Improved Postoperative Pain Control using Thoracic Paravertebral Block for Breast Operations

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Abstract: Thoracic paravertebral block (PVB) in breast surgery can provide regional anesthesia during and after surgery with the potential advantage of decreasing postoperative pain. We report our institutional experience with PVB over the initial 8 months of use. All patients undergoing breast operations at the ambulatory care building from September 09, 2005 to June 28, 2005 were reviewed. Comparison was performed between patients receiving PVB and those who did not. Pain scores were assessed immediately, 4 hours, 8 hours and the morning after surgery. 178 patients received PVB and 135 patients did not. Patients were subdivided into three groups: Group A—segmental mastectomy only (n = 89), Group B—segmental mastectomy and sentinel node surgery (n = 111) and Group C—more extensive breast surgery (n = 113). Immediately after surgery there was a statistically significant difference in the number of patients reporting pain between PVB patients and those without PVB. At all time points up until the morning after surgery PVB patients were significantly less likely to report pain than controls. Patients in Group C who received PVB were significantly less likely to require overnight stay. The average immediate pain scores were significantly lower in PVB patients than controls in both Group B and Group C and approached significance in Group A. PVB in breast surgical patients provided improved postoperative pain control. Pain relief was improved immediately postoperatively and this effect continued to the next day after surgery. PVB significantly decreased the proportion of patients that required overnight hospitalization after major breast operations and therefore may decrease cost associated with breast surgery.

Key Words: breast surgery, length of stay, pain control, paravertebral block, postoperative pain, regional anesthesia

Surgery of the breast and axilla for treatment of breast cancer is a common procedure in the practice of general surgeons and surgical oncologists. The majority of patients with breast cancer will require surgery on both the breast for removal of the primary tumor and the ipsilateral axilla for nodal staging. Segmental mastectomy for removal of the primary tumor can often be performed with local anesthesia with or without sedation; however, mastectomy and axillary surgery, including sentinel lymph node (SLN) surgery, usually require additional anesthesia, traditionally in the form of general anesthesia.

Most patients will require an overnight stay after surgery for breast cancer for management of postoperative pain, as well as nausea and vomiting. Indeed, patients at highest risk for postoperative nausea and vomiting after general anesthesia are women who do not smoke and who have a history of motion sickness or prior postoperative nausea or vomiting and need postoperative opioids for pain control (1). This is thought to be related to the general anesthetic more than directly due to the surgical procedure itself. Alternatives to general anesthesia have been investigated and regional anesthesia is being used in some centers to decrease the need for general anesthesia and to reduce postoperative narcotic requirements.

Regional anesthesia in the form of a thoracic paravertebral block (PVB) can provide intraoperative...
anesthesia and postoperative analgesia by the use of local anesthetic injected near the thoracic spinal nerves at the point where they exit the intervertebral foramina. This results in ipsilateral somatic and sympathetic nerve block without dense motor block. A segmental blockade at the desired dermatomes is achieved. PVBs were performed in the early 1900s, however their use then decreased until a recent resurgence of interest in PVB in recent years.

We initiated the use of thoracic PVBs for breast operations at The University of Texas M. D. Anderson Cancer Center in September 2005 and report on our initial experience with PVBs compared with patients treated during the same timeframe who did not receive a PVB as part of their anesthetic management. The aim of this investigation was to assess the efficacy of PVBs for breast surgery. The primary outcome measure was postoperative pain control and secondary outcomes were length of hospital stay and complications of the block.

METHODS

All patients undergoing breast surgery at the Ambulatory Care Building at The University of Texas M.D. Anderson Cancer Center between September 2005 and April 2006 were enrolled in our prospective breast surgery anesthesia database. Institutional Review Board approval was obtained for this study. Demographic data (age and body mass index) were collected for all patients, and details were recorded prospectively and entered into a database.

Patients underwent their surgery either under general anesthesia alone or received a PVB with or without general anesthesia. At the beginning of our experience with PVBs, patients receiving PVBs also had general anesthesia. As our experience with PVBs increased, patients who received the PVB underwent surgery under light general anesthesia (utilizing fewer narcotics and lower concentrations of inhalation agent) or total intravenous sedation (with an intravenous propofol drip). Decisions as to which patients received the PVB were made by the surgeon and anesthesiologist with consent of the patient.

