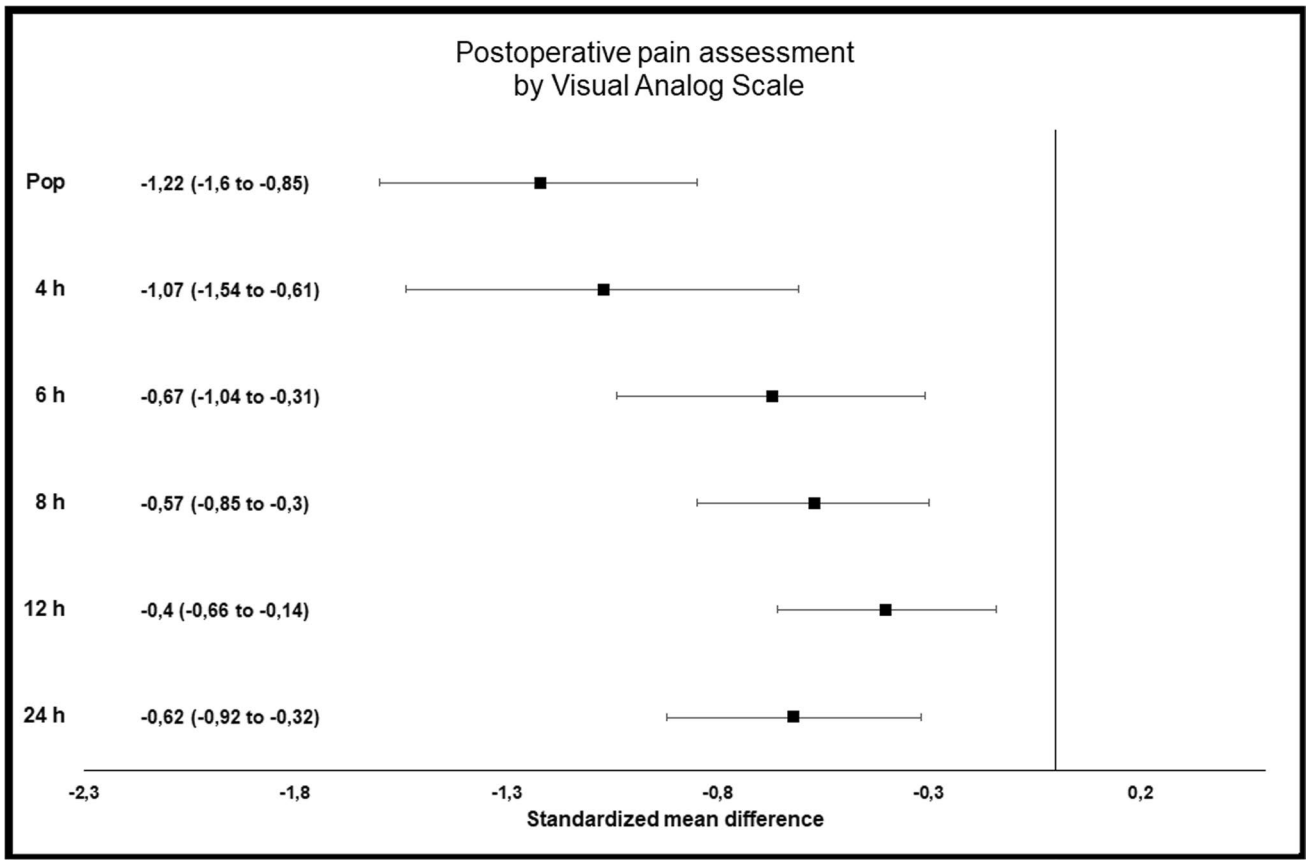

Fig. 3 Summary forest plot comparing pain assessment with VAS scale between BSCPB and no block by postoperative time

Time to first rescue dose

Ten studies assessed the time until the first dose of analgesic rescue medication [16, 17, 22, 26, 32, 34, 35, 38, 43, 44]. In the block group, the SMD time in minutes to first rescue dose was 1.68 (95% CI 0.94–2.43). Supplementary Fig. 8 Due to the limited number of studies, it was not feasible to compare subgroups. Comparing BSCPB to BSCPB plus wound infiltration revealed no significant differences between the two methods.

