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ORIGINAL RESEARCH ARTICLE

The analgesic efficacy of pectoral nerve block for breast augmentation: a meta-analysis of randomized controlled studies

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ABSTRACT

Background: Many patients suffered from serious pain after breast augmentation, but the analgesic efficacy of pectoral nerve block for these patients was not well established. Thus, this meta-analysis was intended to study the analgesic efficacy of pectoral nerve block for breast augmentation.

Methods: Several databases including PubMed, EMbase, Web of Science, EBSCO, and Cochrane library databases were searched, and we included randomized controlled trials (RCTs) regarding the analgesic efficacy of pectoral nerve block for breast augmentation.

Results: Six RCTs were ultimately included in this meta-analysis. Compared with control intervention for breast augmentation, pectoral nerve block could significantly reduce pain scores at 1 h (mean difference [MD] = −2.28; 95% confidence interval [CI] = −3.71 to −0.85; $P = 0.002$), 2 h (MD = −3.08; 95% CI = −3.95 to −2.20; $P < 0.00001$), 4 h (MD = −2.95; 95% CI = −3.32 to −2.58; $P < 0.00001$), 6–8 h (MD = −2.68; 95% CI = −3.24 to −2.11; $P < 0.00001$), 24 h (MD = −2.04; 95% CI = −2.41 to −1.67; $P < 0.00001$), the number of analgesic requirement (odd ratio [OR] = 0.20; 95% CI = 0.09 to 0.45; $P = 0.0001$), and the incidence of nausea (OR = 0.21; 95% CI = 0.08 to 0.54; $P = 0.001$) and vomiting (OR = 0.15; 95% CI = 0.05 to 0.39; $P = 0.0001$).

Conclusions: Pectoral nerve block may be effective for pain relief after breast augmentation.

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KEYWORDS
Breast augmentation; pectoral nerve block; pain control; meta-analysis

Introduction

Breast augmentation has become one common operation in plastic surgery for cosmetic factor [1–5]. However, many patients suffer from moderate-to-severe pain after the surgery due to the insertion of subpectoral prostheses into the breast tissue and surgical dissection of the tissues [6–8]. Thus, opioid drugs are generally used for postoperative pain management, but they may result in some adverse events, including nausea, vomiting, sedation, itching, urinary retention, and extended hospital stays [9, 10].

In order to provide novel effective analgesia approaches, pectoral nerve block was first described by Blanco in 2011 and regarded as one novel interfacial block [11]. It is easy to perform under ultrasound guidance and aims to inject into the interfascial region between the pectoral muscles (Pectoralis Major and Minor) with local anesthetics [12]. Many studies found the efficacy of pectoral nerve block for postoperative pain treatment after different types of breast surgery, including carcinoma, reconstructive, and cosmetic surgeries [13–16].

After breast augmentation, patients with visual analog pain score ≥ 4 needed nerve block. Several trials explored the efficacy of pectoral nerves block for breast augmentation, but the results were not well established [17–21]. We performed this meta-analysis of RCTs in order to study the efficacy of pectoral nerves block after breast augmentation.

Materials and methods

This meta-analysis was performed according to the Preferred Reporting Items for Systematic Reviews and Meta-analysis statement [22] and the Cochrane Handbook for Systematic Reviews of Interventions [23].

Study eligibility criteria (PICOS)

Participants (P) were female adult patients who were scheduled for prosthetic breast augmentation. Intervention (I) was pectoral nerve block, while Control (Comparison) (C) was no block or pectoral nerve block with saline. Outcomes (O) included pain scores at 1 and 2 h as primary outcome, and pain scores at 4, 6–8, and 24 h, and analgesic requirement, nausea, and vomiting as secondary outcomes. Study design (S) was RCT.

