*ORIGINAL ARTICLE*

# The Use of Single-injection Thoracic Paravertebral Block in Breast Cancer Surgeries in our Asian Population: The Singapore General Hospital Experience

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**ABSTRACT**

**Background:** This series of cases describe the experience of using the single-injection thoracic paravertebral block of ropivacaine 1% to provide analgesia in breast cancer surgery in Asian patients within the Singapore General Hospital. **Cases:** Over these eight years, we documented 32 cases scheduled for elective breast cancer surgery with axillary dissection. These patients received 20 ml ropivacaine 1% with adrenaline (5 ug/ml) injected into the paravertebral space prior to surgery. All patients received a standardised regime of general anaesthesia, using fentanyl (if intra-operative supplemental analgesia was required). Patient-controlled analgesia (PCA) of morphine was used for post-operative analgesia. Assessments included peri-operative analgesic requirement, pain score, and shoulder movement limitation, incidence of nausea or vomiting, and adverse effects of the block. **Observations:** Parathesia using the loss of pinprick sensation was elicited in all patients after the institution of the block. A median of seven (range 4–11) dermatomes were recorded in this series. Seventy-five percent of the patients underwent surgery without supplemental analgesia. In the immediate post-operative period, 87.5% of patients reported none-mild pain. Over 90% responded with none-mild pain in the 24-hour post-operative period. No local anaesthetic toxicity or severe adverse effects of paravertebral block was observed. **Conclusion:** The single-injection of ropivacaine 1% into the thoracic paravertebral space is a useful alternate analgesia strategy for breast cancer surgery in our Asian population.

*Keywords:* Anaesthesia, Paravertebral, Regional, Local, Anaesthetic, Ropivacaine, Breast cancer

## INTRODUCTION

Single-injection thoracic paravertebral block using bupivacaine for breast cancer surgery has been described in the western population[1]. In this article, we will address two pertinent issues: The effects and patterns of the single-injection thoracic paravertebral block using ropivacaine in the Asian population and the concerns of systemic local anaesthetic toxicity with injection of a large bolus of local anaesthetic in paravertebral blocks[2,3]. In this series of patients, we chose to use ropivacaine which is known to have a higher safety profile than bupivacaine. This is with the view that it may lessen the risk of cardiotoxicity in the event of an inadvertent intravascular injection of local anaesthetic.

## METHODS

The details of this series of patients and the methodology have been previously approved by our institutional ethics committee. Female patients scheduled for elective mastectomy were recruited for the study. Patients with contraindications for paravertebral block which included bleeding diathesis, previous back surgery, cardiopulmonary diseases, and allergy to local anaesthetic agents were excluded.

None of the patients received any anxiolytic premedication. Prior to surgery, intravenous access was secured and standard monitoring, which included pulse oximetry, electrocardiogram, and non-invasive blood pressure was applied. All patients were positioned in the lateral decubitus with the operative site uppermost. The cohort of

patients received the paravertebral block using the technique described by Eason and Wyatt[4]. The spinous process of 5th thoracic vertebra was located. A 22-gauge, 8 cm beveled spinal needle (Spinocan, Braun) was introduced 3 cm lateral to the spinous process (Fig. 1) and advanced perpendicularly to the skin in all planes until contact with the transverse process was made. The needle was directed cephalad, "walked off" the edge of the transverse process and advanced another 5 to 10 mm till a loss of resistance was elicited as it passed through the costo-transverse ligament. The depth of the needle from skin to paravertebral space was noted. Gentle aspiration with an attached syringe containing the local anaesthetic was applied to exclude the presence of blood or air. Twenty milliliters of ropivacaine 1% with adrenaline (5 ug/ml) was slowly injected over 60 to 90 seconds. Patients were observed closely for symptoms and signs of systemic local anaesthetic toxicity.

Twenty minutes after the block, pinprick testing was conducted to elicit the extent of somatic blockade. Parasthesia involving each specific dermatome as well as the total number of dermatomal involvement was recorded. A failed paravertebral block was defined as the inability to identify any anaesthetic dermatome corresponding to the site of injection.

