JOURNAL OF PLASTIC SURGERY AND HAND SURGERY
2020, VOL. 54, NO. 4, 195–199
https://doi.org/10.1080/2000656X.2019.1661847

ARTICLE

The efficacy of nerve block for pain control after mammaplasty: a meta-analysis of randomized controlled studies

Limin Cai[a], Zhiwen Li[a], Lingyun Liu[b], Dongdong Cao[a], Kuiliang Li[a], Ying Li[b] and Dunwei Wang[a]

[a]Department of Anesthesiology, The First Hospital of Jilin University, Changchun, China; [b]Department of Andrology, The First Hospital of Jilin University, Changchun, China

ABSTRACT

Background: Nerve block shows some potential in alleviating pain after mammaplasty. This systematic review and meta-analysis aims to investigate the efficacy of nerve block for pain control after mammaplasty.

Methods: The databases including PubMed, EMbase, Web of science, EBSCO, and Cochrane library databases are systematically searched for collecting the randomized controlled trials (RCTs) regarding the impact of nerve block on pain intensity after mammaplasty.

Results: This meta-analysis has included four RCTs. Compared with the control group after mammaplasty, nerve block results in remarkably reduced pain scores. At 1, 3, and 6 h, the scores are −1.84; −2.49 to −1.20 (mean difference (MD; 95% confidence interval (CI)); $p < .00001$, −1.04; −1.47 to −0.62; $p < .00001$; and −0.96; −1.48 to −0.43; $p = .0004$, respectively. At 24 h, nerve block shows no significant impact on pain scores: 0.31; −1.05 to 0.43; $p = .41$. The standard MD of analgesic consumption is significantly reduced after nerve block: −1.27; −1.73 to −0.82; $p < .00001$.

Conclusions: Nerve block is associated with substantially reduced pain intensity at 1 h, 3 h, and 6 h, as well as decreased analgesic consumption after mammaplasty. Therefore, a nerve block is a valuable tool for postoperative care after mammaplasty and should be recommended for the surgery.

ARTICLE HISTORY
Received 15 February 2019
Revised 21 July 2019
Accepted 7 August 2019

KEYWORDS
Nerve block; mammaplasty; pain control; randomized controlled trials

Introduction

Mammaplasty such as breast reconstruction and augmentation commonly results in significantly high level of acute postoperative pain which may cause poor recovery and the development of chronic postoperative pain [1–3]. Many methods have been developed to reduce the pain after mammaplasty, and they mainly include intravenous analgesics, indwelling pain catheters, and simple irrigation or infiltration of local anesthetics [4–7]. However, they have no consistent benefits.

Nerve blocks are reported to be effective for pain relief and have the ability to prolong the time to first analgesic requirement [8–10]. The paravertebral block is known as the regional anesthesia modality and obtains great popularity. Paravertebral block using bupivacaine serves as an adjunct to general anesthesia for breast cancer surgery and shows a significant reduction in early postoperative pain scores at 30, 60, 90, and 120 min and 6 h after the surgery [11]. However, in one RCT involving 47 patients undergoing breast reconstruction, intraoperative intercostal and pectoral nerve blocks with 0.25% bupivacaine and 4 mg of dexamethasone are found to have no significant effect on overall quality of recovery and pain control [12].

Recently, several studies on the effect of nerve block on pain intensity after mammaplasty have been published, and the results have been conflicting [12–14]. Considering these inconsistent effects, we, therefore, conduct a systematic review and meta-analysis of randomized controlled trials (RCTs) to evaluate the efficacy of nerve block on pain management after mammaplasty.

Materials and methods

Preferred Reporting Items for Systematic Reviews and Meta-analysis statement [15] and the Cochrane Handbook for Systematic Reviews of Interventions [16] are used for the performance of this systematic review and meta-analysis. Two investigators have independently searched articles, extracted data, and assessed the quality of included studies.

Literature search and selection criteria

Several databases including PubMed, EMbase, Web of science, EBSCO, and the Cochrane library are systematically searched using the keywords: mammaplasty or breast augmentation or breast reconstruction, and nerve block or paravertebral block or intercostal block. The time in publishing the studies is from January 1990 to December 2019.

The inclusion criteria are as follows: (1) study design is RCT, (2) patients undergo mammaplasty, and (3) intervention treatments are a paravertebral block (or intercostal nerve block) versus sham procedures.