Literature search and selection criteria

Several databases including PubMed, EMbase, Web of Science, EBSCO, and the Cochrane library were systematically searched from inception to August 2022, and we used the following search terms: 'breast augmentation' AND 'pectoral nerve block'. Two investigators independently searched the articles, extracted data, and assessed the quality of included studies. We also collected the baseline characteristics of patients from the included RCTs, including first author, publication year, age, body mass index (BMI), American Society of Anesthesiologists (ASA) physical status, sample size, and detailed methods of two groups. Pectoral nerve block was administered after the surgery or before the surgery. Under aseptic conditions, a high-frequency linear US probe covered with a sterile sheath was placed sagittally between the lateral end of the clavicle and the acromioclavicular joint. The pectoralis major and minor muscles (or serratus anterior muscle) were visualized on the artery after visualization of the subclavian artery and vein in the first costae level. Local anesthetic solution was injected into the interfacial space between the two muscles using in-plane

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technique with a block needle. The illustrative figure to show where the nerve block should be placed was previously described (Figure 1) [20].

Quality assessment in individual studies

The methodological quality of included RCTs was evaluated by the Jadad Scale consisting of five evaluation elements: randomization (0–2 points), blinding (0–2 points), dropouts, and withdrawals (0–1 points) [24, 25]. One point would be allocated to each element according to the description, randomization, and/or blinding of the original RCTs. The score of Jadad Scale varied from 0 to 5 points. Jadad score ≥3 indicated high quality, while Jadad score <2 suggested low quality [25, 26].

Statistical analysis

A team consisting of three authors performed the statistical analyses. Odd ratio (OR) with 95% confidence interval (CI) was applied to evaluate dichotomous outcomes, and mean difference (MD) with 95% CI was used to assess continuous outcomes. I^2 statistic was used to assess the heterogeneity, and significant heterogeneity was observed when $I^2 > 50\%$ [27]. The random-effect model was used regardless of the heterogeneity. We conducted the sensitivity analysis through detecting the influence of a single study on the overall estimate via omitting one study in turn or using the subgroup analysis. $P < 0.05$ indicated statistical significance, and Review Manager Version 5.3 was used in all statistical analyses.

Quality of evidence

The quality of evidence for each outcome was assessed according to the methodological quality and the confidence in the results, and it was assessed by GRADE recommendations as high quality, moderate quality, low quality, or very low quality [28].

Results

Literature search, study characteristics, and quality assessment

Figure 2 demonstrates the flow chart for the selection process and detailed identification. A total of 338 publications were identified through the initial search of databases. Of which, 125 were removed for duplication, and 204 papers were excluded after checking the titles/abstracts. Three studies were removed because of the study design. Finally, six RCTs were included in the meta-analysis [16–21].

The baseline characteristics of six eligible RCTs were shown in Table 1. These included studies were published between 2019 and 2021, and the total sample size was 305. Pectoral nerve block was administered using 0.25% bupivacaine or 3.75 mg/ml ropivacaine, while the patients in the control group obtained no block or pectoral nerve block with saline.

Among the six RCTs, five studies reported pain scores at 1 h [16, 18–21], three studies reported pain scores at 2 and 4 h [16, 18, 20], four studies reported pain scores at 6–8 h and 24 h [16–18, 20], four studies reported analgesic requirement [16, 18, 20, 21], while two studies reported nausea and vomiting [18, 20]. Jadad scores of the six eligible studies varied from 4 to 5, and thus, these studies were thought to have high quality. The quality of evidence for each outcome was presented in Table 2.

Primary outcomes: pain scores at 1 and 2 h

In comparison with control group for breast augmentation, pectoral nerve block was associated with significantly decreased pain scores at 1 h (MD = −2.28; 95% CI = −3.71 to −0.85; $P = 0.002$, very low quality) with significant heterogeneity among the studies ($I^2 = 92\%$, heterogeneity $P < 0.00001$, Figure 3) and pain scores at 2 h (MD = −3.08; 95% CI = −3.95 to −2.20; $P < 0.00001$, very low quality) with significant