Adjustment for methodological quality

The subgroup analysis based on the risk of bias found no difference in the need for rescue analgesia or the total consumption of opioids when comparing studies classified as low risk to those classified as having some concerns. When evaluating rescue analgesia and postoperative opioid use, subgroup analysis comparing studies using placebo to those with no intervention revealed that the outcomes were consistent. Excluding the outliers from the comparisons in the sensitivity analysis had no effect on the direction of the results in any of the cases.

Discussion

The effective management of pain is essential for assuring the health and recovery of surgical patients [48]. However, the reliance on opioids as the primary method of pain management has resulted in an alarming increase in opioid abuse and addiction [49]. Targeted pain management strategies that minimize or eliminate the need for analgesics, thereby mitigating the risks associated with their use, while still effectively treating patients' pain, will be advantageous in the long run.

Thyroid surgery is considered to be a moderately painful procedure [2]. Post-thyroidectomy pain is likely caused by multiple factors, including superficial and deep wound layers, excessive dissection, intraoperative neck position, and wound drainage. According to studies, patients experience substantial pain, particularly in the first postoperative hours [2]. In the postoperative period, analgesics are used as part of the conventional method for pain management. However, they may increase the frequency of nausea and vomiting, which can have a negative impact on the patient's comfort, recuperation time, and return to normal life [50].

