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Original contribution

Single-injection thoracic paravertebral block and postoperative analgesia after mastectomy: a retrospective cohort study☆,☆☆,★

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Abstract

Background: The treatment of postoperative pain after mastectomy is an area of increasing interest, as this treatment option is now considered a standard of care for those affected by breast cancer. Thoracic paravertebral nerve block (tPVB) using local anesthetics administered before mastectomy can theoretically provide postoperative analgesia, thereby facilitating a more comfortable and shorter hospitalization.

Methods: In this retrospective cohort study, we aimed to determine the duration and degree to which tPVB provides postoperative analgesia in patients who underwent either unilateral or bilateral mastectomy (n = 182). We retrospectively examined the numeric rating scale (NRS) for pain scores recorded by nursing staff throughout individual patient hospitalizations, looking specifically at the following time points: arrival from the postanesthesia care unit to the surgical wards, noon on postoperative day 1 (POD1), and discharge. We also examined the number of days until patients were discharged from the hospital.

Results: Our results revealed a statistically significant decrease in NRS in pain scores for patients who had received a tPVB (n = 92) on arrival from the postanesthesia care unit to the surgical wards (mean NRS decrease of 1.9 points; 99% confidence interval [CI], −3.0 to −0.8; $P < .001$) but did not show statistically significant decreases in NRS for pain scores for patients at noon on POD1 (mean NRS decrease of 0.3 points at noon on POD1, $P = .43$) or at discharge (mean NRS decrease of 0.1 point at discharge, $P = .65$). Moreover, use of tPVB did not have an impact on time until discharge (average decrease of 0.5 hours; 95% CI, −6 to +5 hours, $P = .87$).

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Conclusions: Single-injection tPVB appears to provide meaningful postoperative analgesia in the immediate postoperative period after mastectomy but not after the first day of surgery.
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1. Background

The prevalence of breast cancer in women within the United States is more than 3 million, with an annual incidence of approximately 100,000 and more than 35,000 women undergoing mastectomy annually [1,2]. Pain after mastectomy is often severe [3] and described as a "continuous aching pain" the day after surgery [4]. As such, adequate pain control is a primary concern for both patients and health care providers. In addition, postoperative opioid analgesics often induce nausea and vomiting, increasing patient discomfort as well as postanesthesia recovery room and hospitalization durations.

In contrast, there is evidence that a single-injection thoracic paravertebral nerve block (tPVB) may provide potent and safe intraoperative and postoperative analgesia [4,5]. A tPVB involves the percutaneous injection of long-acting local anesthetic adjacent to the peripheral nerves that innervate the breast immediately lateral to the upper thoracic vertebra, either unilaterally or bilaterally. The aim of this retrospective cohort study was to determine if—and to what degree—a single--injection ropivacaine tPVB provides postoperative analgesia after unilateral and bilateral mastectomy.

2. Methods

After institutional review board (University of California San Diego, San Diego, CA) approval, we analyzed the records of 182 patients who underwent either unilateral or bilateral mastectomy with a single surgeon at the University of California San Diego between the years 2009 and 2011. Before 2010, patients undergoing mastectomy received an opioid-based analgesic regimen. During 2010, the Regional Anesthesia and Acute Pain Medicine Division began providing tPVBs for patients having mastectomy. All patients received oral and intravenous opioids as well as oral acetaminophen for analgesia, as necessary.

For subjects who had received a single-injection tPVB: with a low-frequency (5-2 MHz) curved array transducer (C60x; SonoSite MicroMaxx, Bothell, WA), the paravertebral space between the third and fourth thoracic vertebrae was identified in a parasagittal view approximately 3 cm lateral to midline on the side of surgery by a regional anesthesiology attending or fellow. Following sterile preparation, local anesthetic skin wheal was raised caudal to the ultrasound transducer. An 8.9-cm, 17-gauge, Tuohy-tip needle (Teleflex Medical/Arrow International, Research Triangle Park, NC) was inserted through the skin wheal in plane beneath the ultrasound transducer and directed to the paravertebral space. Ropivacaine 0.5% with epinephrine 5 μg/mL (20 mL) was slowly injected with gentle aspiration every 3 mL.

We hypothesized that use of a single-injection tPVB would be associated with lower pain scores during hospitalization after mastectomy from arrival on the postsurgical ward through noon the day after surgery (postoperative day 1 [POD1]). Pain was recorded by nursing staff using a 0-10 Likert numeric rating scale (NRS) for pain (0, no pain; 10, worst pain imaginable pain). The primary outcome measures of interested included the NRS (1) at the time of arrival to the surgical wards, (2) at noon on POD1, (3) the minimum NRS between those 2 time points; (4) the maximum NRS between those 2 time points, and (5) the NRS at discharge. A secondary outcome measure was the total number of hospitalization days.

2.1. Statistical analysis

Linear regression was used to assess the association between single-injection tPVB vs no injection and postoperative NRS pain scores (at 5 times: arrival to the surgical wards, noon on POD1, minimum between these 2 time points, maximum between these 2 time points, and at discharge). For pain scores, α level was .05 overall, with significance criterion of $P < .05/5 = .01$ (Bonferroni correction) for each time point. Statistical software (SAS, Cary, NC) was used for all analyses.