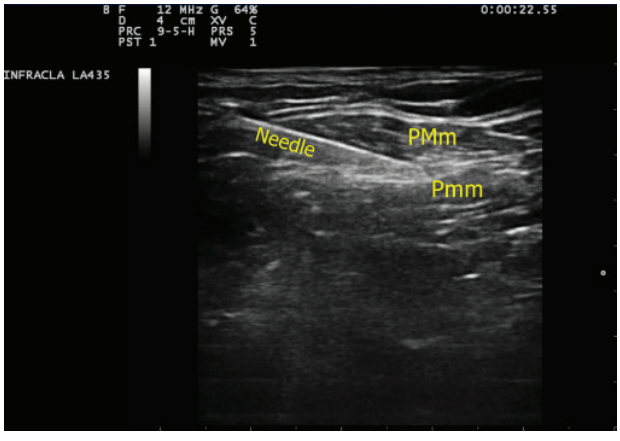

Figure 1. Ultrasound image of needle direction between muscle.

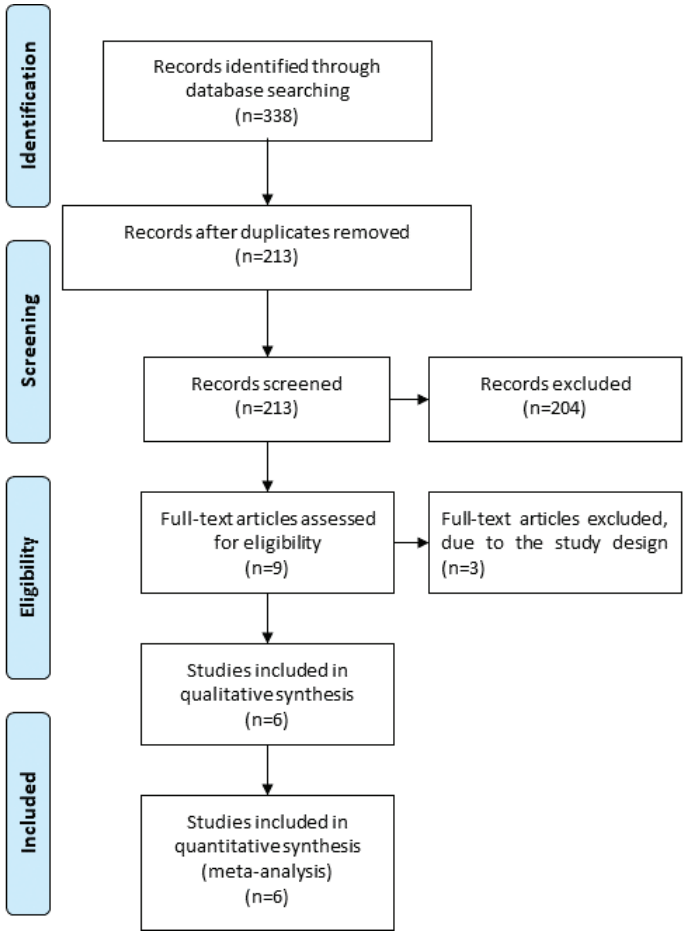

Figure 2. Flow diagram of study searching and selection process.

Table 1. Characteristics of included studies.

No.	Author	Pectoral nerve block group					Control group					Jada scores
		Number	Age (years)	BMI	ASA physical status (I/II)	Methods	Number	Age (years)	BMI	ASA physical status (I/II)	Methods	
1	Aarab 2021	35	33 (28–39) mean (interquartile range)	20.6 (19.3–22.2)	32/3	Pectoral nerve block with 25 ml of ropivacaine (3.75 mg/ml)	38	32 (28–39)	20.2 (19.1–21.6)	34/4	No block	4
2	Ciftci 2021	30	35.60 ±10.43	-	26/4	Pectoral nerve block with 0.4 ml/kg of 0.25% bupivacaine	30	39.10 ± 7.26	-	21/9	No block	4
3	Desroches 2020	14	36.0 ± 8.9	-	-	Pectoral nerve block with 0.4 ml/kg of 0.25% bupivacaine	14	36.0 ± 8.9	-	-	Placebo	5
4	Ekinci 2019	30	38.67 ± 6.21	-	21/9	Pectoral nerve block with 30 ml of 0.25% bupivacaine	30	38.17 ± 7.56	-	20/10	No block	4
5	Karaca 2019	27	35.26 ± 7.5	22.84 ± 3.7	19/8	Pectoral nerve block with 20 ml of 0.25% bupivacaine	27	35.11 ± 6.1	23.18 ± 3.1	21/6	No block	4
6	Schuitemaker 2019	15	33 ± 9	20 ± 1	7/8	Pectoral nerve block with 40 ml of 0.25% bupivacain	15	33 ± 6	20 ± 2	8/7	Placebo	4