Data extraction and outcome measures

Some information is collected for summarizing the baseline characteristics of patients in the included RCTs, and they include first author, publication year, sample size, body mass index, the number of unilateral/bilateral surgery/implant exchange and detail methods of two groups.

CONTACT Dunwei Wang jzfdl@sina.com Department of Anesthesiology, The First Hospital of Jilin University, No. 71, Xinmin Street, Changchun, Jilin 130021, China

The primary outcomes are pain scores at 1 h and 3 h. Secondary outcomes include pain scores at 6 h and 24 h, analgesic consumption.

Quality assessment in individual studies

The methodological quality of included RCTs is evaluated using the Jadad Scale, which is composed of three evaluation elements including randomization (0–2 points), blinding (0–2 points), drop-outs, and withdrawals (0–1 points) [17]. One point would be allocated to each element based on the description, randomization and/or blinding of the included RCTs. The score of the Jadad Scale has a range from 0 to 5 points, and one study with Jadad score $\geq$3 is thought to have a high quality [18].

Statistical analysis

Review Manager Version 5.3 (The Cochrane Collaboration, Software Update, Oxford, UK) is used for all statistical analyses. We have calculated the mean differences (MDs) or standard mean differences (Std. MDs) with 95% confidence intervals (CIs) for continuous outcomes (pain scores at 1 h, 3 h, 6 h, and 24 h, analgesic consumption). Heterogeneity is quantified with the I^2 statistic, and an I^2 value greater than 50% represents the significant heterogeneity. The random-effect model with DerSimonian and Laird weights is applied for all the meta-analyses regardless of the heterogeneity. When the significant heterogeneity presents, sensitivity analysis is conducted to detect the influence of a single study on the overall estimate or perform the subgroup analysis. Publication bias is not evaluated because of the limited number (<10). $p < 0.05$ is thought to be statistically significant.

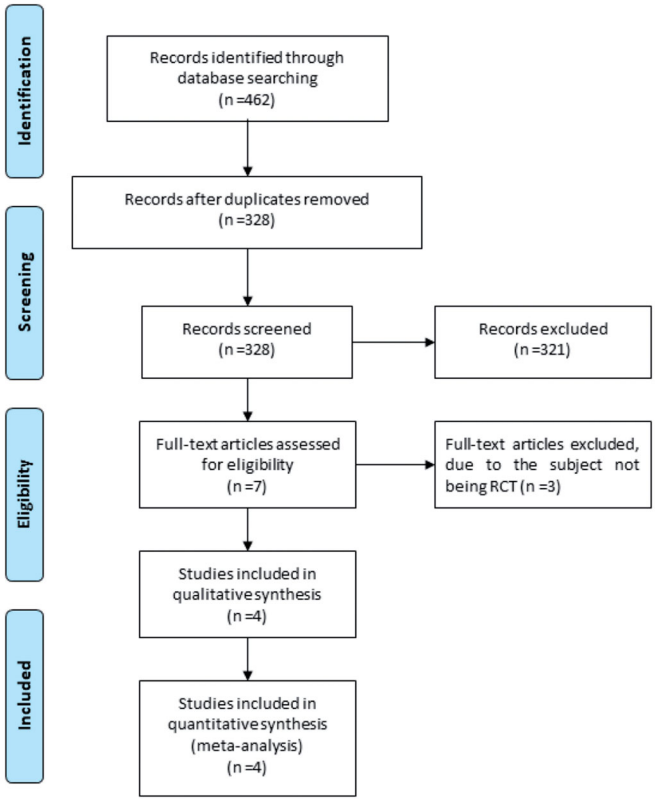

Figure 1. Flow diagram of study searching and selection process.

Table 1. Characteristics of included studies.