All PVBs were performed by three anesthesiologists (F.G, R.P., S.K.). The study period reported includes the learning curve for these three anesthesiologists with the PVB technique, as none of the anesthesiologists had performed PVBs prior to this time period. One anesthesiologist (F.G.) had visited another institution to learn the technique and subsequently instructed the other anesthesiologists (R.P, S.K.). During the time period reported all three anesthesiologists went from no experience with blocks to over 100, 50, and 20 cases each, respectively.

Paravertebral blocks were performed in a dedicated preoperative area with patients continuously monitored. Patients were sedated with intravenous midazolam, fentanyl, promethazine, and propofol as needed for block placement. The patient was supported in a sitting position by an assistant. The PVB technique used was a unilateral multilevel injection technique of 1% and 0.5% ropivacaine with 1:400,000 epinephrine into the ipsilateral paravertebral space at six levels from T1 through T6. The spines of the target vertebral bodies (T1–T6) were identified and marked and topical antiseptic applied. Using sterile conditions a 22 g Tuohy needle was inserted 2.5 cm from the midline. The needle was advanced in the parasagittal plane until the transverse process of the vertebral body was contacted. The needle was redirected off the inferior border of the transverse process and advanced into the paravertebral space. The paravertebral space was confirmed by loss of resistance to local anesthetic solution. Each corresponding spinal nerve received 3–6 mL of 0.5–1.0% ropivacaine with 1:400,000 epinephrine. The 1% ropivacaine solution was used for T1–T4 spinal nerves and the 0.5% solution was used for the remainder of the block. After completion of the block, the patient was repositioned supine with the back of the bed elevated 20°. The effect of the block was tested by sensitivity to ice water in appropriate dermatomes. Patients with unsuccessful blocks were not excluded from this study; patients were analyzed on an intention to treat basis. General anesthesia for patients without block was standardized and opioid supplement was titrated to normal cardiovascular parameters. All patients whether receiving general anesthesia or PVB received postoperative nausea and vomiting prophylaxis that consisted of promethazine, dexamethasone, and ondansetron.

After surgery patients were discharged home when they met standard discharge criteria provided by both the anesthesiologist and the surgeon. Discharge criteria were applied consistently to all patients regardless of anesthesia technique. This required that patients had their pain under control with oral medications, were able to tolerate oral intake, were able to ambulate independently and had minimal, if any, nausea or vomiting. Pain at the surgical site was evaluated using
the visual analog scale routinely employed at our institution and was recorded as a numerical value from 0–10 (0 = no pain, 10 = worst pain) immediately after surgery on arrival to the postanesthesia care unit, at 4 hours, 8 hours and on the morning after surgery. If the patient was discharged on the day of surgery, pain scores were recorded from the follow-up telephone call on the day after surgery. Length of hospital stay and operative procedure were recorded. The presence or absence of postoperative nausea and/or vomiting was recorded.

Chi-Square test or the Fisher’s exact test was used to assess the association between two factors, where appropriate. The Wilcoxon rank sum test was used to compare pain scores and time of stay across two levels of clinical factors. Logistic regression analysis was used to assess the effects of clinical factors on binary outcomes (e.g., overnight stay or discharge on day of surgery). All tests were two-sided and p-values less than 0.05 were considered significant. All statistical analyses were carried out using SAS release 8.02 (SAS Institute, Cary, NC).

RESULTS

Three hundred and thirteen patients underwent breast surgery at the Ambulatory Care Building between September 2005 and April 2006. Patients undergoing bilateral procedures or reconstructive procedures were excluded from this study. One-hundred and seventy-eight patients received a PVB and 135 patients received general anesthesia without a PVB block.

There was a statistically significant difference in the percentage of patients who experienced pain immediately after surgery with 144 (81%) patients who received a PVB reporting a pain score of zero, compared with only 77 (57%) patients who did not receive a PVB (p = 0.000006). Similarly, when assessed at 4 hours after surgery, 123 (71%) patients with a PVB reported no pain compared with 48 (38%) of patients without a PVB (p = 0.000000004). This pattern remained at 8 hours after surgery with 98 (60%) patients with a PVB reporting no pain compared to 40 (36%) of patients without a block (p = 0.000007). The proportion of patients that were pain free the morning after surgery continued to be higher in the patients who received a PVB (49% of patients with PVBs with a pain score of zero versus 42% of patients without a PVB [p = 0.048]).