BMI: body mass index; American Society of Anesthesiologists (ASA)

heterogeneity among the studies (I^2 = 78%, heterogeneity P = 0.01, Figure 4).

Sensitivity analysis

Significant heterogeneity was seen for the primary outcomes, but there was still significant heterogeneity when performing sensitivity analysis by omitting one study in each turn.

Secondary outcomes

Compared to control intervention for breast augmentation, pectoral nerve block could substantially reduce the pain scores at 4 h (MD = −2.95; 95% CI = −3.32 to −2.58; P < 0.00001; moderate quality, Figure 5), pain scores at 6–8 h (MD = −2.68; 95% CI = −3.24 to −2.11; P < 0.00001; very low quality, Figure 6), pain scores at 24 h (MD = −2.04; 95% CI = −2.41 to −1.67; P < 0.00001; low quality, Figure 7), the number of analgesic requirement (OR = 0.20; 95% CI = 0.09 to 0.45; P = 0.0001; moderate quality, Figure 8), and the incidence of nausea (OR = 0.21; 95% CI = 0.08 to 0.54; P = 0.001; moderate quality, Figure 9) and vomiting (OR = 0.15; 95% CI = 0.05 to 0.39; P = 0.0001; moderate quality, Figure 10).

Discussion

Previous study documented the potential analgesia efficacy of pectoral nerve block for pain control after breast augmentation [11]. Our meta-analysis included six RCTs and 305 patients. The results found that compared with control intervention for breast augmentation, pectoral nerve block was associated with significantly reduced pain scores at 1, 2, 4, 6–8, and 24 h, and the number of analgesic requirement.

Breast augmentation is regarded as one of the most popular plastic surgery procedures [17]. This operation type leads to postoperative pain because of surgical dissection, damage to the muscles, and expansion of breast tissues [29]. Insufficient pain control results in an increased rate of readmission, dissatisfaction, impaired quality of life, nausea, and vomiting [30–32]. Adequate pain control benefits to patients' recovery and satisfaction [10, 34]. Our findings unraveled the effectiveness of pectoral nerve block for pain control after breast augmentation, as evidenced by the significant reduction in pain scores at 1, 2, 4, 6–8, and 24 h, and the number of analgesic requirement.

Regarding the sensitivity analysis, there was still significant heterogeneity when performing the sensitivity analysis via omitting one study in turn. Several factors may account for this heterogeneity. First, the local analgesics for pectoral nerve block included 0.25% bupivacaine and 3.75 mg/ml ropivacaine, and their comparison remained elusive. Second, the operative types included submuscular, subglandular, and dual plane augmentation, which may produce different levels of pain intensity and affect the assessment of analgesic efficacy. Third, various concomitant pain killers may produce some impact on the pooling results. In addition, pectoral nerve block was reported to reduce the adverse events for breast surgery [34].

Our meta-analysis found significantly reduced incidence of nausea and vomiting after pectoral nerve blocks for breast augmentation compared to control intervention. We also should consider some limitations. First, only six RCTs were included in this meta-analysis, and more RCTs with large sample size were required to identify our findings. Second, there was significant heterogeneity, which may be caused by different operation types and analgesics. Third, various concomitant pain killers may produce some bias. Fourth, the local anesthetics were injected into pectoralis major and minor muscles (or serratus anterior muscle), which may affect the pooling results.

Table 2. Summary of findings.