		Nerve block group					Control group					
No.	Author	Number	Age (years)	Body mass index (kg/m^2)	Unilateral/ Bilateral surgery/ Implant exchange	Methods	Number	Age (years)	Body mass index (kg/m2)	Unilateral/ Bilateral surgery/ implant exchange	Methods	Jada scores
1	Lanier (2018)	23	48 (43–58), median (IQR)	26 (23-32)	5/18/0	Intercostal nerve blocks with 0.25% bupivacaine with 1:200,000 epinephrine and 4 mg of dexamethasone (volume, 30 ml per side)	22	50 (42–57), median (IQR)	26 (20–30)	10/12/0	Sham nerve blocks with normal saline	5
2	Wolf (2016)	35	48.43 ± 11.48	27.85 ± 4.83	12/4/19	Paravertebral block technique by unilateral multilevel injection technique of 1% and 0.5% ropivacaine with epinephrine diluted by 1:400,000 into the ipsilateral paravertebral spaces of T1 through T6, plus general anesthesia	39	51.49 ± 10.19	27.14 ± 4.82	8/10/21	General anesthesia alone	4
3	Gardiner (2012)	20	33.4 ± 10.0	20.1 ± 2.7	–	Paravertebral blockade with ropivacaine	20	34.9 ± 8.0	20.5 ± 1.8	–	Local infiltration with ropivacaine	4
4	Klein (2000)	29	48 ± 14	–	1/18/22	Thoracic paravertebral block (levels T1–7) plus general anesthesia	30	44 ± 14	–	1/13/16	General anesthesia	3

IQR: interquartile range.

Results

Literature search, study characteristics, and quality assessment

Figure 1 demonstrates the flow chart for the selection process and detailed identification. Four hundred and sixty-two publications are searched after the initial search of databases. One hundred and thirty-four duplicates and three hundred and twenty-one papers after checking the titles/abstracts are excluded. Three studies are removed because of the study design and four RCTs are ultimately included in the meta-analysis [12–14,19].

Table 1 shows the baseline characteristics of four eligible RCTs. The four studies are published between 2000 and 2018, and the total sample size is 218. The detail methods of nerve block for mammaplasty are summarized in Table 1. Three RCTs involve paravertebral block [13,14,19] and the remaining one RCT involves intercostal nerve block [12].

Among the four RCTs, three studies report pain scores at 1 h [12–14], two studies report pain scores at 3 h, 6 h, 24 h [12,13], and three studies report analgesic consumption [12,13,19]. Jadad scores of the four eligible studies vary from 3 to 5, and, thus, this quality assessment confirms these studies with high quality.

Primary outcomes: pain scores in 1 h and 3 h

The random-effect model is used for the analysis of primary outcomes. The results find that compared to control intervention after mammoplasty, nerve block is associated with substantially reduced pain scores at 1 h (MD = −1.84; 95% CI = −2.49 to −1.20; $p < .00001$) with no heterogeneity among the studies ($I^2 = 0\%$, heterogeneity $p = .81$, Figure 2) and pain scores at 3 h (MD = −1.04; 95% CI = −1.47 to −0.62; $p < .00001$) with no heterogeneity among the studies ($I^2 = 0\%$, heterogeneity $p = .65$, Figure 3).

Sensitivity analysis

The meta-analysis of pain scores at 1 h and 3 h has no heterogeneity among the included studies, and, thus, we do not perform sensitivity analysis by omitting one study in each turn or conduct the subgroup analysis.

Secondary outcomes

In comparison with control intervention after mammaplasty, nerve block results in significantly reduced pain scores at 6 h (MD = −0.96; 95% CI = −1.48 to −0.43; $p = .0004$; Figure 4), but has no obvious influence on pain scores at 24 h (MD = −0.31; 95% CI = −1.05 to 0.43; $p = .41$; Figure 5). In addition, a nerve block can remarkably reduce analgesic consumption after the surgery compared to the control group (Std. MD = −1.27; 95% CI = −1.73 to −0.82; $p < .00001$; Figure 6).

Discussion

Postoperative pain following breast surgery has become a significant concern [20–23]. In one prior retrospective cohort study of 132 patients with a tissue expander and implant breast reconstruction, nerve blocks are associated with less requirement of morphine and diazepam and shorter length of stay compared with peri-incisional infiltration [24]. A paravertebral block before mastectomy with immediate reconstruction also results in the reduction in the length of stay, time to conversion to oral narcotics, and the episodes of postoperative nausea and vomiting

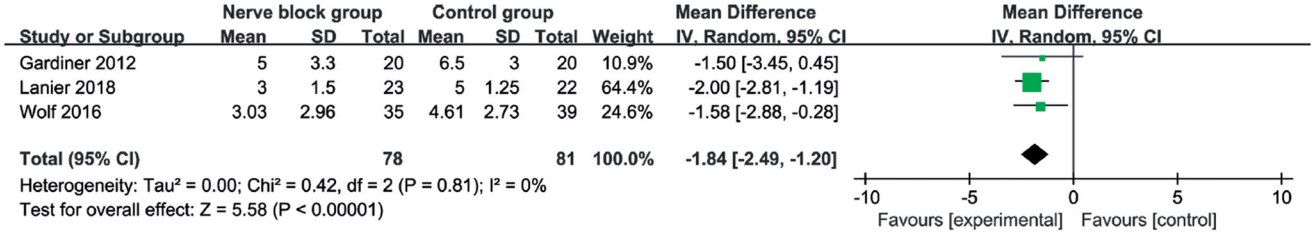

Figure 2. Forest plot for the meta-analysis of pain scores in 1 h.