All patients received general anaesthesia. Anaesthesia was induced with intravenous propofol 2 to 2.5 mg/kg and an appropriate sized laryngeal mask airway was placed. Under spontaneous respiration, anaesthesia was maintained with isoflurane and 66% of nitrous oxide in oxygen. The end-tidal isoflurane concentration was maintained at 1%. The bispectral index values were maintained between 40 to 50. Supplemental fentanyl in bolus doses of 0.5 to 1 ug/kg was administered if there was an increase in blood pressure or heart rate beyond 20% of baseline values or when the respiratory rate increased beyond 25 breaths per minute in response to surgical manipulation. No local anaesthestic infiltration was used for the skin wound after surgeries.

Patients were managed and assessed in the post-anaesthetic care unit (PACU) after surgery. Intravenous morphine in titrated doses was administered upon request of the patient for pain relief. Intravenous ondanseton 4 mg was administered in the presence of nausea or vomiting. All patients were given the use of a PCA delivery device post-operatively. The PCA device was programmed to deliver 1 mg of morphine on demand with a lockout time interval of five minutes.

Post-operative assessment included 4-point verbal descriptive score (none, mild, moderate, and

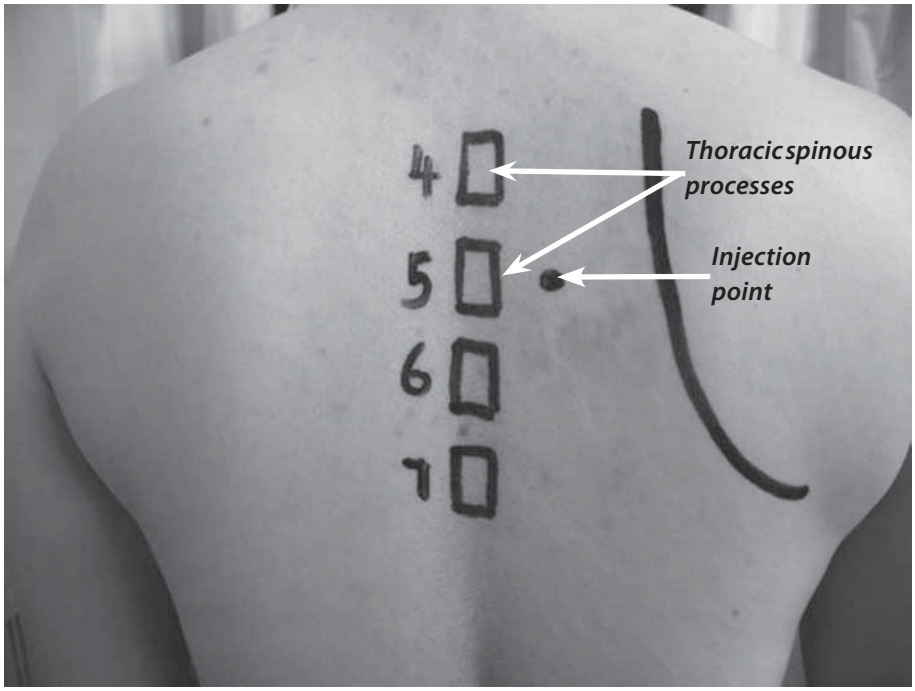


Fig. 1. Landmarks for paravertebral block.

Table 1. Demographic Data and Operation Type.

| | |
|---|---|
| Number of patients | 32 |
| Age ( mean ± SD*) in years | 51.0 ± 8.5 |
| Weight (mean ± SD*) in kilograms | 56.2 ± 10.9 |
| Height (mean ± SD*) in centimetres | 161.5 ± 4.9 |
| Race ( Chinese / Malay / Indian / Others) in numbers | 25 / 4 / 2 / 1 |
| ASA# class (I / II) | 20 / 12 |
| Simple mastectomy with axillary clearance | 18 |
| Wide excision with axillary clearance | 14 |
| Duration of surgery (mean ± SD*) in minutes | 75.5 ± 30.8 |

* SD: standard deviation
\# ASA: American Society of Anaesthesiologists

Table 2. Summary of Anaesthesia Data.