Patient or population: Patients with the pain control of breast augmentation
Settings: Pectoral nerve block and control group
Intervention: Pectoral nerve block

Outcomes	Illustrative comparative risks* (95% CI) Assumed risk	Corresponding risk	Relative Effect (95% CI)	No of Participants (studies)	Quality of the evidence (GRADE)
	Control	**Pectoral nerve block**			
Pain scores at 1 h	The mean pain scores at 1 h in the control groups was **0**	The mean pain scores at 1 h in the intervention groups was **2.28 lower** (0 higher to 0.61 lower)		232 (5 studies)	⊕⊖⊖⊖ **Very low**[1,2]
Pain scores at 2 h	The mean pain scores at 2 h in the control groups was **0**	The mean pain scores at 2 h in the intervention groups was **3.08 lower** (0 higher to 2.20 lower)		174 (3 studies)	⊕⊖⊖⊖ **Very low**[1,2]
Pain scores at 4 h	The mean pain scores at 4 h in the control groups was **0**	The mean pain scores at 4 h in the intervention groups was **2.95 lower** (0 higher to 2.58 lower)		174 (3 studies)	⊕⊕⊕⊖ **Moderate**[1]
Pain scores at 6-8 h	The mean pain scores at 6-8 h in the control groups was **0**	The mean pain scores at 6-8 h in the intervention groups was **2.28 lower** (0 higher to 0.85 lower)		232 (4 studies)	⊕⊖⊖⊖ **Very low**[1,2,3]
Pain scores at 24 h	The mean pain scores at 24 h in the control groups was **0**	The mean pain scores at 24 h in the intervention groups was **2.95 lower** (0 higher to 2.58 lower)		174 (4 studies)	⊕⊕⊖⊖ **Low**[1,3]
Analgesic requirement	**Study population**				
	716 per 1000	**335 per 1000** (185 to 531)	**OR 0.2** (0.09 to 0.45)	204 (4 studies)	⊕⊕⊕⊖ **Moderate**[1]
	Moderate				
Nausea	**Study population**				
	383 per 1000	**115 per 1000** (0 to 251)	**OR 0.21** (0 to 0.54)	120 (2 studies)	⊕⊕⊕⊖ **Moderate**[1]
	Moderate				
Vomiting	**Study population**				
	433 per 1000	**103 per 1000** (0 to 230)	**OR 0.15** (0 to 0.39)	120 (2 studies)	⊕⊕⊕⊖ **Moderate**[1]
	Moderate				

*The basis for the **assumed risk** (e.g. the median control group risk across studies) is provided in footnotes. The **corresponding risk** (and its 95% confidence interval) is based on the assumed risk in the comparison group and the **relative effect** of the intervention (and its 95% CI).

CI: Confidence interval; **OR:** Odds ratio.

GRADE Working Group grades of evidence

High quality: Further research is very unlikely to change our confidence in the estimate of effect.

Moderate quality: Further research is likely to have an important impact on our confidence in the estimate of effect and may change the estimate.

Low quality: Further research is very likely to have an important impact on our confidence in the estimate of effect and is likely to change the estimate.

Very low quality: We are very uncertain about the estimate.

[1] lack of allocation concealment

[2] I2>75%

[3] different analgesics

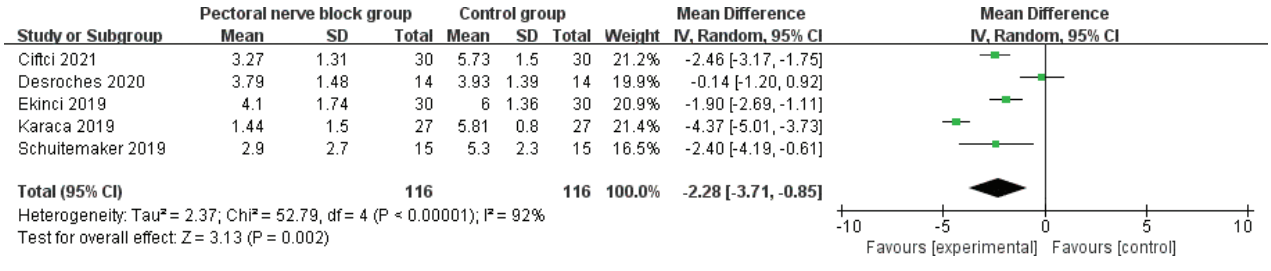

Figure 3. Forest plot for the meta-analysis of pain scores at 1 h.