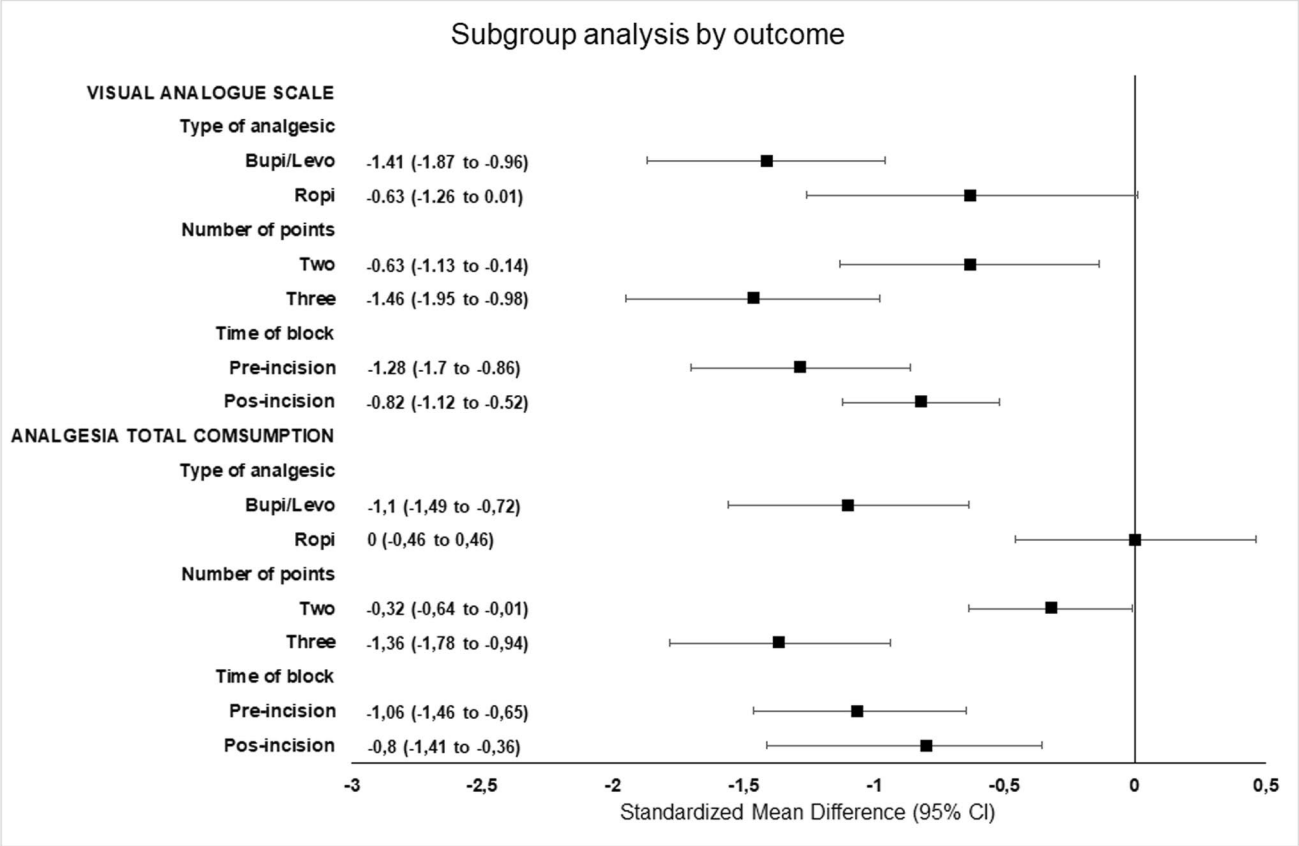

Fig. 4 Summary forest plot comparing pain assessment with VAS scale between BSCPB and wound infiltration by subgroups

Therefore, alternative pain management strategies are available. Since the 1970s, BSCPB has been utilized as an analgesic option for patients undergoing thyroidectomies [51]. The technique is straightforward and can be performed by surgeons or anesthesiologists with few complications. However, its use has not gained sufficient acceptance.

The analgesic efficacy of BSCPB has been the subject of numerous RCTs with contradictory findings and there are still discrepancies regarding certain outcomes. In addition, while it is widely acknowledged that BSCPB offers benefits, certain aspects of the intervention, such as the optimal anesthetic, timing, and technique, remain unclear. Warschkow et al., [7] published the first meta-analysis in 2012 with eight studies and they discovered an effect on pain but not on any other outcomes. In 2018, Mayhew et al. [6] conducted a meta-analysis with 14 RCTs and showed a significant reduction in analgesic requirement. There are still unanswered questions regarding the effect on pain scores using VAS scales, time to first dose, and total opioid consumption, as well as questions regarding the type of anesthetic, number of block sites, ultrasound assistance and timing of block. Since this time, more than fifteen new RCTS have been published, [30–46] and this information may help to clarify some of these concerns.

Our meta-analysis included 34 RCTs. The main result of the present study is confirmation that analgesic effect of BSCPB persists from the immediate postoperative period to 24 h. The VAS scores indicate 1.2 units (3.2 vs. 5.3) of less pain in the immediate postoperative period and up to 0.6 units (1.9 vs. 2.7) of less pain at 24 h. Although there is a statistically significant difference in VAS values, none of the studies evaluated the minimal clinically important difference (MCID). Some studies have established that a difference of at least 1.7 units on the VAS scale is clinically significant; therefore, these results should be interpreted with caution [52]. However, the analgesic effect of BSCPB is clinically translated into a decrease in total postoperative analgesic consumption (11 mg vs 17 mg morphine equivalent, SMD = − 1.04) and in the need for rescue analgesics (34% vs 59%, OR = 0.24), as well as an increase in the time to the first dose of rescue analgesia (261 min vs 115 min, SMD = 1.89), indicating a potential reduction in postoperative opioid use.

The analgesic effect was greater with bupivacaine than with ropivacaine. However, this effect was inconsistent when