| | |
|---|---|
| Median time for performance of blocks | 11 (range of 7–21) minutes |
| Median time for completion of block to general anaesthesia | 32 (range of 20–57) minutes |
| Mean (SD*) depth from skin to paraverterbral space | 5.1 (1.5) cm |
| Median number of dermatomal involvement | 7 (range of 4–11) |
| Number of patients requiring fentanyl supplement: | |
| During breast surgery | 1 |
| During axillary dissection | 7 |

* SD: standard deviation

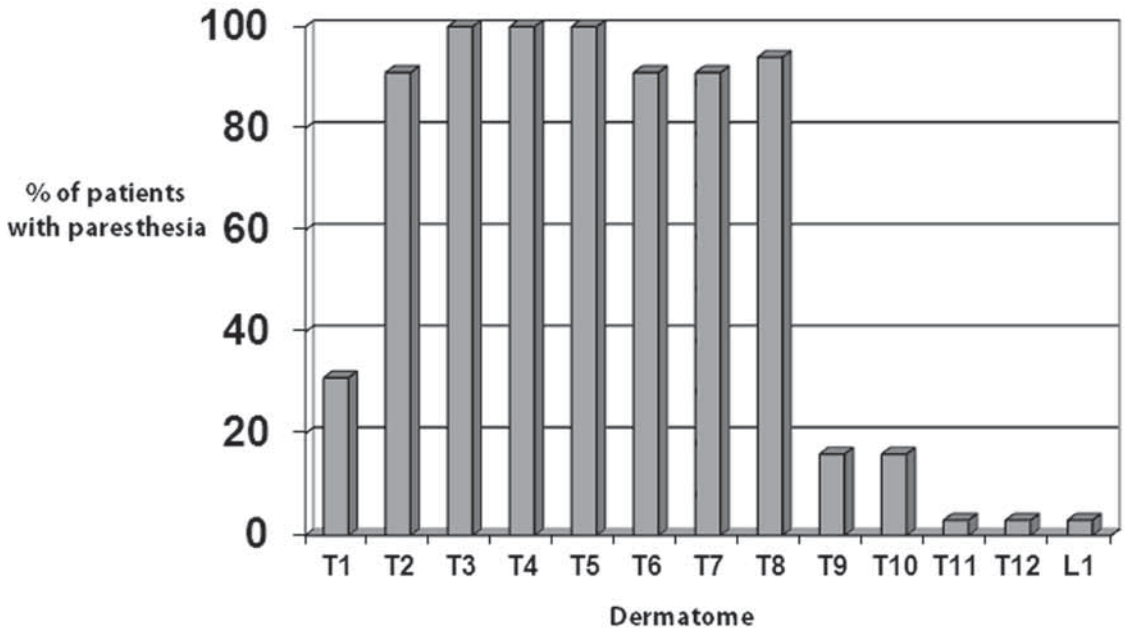


Fig. 2. The percentage of patients with paresthesia in the respective dermatomes.

severe) for pain assessment in PACU and 24-hours after surgery, 24-hour morphine requirement, and side-effects (nausea, vomiting, and breathlessness). Restriction of shoulder movement on the operative side (none: full range of movement, mild: slightly limited and able to abduct more than 90 degrees, moderate: unable to abduct more than 90 degrees, and severe: unable to move) was also assessed 24-hours after surgery.

## RESULTS

Thirty-two female patients underwent this regime of treatment. Demographic data and type of surgical procedures are presented in Table 1 while anaesthesia data are presented in Table 2.

The median time (range of 7–21 minutes) for performance of blocks (start of patient positioning to complete injection of block**)** was 11 minutes. The mean (standard deviation [SD]) depth from skin to paravertebral space was 5.1 (1.5) cm. The involvement of the dermatomes ranged from T1 to L1 and the median (range of 4–11) number of dermatomal involvement was seven. The percentage of patients developing paresthesia at each specific dermatome is represented in Figure 2. The median time (range of 20–57 minutes) from completion of the paravertebral block to general anaesthesia was 32 minutes. There was no record of any failed blockade.

The surgical technique in all patients involved operation on the breast followed by axillary dissection. Eight of the 32 patients required supplemental analgesia intra-operatively. Initial supplemental fentanyl was administered to one patient at the commencement of breast surgery and seven patients during axillary dissection. The median dose (range of 0–75 ug) of fentanyl used was 25 ug. In the PACU, the need for supplemental analgesia was needed in six patients. The median dose (range of 0–2 mg) of morphine administered in PACU was 0 mg.