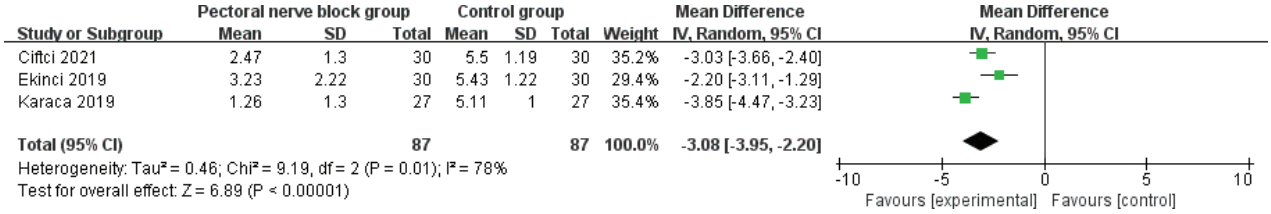

Figure 4. Forest plot for the meta-analysis of pain scores at 2 h.

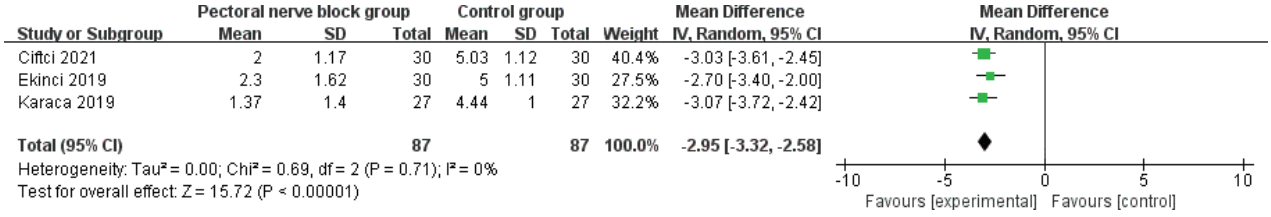

Figure 5. Forest plot for the meta-analysis of pain scores at 4 h.

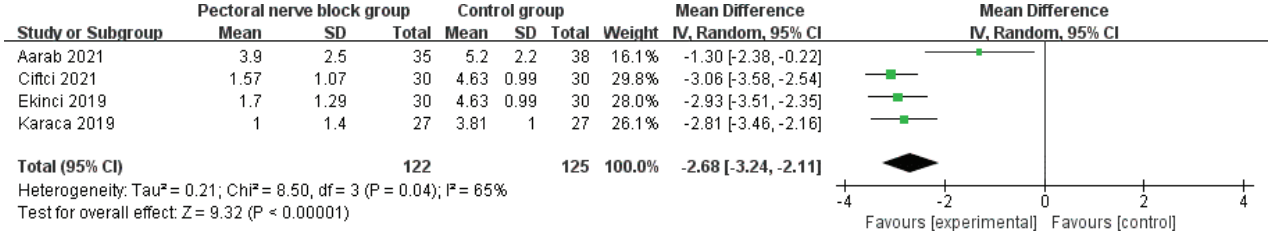

Figure 6. Forest plot for the meta-analysis of pain scores at 6–8 h.

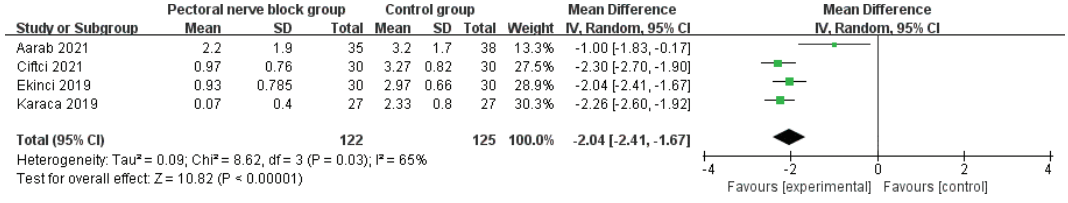

Figure 7. Forest plot for the meta-analysis of pain scores at 24 h.