To assess for differences based on the extent of surgery, patients were subdivided into three groups: 89 patients underwent segmental mastectomy only (Group A), 111 patients underwent segmental mastectomy and SLN surgery (Group B), and 113 patients underwent surgery that included either a total mastectomy or axillary lymph node dissection (ALND) or both (Group C).

Thirty-seven patients (42%) in group A, 67 (60%) patients in group B, and 74 (65%) patients in C received a PVB. The difference in the proportion of patients receiving a PVB between each group was statistically significant (p = 0.002). A PVB was used more frequently in patients undergoing more extensive surgery.

Thirty-one (84%) patients in group A who received a PVB reported a pain score of zero immediately after surgery, compared with 38 (73%) patients who did not receive a PVB (p = NS). In group B, the percentage of patients who reported no pain immediately after surgery was significantly different with 91% who received a PVB reporting no pain versus 57% who did not receive a PVB (p = 0.001). This difference was also significant in group C patients (70% and 36%, respectively, p = 0.001). This difference persisted in the 4 hour postoperative pain score ratings with a significantly higher percentage of patients who received the PVB reporting a pain score of zero compared with the patients not receiving a PVB in both Groups B and C. At 8 hours postoperatively and on the day after surgery, the proportion of patients reporting they were pain free remained significantly different between patients receiving a PVB compared with those who did not for patients in group B. Patients in groups A and C did not have a statistically significant difference in the absence of pain at these times.

The difference in absolute pain scores between patients who received a PVB and those that did not was statistically significant in patients in group B immediately after surgery, 4 hours and 8 hours after surgery and in patients in group C immediately after surgery and 4 hours after surgery and approached statistical significance at 8 hours after surgery (see Table 1). By the morning after surgery there was no statistically significant difference in pain scores between the patients who received a PVB and those that did not receive a PVB in any of the groups. Among the patients in group A, the only difference in pain scores was seen at 4 hours after surgery.
The incidence of postoperative nausea and vomiting was 6% in the PVB group and 4% in the group that did not receive PVB (p = 0.62) and was not significantly different between the groups.

The length of stay was significantly shorter for patients that received the PVB compared with those that did not in both group B (2.4 hours versus 3.0 hours, p = 0.0003) and in group C (17.5 hours versus 20.3 hours, p = 0.0005), however, use of a PVB had no impact on the length of stay for group A patients (see Table 1). Forty-five (61%) patients in group C who received a PVB stayed overnight compared with 38 (97%) of patients in group C who did not receive a PVB (p = 0.0001). The proportion of patients staying overnight in groups A and B was not different based on the use of a PVB (see Table 2).

### Complications of PVB

There are complications specific to the placement and use of a PVB. In our study of 178 patients undergoing PVBs, three patients had epidural spread of the block, two patients had a temporary Horner’s syndrome, and one patient developed transient hypotension during placement of the block. There were no clinical pneumothoraces noted in these 178 patients as determined by the lack of hypoxia, tachypnea, chest pain or dyspnea on questioning once awake. X-ray was available as needed and was obtained on one PVB patient for chest pain postoperatively. The X-ray was negative for pneumothorax. The overall complication rate was 3.4%. These complications were all short-lived and none were life-threatening.
Postoperative surgical site hematomas occurred in three patients in this study group, two in the general anesthesia only group (1.5%), and one in the PVB group (0.6%) (p = NS).

**DISCUSSION**

The use of a thoracic PVB provides an alternative form of anesthesia that can improve postoperative analgesia for patients undergoing surgery of the breast and axilla. We found that the use of a PVB was practical and associated with a 3.4% complication rate in our initial experience. We noted that there was a significant improvement in postoperative pain scores in patients undergoing segmental mastectomy with SLN surgery or more extensive breast or axillary operations when a PVB was utilized. There was also a significant decrease in the length of stay for these patients. Among the patients who were undergoing segmental mastectomy alone, PVBs did not result in a significant difference in pain scores except at the 4-hour time point and there was no reduction in the length of stay. This suggests that use of a PVB in patients undergoing segmental mastectomy alone may not be warranted given the time, cost, and potential complications associated with PVB. This is in keeping with a previous report of 30 patients undergoing minor surgery (lumpectomy with or without sentinel node procedure) that suggested the advantages of using a PVB in this population were minimal (2).