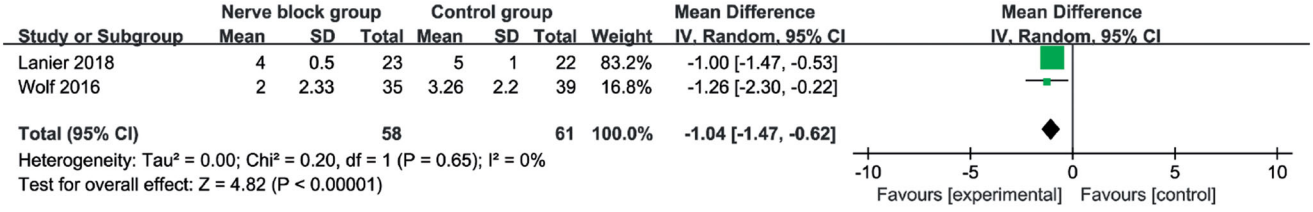

Figure 3. Forest plot for the meta-analysis of pain scores in 3 h.

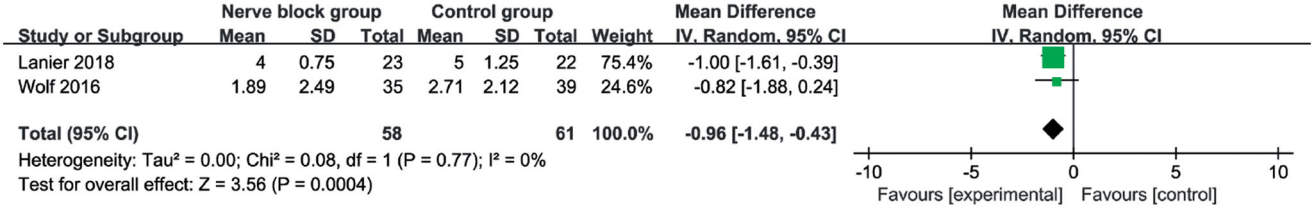

Figure 4. Forest plot for the meta-analysis of pain scores in 6 h.

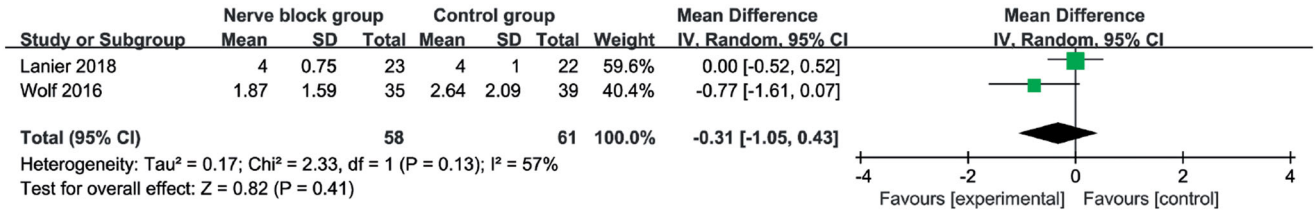

Figure 5. Forest plot for the meta-analysis of pain scores in 24 h.

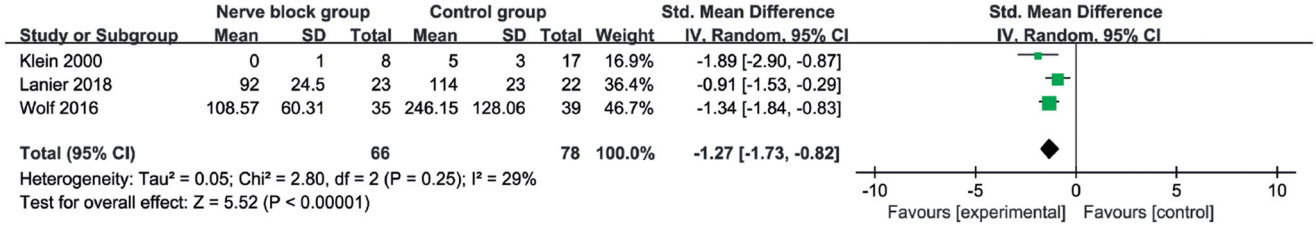

Figure 6. Forest plot for the meta-analysis of analgesic consumption.