The severity of pain in the immediate and 24-hour post-operative period is shown in figures 2 and 3. The mean (SD) dosages of 24-hour morphine requirement for the patients were 12.9 ± 4.4 mg.

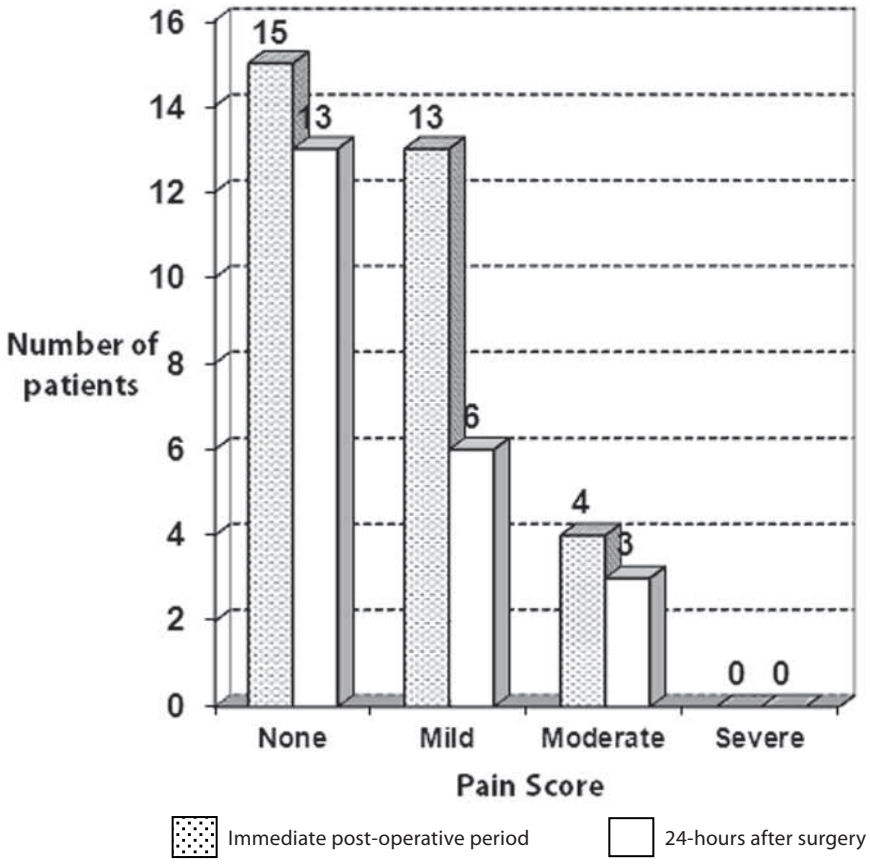


Fig. 3. Pain severity in the immediate post-operative period and 24-hours after surgery.

Table 3. 24-hours Post-operative Assessment.

| | |
|---|---|
| Morphine requirement (mg / 24 hours) | 12.9 ± 4.4 |
| Restricted arm movement (none-mild / moderate-severe) | 26 / 6 |
| Post-operative nausea / vomiting | 5 |
| Duration of surgery (mean ± SD*) in minutes | 75.5 ± 30.8 |

None of the patients reported severe pain in the immediate or 24-hour post-operative period. The assessment of shoulder movement demonstrated that more than 80% of patients had none-mild restriction (Table 3).

There were no serious adverse effects or systemic local anaesthetic toxicity noted. However, blood was aspirated in two patients when the paravertebral space was entered which required second attempts at the blocks. One patient experienced bilateral thoracic paresthesia as well as extension to the 1st lumbar dermatome on the side of the block, with no haemodynamic compromise.

## DISCUSSION

The administration of bupivacaine into the paravertebral space in the form of multi-injections at various consecutive cervical to thoracic levels has been successful in providing anaesthesia for breast surgery[5–8]. Pusch et al. described a single-injection of a high volume of bupivacaine into the thoracic paravertebral space and reported effective anaesthesia for breast lump excisions as well as mastectomies with axillary clearance[1].