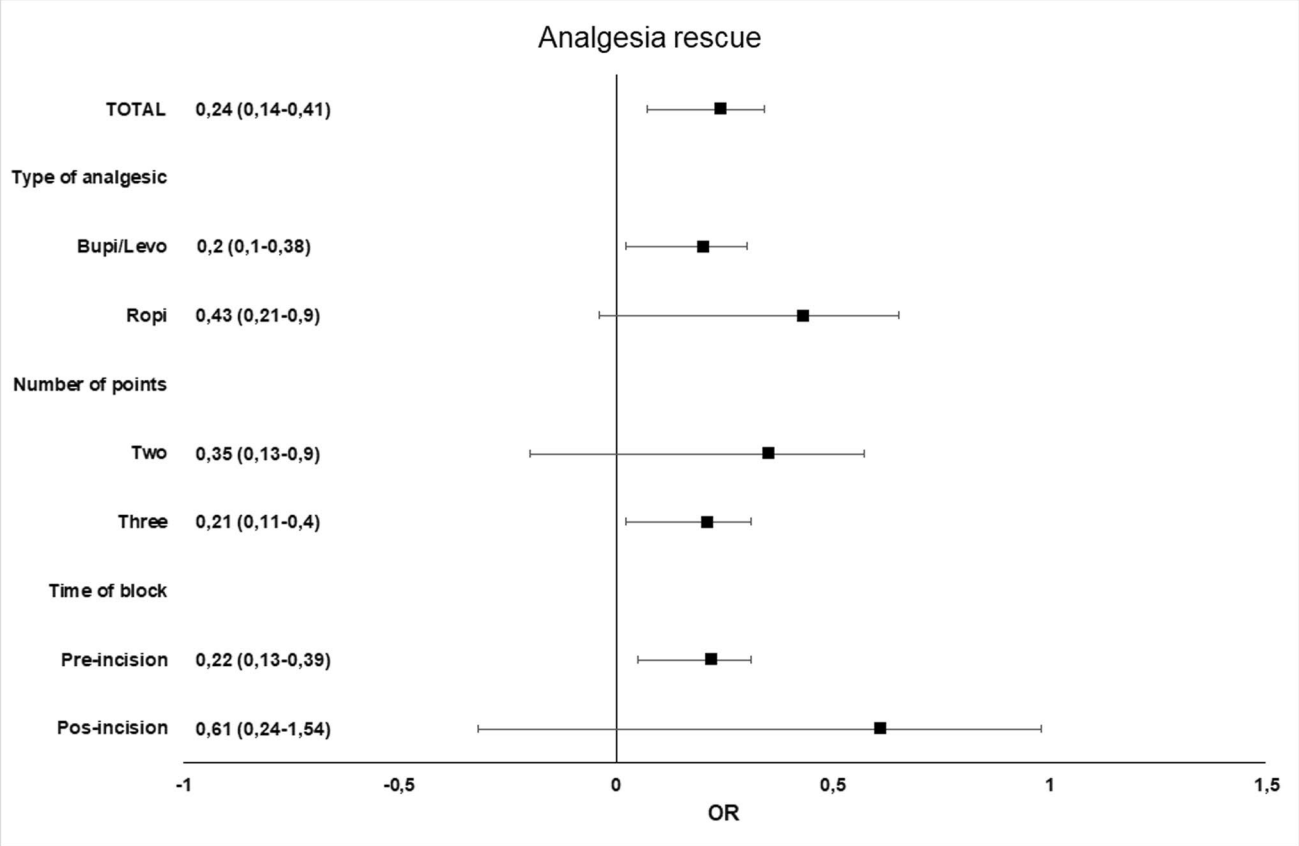

Fig. 5 Summary forest plot comparing rescue analgesia need between BSCPB and no block by subgroups

total analgesic consumption and the need for rescue were evaluated, where the two anesthetics demonstrated comparable results. Although data from other types of blocks imply that ropivacaine has a better safety profile, these findings are still debatable [53, 54]. Cost, which is higher for ropivacaine, and drug availability, which may be limited in certain contexts, must be added to this discussion.