[25]. Improved intraoperative compliance and decreased pain scores are observed after using paravertebral block for subpectoral breast augmentation [14].

Our meta-analysis includes intercostal and paravertebral nerve block following mammaplasty, and the results find that nerve block can substantially reduce pain scores at 1 h, 3 h, 6 h, and analgesic consumption, but shows no significant impact on pain scores at 24 h. These indicate that the short periods of pain relief can be promoted by nerve block for mammaplasty. The execution of nerve blocks requires multidisciplinary planning, team coordination, and preoperative communication between the anesthesiologist, surgeon, and nurses in the operating room and the recovery room.

A recent meta-analysis shows that paravertebral nerve block is a feasible and effective method to improve postoperative analgesia after breast surgery [26]. Effective blocking of pain pathways enables to reduce the acute (surgical) stress response and improve the quality of recovery [27]. Twelve published studies (538 patients) report the paravertebral nerve block for breast surgery, and there is no report of systemic toxicity. The overall incidence of complications such as pneumothorax and hypotension is very low [28,29]. One included RCT also confirms no increase in nausea and vomiting after nerve block [13].

There are still several limitations. First, only four RCTs are included in this meta-analysis, and all of them have a relatively small sample size ($n < 100$). These may lead to the overestimation of the treatment effect in smaller trials. Although there is no heterogeneity among the included studies, different procedures of mammaplasty can produce various pain intensity scales which may affect the pooled results. Finally, intercostal and paravertebral nerve block are both included in this meta-analysis, and they may lead to some bias for the pooled effect.

Conclusion

A nerve block can significantly improve pain relief at 1 h, 3 h, and 6 h, and decrease analgesic consumption after mammaplasty. Therefore, the nerve block is a valuable tool for postoperative care after mammaplasty.

Disclosure statement

No potential conflict of interest was reported by the authors.

References

[1] Hetta DF, Mohamed MA, Mohammad MF. Analgesic efficacy of pregabalin in acute postmastectomy pain: placebo controlled dose ranging study. J Clin Anesth. 2016;34:303–309.

[2] De Oliveira GS Jr, Bialek JM, Nicosia L, et al. Lack of association between breast reconstructive surgery and the development of chronic pain after mastectomy: a propensity matched retrospective cohort analysis. Breast. 2014;23(4):329–333.

[3] Hozumi J, Egi M, Sugita S, et al. Dose of intraoperative remifentanil administration is independently associated with increase in the risk of postoperative nausea and vomiting in elective mastectomy under general anesthesia. J Clin Anesth. 2016;34:227–231.

[4] Steyaert A, Forget P, Dubois V, et al. Does the perioperative analgesic/anesthetic regimen influence the prevalence of long-term chronic pain after mastectomy? J Clin Anesth. 2016;33:20–25.

[5] Lu L, Fine NA. The efficacy of continuous local anesthetic infiltration in breast surgery: reduction mammaplasty and reconstruction. Plast Reconstr Surg. 2005;115(7):1927–1934. discussion 35-6.

[6] Kasimahanti R, Arora S, Bhatia N, et al. Ultrasound-guided single- vs double-level thoracic paravertebral block for postoperative analgesia in total mastectomy with axillary clearance. J Clin Anesth. 2016;33:414–421.

[7] Maheshwari P, Maheshwari P. Single-injection vs continuous thoracic paravertebral block for postoperative analgesia after mastectomy. J Clin Anesth. 2016;28:90–91.

[8] Andreae MH, Andreae DA. Local anaesthetics and regional anaesthesia for preventing chronic pain after surgery. Cochrane Database Syst Rev. 2012;10:CD007105.

[9] Parrington SJ, O'Donnell D, Chan VW, et al. Dexamethasone added to mepivacaine prolongs the duration of analgesia after supraclavicular brachial plexus blockade. Regional Anesth Pain Med. 2010;35(5):422–426.