3. Results

Between 2009 and 2011, 92 received tPVB (unilateral or bilateral) immediately before surgery, and 90 patients did not receive tPVB (Table 1). Use of tPVB was associated with lower pain scores on arrival to the surgical wards (mean NRS

Table 1 Population data

	Paravertebral Block (n = 92)	No paravertebral Block (n = 90)
Age (y)	51 ± 12	54 ± 12
Unilateral mastectomy	66 (72%)	52 (58%)
Bilateral mastectomy	26 (28%)	38 (42%)

Values are reported as mean (SD) indicated or number of subjects (percentage of group), as indicated.

decrease of 1.9 points; 99% CI, −3.0 to −0.8; $P < .001$) (Table 2). However, by the following day at noon on POD1 and at subsequent discharge, there were no statistically significant differences between the 2 treatments (mean NRS decrease of 0.3 points at noon on POD1, $P = .43$ and mean NRS decrease of 0.1 point at discharge, $P = .65$) (Table 3). Furthermore, use of tPVB was not associated with shorter time to discharge, with average decrease of 0.5 hours; 95% CI, −6 to +5 hours; $P = .87$).

Table 3 Association between tPVB injection and postoperative pain scores

Outcome	Difference in means tPVB minus placebo	(99% CI) †	P *
NRS, floor arrival	−1.89	−2.97 to −0.82	<.001
NRS, POD1 at noon	−0.27	−1.16 to 0.61	.428
NRS, minimum	−0.29	−0.66 to 0.08	.047
NRS, maximum	−0.01	−0.87 to 0.85	.971
NRS at discharge	−0.14	−0.94 to 0.65	.646

* P values from linear regression adjusting for age and bilateral/unilateral significant if $P < .05/5 = .01$ (Bonferroni correction).
† Ninety-nine percent CI to maintain α of .05 across 5 time points.

4. Discussion

This retrospective cohort study provides further evidence that the addition of a single-injection ropivacaine tPVB to a multimodal analgesic regimen decreases pain in the immediate postoperative period after mastectomy. However, our study reveals no analgesic benefits to single-injection tPVB the day after surgery. Our results are consistent with current data on long-acting local anesthetics like ropivacaine lasting less than 24 hours [5]. Moreover, the vertical spread of local anesthetic is limited when given as a single injection and is thus unable to provide analgesia to all of the thoracic level dermatomes involved with mastectomy [5]. Both are significant limitations to single-injection tPVB that warrant discussion.

A prior randomized controlled trial by Kairaluoma et al [4] provided evidence of the benefits of single-injection tPVB in reducing postoperative pain in the immediate postoperative period after mastectomy, whereas a separate randomized controlled trial by Klein et al [5] suggested the benefit of multilevel tPVB (levels T1-T7) in reducing postoperative pain up to 72 hours postoperatively after reconstructive breast surgery. However, although administering local anesthetic injections at multiple levels may provide a greater degree and duration of analgesia postoperatively, doing so increases the invasiveness of the procedure as well as the likelihood of related adverse events.

The use of a continuous local anesthetic perineural infusion to complement an initial single-injection tPVB provides prolonged postoperative analgesia and addresses this issue [6]. Multiple studies similarly demonstrate an advantage with femoral and sciatic nerve blocks used in conjunction with continuous local anesthetic infusions as opposed to using single-injection nerve blocks alone [7]. Moreover, patients who receive both single-injection and continuous tPVB for mastectomy exhibit a decrease in the severity of chronic pain, fewer signs and symptoms of chronic pain, and increase in physical and mental health–related quality of life [8].

Interestingly, although our study suggests that most of the benefit of single-injection tPVB appears to be afforded during the day of surgery, new products are being developed that prolong the duration of local anesthetics used for single-injection regional blocks by using a liposomal suspension for drug delivery [9,10]. Such products have the potential to further enhance the efficacy of combining single-injection regional blocks with continuous peripheral nerve blocks in achieving postoperative analgesia after mastectomy as well as other types of surgeries.

4.1. Study limitations

As with any retrospective study, there is a chance that the results are biased due to unmeasured confounding variables. Nevertheless, these findings highlight the possible importance of prolonging the initial surgical nerve block with a continuous local anesthetic perineural infusion.

Table 2 Baseline variables and descriptive outcome summaries

	tPVB (n = 92)	No tPVB (n = 90)	P
Age	51.1 ± 11.5	54.2 ± 11.7	.077 †
NRS, floor arrival	1.6 ± 2.5	3.4 ± 3.1	
NRS, POD1 at noon	3.2 ± 2.5	3.2 ± 2.2	
NRS, minimum	0.3 ± 0.8	0.6 ± 1.2	
NRS, maximum	6.0 ± 2.3	5.9 ± 2.1	
NRS at discharge	2.8 ± 2.2	2.8 ± 2.0 *	
Days to discharge	1.6 ± 0.7	1.6 ± 0.8	

* n = 89.
† *t* test.

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