The use of ropivacaine as a single-injection into the thoracic paravertebral blocks is increasingly being chosen[9,10]. This local anaesthetic agent has been shown to be equally effective but less toxic than bupivacaine[11,12]. Following accidental intravascular injection of bupivacaine during the induction of regional anaesthesia, sudden cardiovascular collapse may result. The resultant malignant arrhythmia and ventricular fibrillation could be resistant to treatment with fatal consequences[13]. On the other hand, clinical experience with ropivacaine showed that accidental intravenous administration resulted primarily in central nervous system complications that were easily treatable and minimal incidence of cardiac toxicity[14]. Ropivacaine's improved safety profile has permitted its use in higher concentrations. The option of using a higher concentration of bupivacaine was lost with the ban on bupivacaine 0.75% after reports of increased incidence of adverse effects[15]. The use of ropivacaine 1% in epidural anaesthesia for hip surgery and abdominal hysterectomy has shown to provide longer periods of analgesia than bupivacaine 0.5%[16,17]. Superior clinical efficiency resulted with the use of a higher concentration of ropivacaine and made feasible because of its low incidence of unacceptable side effects.

The average dose of 0.31 ml/kg of ropivacaine 1% injected into the paravertebral space in Asian patients at the T5 level elicited a spread of seven dermatomes in our study. The spread of ropivacaine as a single injection has not been previously evaluated in this population group. Manoj et al. reported a spread of five dermatomes in a patient when a mixture of 3 ml lignocaine 2% and 10 ml ropivacaine 0.5% was used in the paravertebral block[18]. Studies with bupivacaine (0.375%–0.5%) 15 ml demonstrated somatic block averaging four to five segments[19]. A report injecting 22 ml of lidocaine 1% (at T11 level) demonstrated a mean of 12 dermatomes blocked[20]. The spread of local anaesthetic agent from the paravertebral space is known to be variable. Injected agents can extend laterally, superio-inferiorally, and even medially. Radiological studies examining the spread of single-injections of radio-opaque dye into the thoracic paravertebral space showed two distinct patterns of distribution[18,21]. These were classified as longitudinal and cloud-like distributions. A strong correlation between the volume of injectate and the number of covered segments for the longitudinal group was reported (0.25 ml/kg of agent covering an average of six segments). The cloud-like distributions have less extensive clinical distribution of block and reduced extent of analgesia. Saito et al. suggested that the deposition of injectate at different locations of the

paravertebral space could result in differences in the distribution characteristics[20].

The block proved to be effective in providing analgesia for surgery of the breast in 97% of our patients. However, 25% of patients required supplemental analgesia during subsequent axillary dissection. A comparable study by Pusch et al. in which single doses of 0.3 ml/kg bupivacaine 0.5% were injected into the paravertebral space, reported about 19% of patients needing supplemental analgesia during axillary dissection[1]. This suggests that a single-injection of 0.3 ml/kg of local anaesthetic into the thoracic paravertebral space (T4 or T5) is associated with a significant risk of inadequate analgesia during axillary dissection.

Clinical signs or symptoms of systemic local anaesthetic toxicity were absent in this study. No epinephrine was added with the ropivacaine injections in this series of cases.

Administration of epinephrine-containing local anaesthetic agents injected into the paravertebral is advocated to reduce the risk of systemic toxicity[3,22]. The addition of 5 ug/ml epinephrine to ropivacaine has been found to significantly delay the systemic absorption of ropivacaine and reduces its peak plasma concentration[23]. However, the addition of epinephrine has not been shown to prolong local anaesthetic effects in animal models or clinical observations[24–26].

There are considerable reports that the paravertebral blocks provide good post-operative pain relief accompanied by little adverse effects. This is of great advantage when compared to other analgesic modalities involving the use of narcotics[27].

There are recent interests in the ultilisation of ultrasound technologies in thoracic paravertebral punctures[28,29] . The increase in success rates for ultrasound-guided paravertebral needle placement and injection would potentially increase the safety and encourage the usage of this technique.

## CONCLUSION

The use of a single-injection of ropivacaine 1% into the thoracic paravertebral space can provide a useful analgesic alternative for breast cancer surgery in our Asian population. It is associated with a low need for supplemental post-operative analgesia and facilitates shoulder mobilisation in the early post-operative period.

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