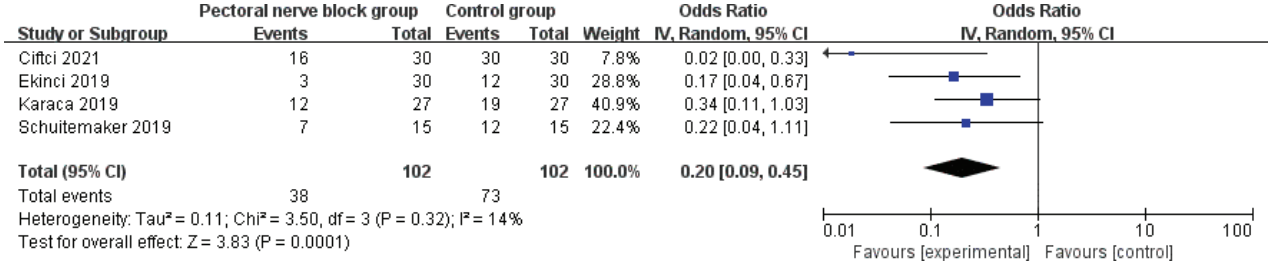

Figure 8. Forest plot for the meta-analysis of analgesic requirement.

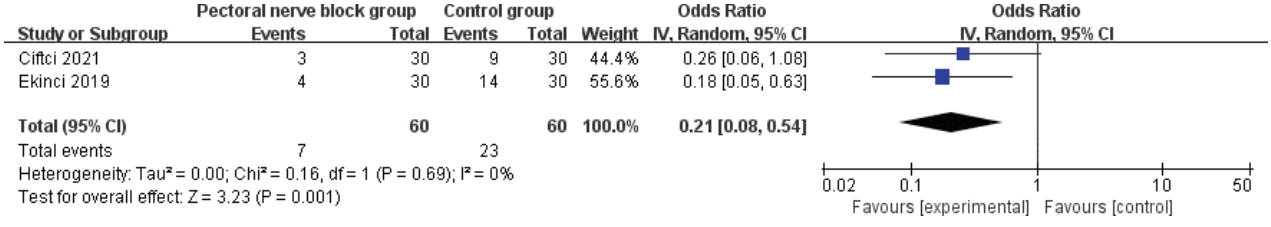

Figure 9. Forest plot for the meta-analysis of nausea.

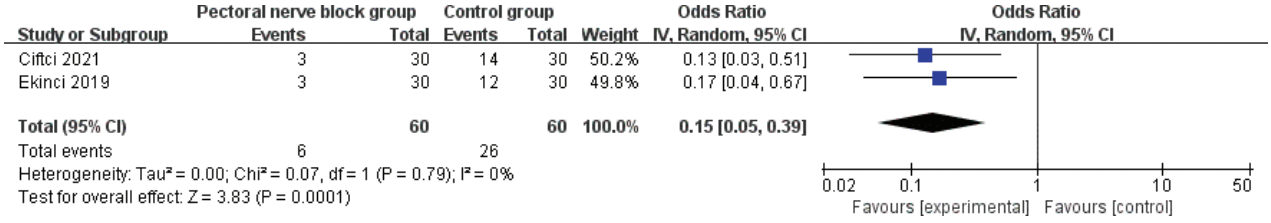

Figure 10. Forest plot for the meta-analysis of vomiting.

Conclusion

Pectoral nerve block may benefit to improve pain relief for breast augmentation.

Compliance with ethical standards

Acknowledgments

None.

Disclosure of potential conflicts of interest

The authors declare no conflict of interest.

Research involving human participants and/or animals

Not applicable.

Declaration of conflict of interest

None.

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