[10] Tandoc MN, Fan L, Kolesnikov S, et al. Adjuvant dexamethasone with bupivacaine prolongs the duration of interscalene block: a prospective randomized trial. J Anesth. 2011;25(5):704–709.
[11] Kairaluoma PM, Bachmann MS, Korpinen AK, et al. Single-injection paravertebral block before general anesthesia enhances analgesia after breast cancer surgery with and without associated lymph node biopsy. Anesth Analg. 2004;99(6):1837–1843.
[12] Lanier ST, Lewis KC, Kendall MC, et al. Intraoperative nerve blocks fail to improve quality of recovery after tissue expander breast reconstruction: a prospective, double-blinded, randomized, placebo-controlled clinical trial. Plast Reconstr Surg. 2018;141(3):590–597.
[13] Wolf O, Clemens MW, Purugganan RV, et al. A prospective, randomized, controlled trial of paravertebral block versus general anesthesia alone for prosthetic breast reconstruction. Plast Reconstr Surg. 2016;137(4):660e–666e.
[14] Gardiner S, Rudkin G, Cooter R, et al. Paravertebral blockade for day-case breast augmentation: a randomized clinical trial. Anesth Analg. 2012;115(5):1053–1059.
[15] Moher D, Liberati A, Tetzlaff J, et al. Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement. BMJ. 2009;339(1):b2535.
[16] Higgins JPT, Green S. Cochrane handbook for systematic reviews of interventions version 5.1.0. The Cochrane Collaboration. 2011; Available from www.cochrane-handbook.org.
[17] Jadad AR, Moore RA, Carroll D, et al. Assessing the quality of reports of randomized clinical trials: is blinding necessary? Control Clin Trials. 1996;17(1):1–12.
[18] Kjaergard LL, Villumsen J, Gluud C. Reported methodologic quality and discrepancies between large and small randomized trials in meta-analyses. Ann Intern Med. 2001;135(11):982–989.
[19] Klein SM, Bergh A, Steele SM, et al. Thoracic paravertebral block for breast surgery. Anesth Analg. 2000;90(6):1402–1405.
[20] Jiang Y, Li J, Lin H, et al. The efficacy of gabapentin in reducing pain intensity and morphine consumption after breast cancer surgery: a meta-analysis. Medicine. 2018;97(38):e11581.
[21] Onishi E, Murakami M, Nishino R, et al. Analgesic effect of double-level retrolaminar paravertebral block for breast cancer surgery in the early postoperative period: a placebo-controlled, randomized clinical trial. Tohoku J Exp Med. 2018;245(3):179–185.
[22] Gurkan Y, Aksu C, Kus A, et al. Ultrasound guided erector spinae plane block reduces postoperative opioid consumption following breast surgery: a randomized controlled study. J Clin Anesth. 2018;50:65–68.
[23] Marcusa DP, Mann RA, Cron DC, et al. Prescription opioid use among opioid-naive women undergoing immediate breast reconstruction. Plast Reconstr Surg. 2017;140(6):1081–1090.
[24] Shah A, Rowlands M, Krishnan N, et al. Thoracic intercostal nerve blocks reduce opioid consumption and length of stay in patients undergoing implant-based breast reconstruction. Plast Reconstr Surg. 2015;136(5):584e–591e.
[25] Coopey SB, Specht MC, Warren L, et al. Use of preoperative paravertebral block decreases length of stay in patients undergoing mastectomy plus immediate reconstruction. Ann Surg Oncol. 2013;20(4):1282–1286.
[26] Schnabel A, Reichl SU, Kranke P, et al. Efficacy and safety of paravertebral blocks in breast surgery: a meta-analysis of randomized controlled trials. Br J Anaesth. 2010;105(6):842–852.
[27] Dabbagh A, Elyasi H. The role of paravertebral block in decreasing postoperative pain in elective breast surgeries. Med Sci Monit. 2007;13:CR464–CR467.
[28] Richardson J, Lonnqvist PA, Naja Z. Bilateral thoracic paravertebral block: potential and practice. Br J Anaesth. 2011;106(2):164–171.
[29] Cooter RD, Rudkin GE, Gardiner SE. Day case breast augmentation under paravertebral blockade: a prospective study of 100 consecutive patients. Aesth Plast Surg. 2007;31(6):666–673.