The three-point technique was superior to the two-point technique in all evaluated outcomes. The primary distinction between the two techniques is the size of the sensitive area covered by the block since the volume comparison and the quantity of anesthetic used were identical. Two meta-analyses [6, 7] reported previously that the two-point technique had no statistically significant impact. The greater number of studies included in this meta-analysis may account for this difference in outcome. Although the use of ultrasonography has been suggested as an effective way to enhance the results of the block, [29, 55] we did not observe any differences between the outcomes. This may be because the localization of the sensitive plexus is constant, the anatomical landmarks are readily identifiable, and the superficial position of the plexus renders ultrasonography unnecessary. In relation to the timing of the block, pre-incision use was comparable in terms of its effect on VAS scale value and total analgesic consumption, but not in terms of rescue use. Due to the limited number of studies examining post-incision use, these comparisons may be susceptible to bias. The benefits of pre-incision analgesia are supported by clinical evidence from other settings and could be extrapolated to this intervention [56, 57]. In terms of pain and the need for rescue analgesia, no differences were found between the different amounts of anesthetic used to perform the block. Even at large doses, postoperative opioid consumption was unaffected. This result opposes that of Warschkow et al., [7] who demonstrated a correlation between the quantity of anesthetic and the value of the VAS scale. With this knowledge, it is possible to recommend that the blocking technique be conducted prior to the surgical incision using the three-point technique and anesthetic doses not exceeding 100 mg. The use of ultrasound is at the discretion of the operator.

A comparison evaluating the effect of adding wound infiltration to BSCPB that had not been included in previous reviews failed to find an improvement in analgesic effect. This outcome may be attributable to the fact that BSCPB covers the incision site and precludes local infiltration from enhancing analgesia [42].

Regarding the validity of the evidence, most studies were categorized as low risk or some concern, and none as high risk. The most common factor associated with a significant risk of bias was the absence of placebo in the control group of some studies, which may influence the VAS measurement of pain [58]. Nonetheless, the analysis based on quality or placebo use did not identify significant differences in the magnitude and direction of outcomes. The most crucial methodological consideration is clinical and statistical heterogeneity, which was high in all analyses and could not be explained by the anticipated subgroup analyses. In most studies, the interventions, pain management strategies, and medications used after surgery varied. Despite this circumstance, the summary measures remained unchanged, but these differences may impact the results.

Despite the benefits of BSCPB, it may have temporary problems that, while uncommon, must be considered by surgeons. Unilateral paralysis of the recurrent laryngeal nerve with dysphonia [29, 33, 35, 38], phrenic nerve anesthesia with diaphragmatic paralysis [22], Horner syndrome due to cervical sympathetic plexus block [24, 38], and paresis and paresthesia of the brachial plexus [14, 17, 40], caused by inadequate needle location during infiltration or anesthetic spillage to deeper planes were reported. These are technical issues that can be avoided with proper training or the use of ultrasonography guidance. Other potential complications, such as bilateral laryngeal nerve paralysis, intravascular anesthetic infiltration resulting in intoxication, and traumatic nerve damage from the needle, were not reported in these studies but should be considered by surgeons.

The most relevant question at this time is why the BSCPB is not used more frequently, given the abundance of literature justifying its benefits [59]. The inertia in the use of intravenous analgesia, which has a long history in practice and is difficult to modify, the lack of equipment and experience in the use of blocks, and the lack of knowledge about the advantages of multimodal analgesia, of which sensory blockade is an essential component, are among the reasons [60–62]. This meta-analysis seeks to overcome knowledge barriers and specific technical considerations, as well as provide an alternative that improves patient outcomes and contributes to a more rational use of opioids [52].

Conclusion

This meta-analysis, which included 34 RCTS with a low or moderate risk of bias and evaluated 2519 patients, found that BSCPB has an analgesic effect that lasts for up to 24 h, resulting in a decreased need for rescue analgesia, decreased postoperative opioid consumption, and a delay in the administration of the first dose of rescue analgesia. The use of bupivacaine at intermediate doses, with application prior to the incision, and the utilization of three blocking sites are some of the recommended technical aspects.

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Author contributions Carlos Betancourt: conceptualization, methodology, validation, investigation, data curation, writing—original draft and writing—review and editing. Alvaro Sanabria: conceptualization, methodology, validation, investigation, data curation, formal analysis, writing—original draft and writing—review and editing.

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Declarations

Conflict of interest Carlos Betancourt and Alvaro Sanabria declare not to have any kind of conflict of interest.

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