Pain scores were significantly different in patients undergoing segmental mastectomy with SLN surgery or more extensive breast or axillary surgery, at all time points until the morning after surgery. These data are consistent with previous studies from Duke University which showed decreased postoperative analgesia requirements for patients receiving PVBs (3). Another study using a single injection technique of PVB at the T4 level reported improvements in pain and decreased recovery time from anesthesia (4).

In this study the length of hospital stay was significantly decreased in patients undergoing segmental mastectomy with SLN surgery or more extensive procedures. In the segmental mastectomy with SLN group this decrease in length of hospital stay was on the order of 40 minutes, which probably does not have a significant impact on overall costs or clinical practice. However, for the patients undergoing more extensive breast and axillary surgery, this decrease in hospital stay was approximately 3 hours in patients undergoing PVB. More important clinically is the change in the proportion of patients requiring overnight observation in the hospital setting. We found that the use of PVB decreased the overnight admission rate from 97% to 61% for patients undergoing major breast surgery. These data are in keeping with reports from other investigators who have also demonstrated a decrease in hospital stay with the use of PVB (5). This has implications for the cost to the patient as well as utilization of nursing staff and hospital beds. Operating room, operative supplies, and pharmaceuticals have similar costs for patients in both groups, anesthetic charges and pharmaceutical charges may vary between the two groups. The actual cost of the supplies for the PVB including medication, syringes, tubing, needle, gloves, 4 × 4 is only $49. The total Medicare charge for a PVB is around $109.63, as compared with the charge for an overnight stay in the Ambulatory Care Building which is $1200. Therefore at a charge of $10,900 for 100 patients to avoid 36 admissions at $1200 each ($43,200), PVB is overall cost effective with a savings over these 100 patients of $32,300. The total potential cost savings from PVB however may be greater than this as it leads to potentially less medication requirements during surgery and the postoperative period and fewer hours in the recovery room. Additionally no price can be placed on patient satisfaction. Previous literature has shown that room charges average 11% of the total charges for patients admitted to postoperative observation rooms (6) and therefore decreasing admission rates can significantly decrease hospital charges.

As our study was not randomized, there could be some inherent bias from the surgeon and/or the anesthesiologist as to which patients received a PVB and which did not. We noted that PVB were more commonly used in patients undergoing more major surgery than in patients undergoing segmental mastectomy alone. This inherent preference to use the PVB in patients undergoing more major surgery is based on the results of a previous study indicating that PVB does not improve postoperative analgesia in patients undergoing segmental mastectomy alone. It is possible that the surgeon may be more likely to offer a PVB to patients with a low pain threshold to improve postoperative pain control.

Postoperative nausea and vomiting were not significantly decreased in this study. This is probably related to the use of an aggressive anti-emetic protocol. We have documented a decrease in the postoperative
nausea and vomiting rate (S. F. Kee, F. Goravanchi, R. N. Parris, J. C. Frenzel, J. R. Ruiz, unpublished data), therefore it may be difficult to demonstrate a difference in postoperative nausea rates with the use of PVB in our study population.

The complication rate following PVBs at our institution was 3.4%, consistent with the published literature (2–5,7,8). All complications in this study resolved spontaneously and none resulted in long-term sequelae. Complication rates presumably decrease with the increasing experience of the anesthesiologist performing the PVB. This report includes the learning curve of our anesthesiologists and therefore should be a true reflection of complications to be anticipated when initiating the use of PVB in a new institution. Additionally, as experience with PVB increases, the blocks should become routinely more effective and may result in a greater improvement in outcomes.

A limitation of this study was the lack of patient randomization. We are currently conducting a prospective, randomized trial of PVBs in patients undergoing breast surgery at our institution. The study group is limited to patients undergoing unilateral breast surgery without reconstructive procedures. PVB has been shown to be effective in patients undergoing breast augmentation (8) and breast reduction procedures. Further studies are required in patients undergoing mastectomy with immediate breast reconstruction and patients undergoing bilateral breast procedures.

In summary, this review of our initial experience at a large multi-disciplinary cancer center showed that PVBs improved short-term pain control and decreased length of hospital stay for patients undergoing major breast and axillary procedures. We await data from our prospective randomized trial of PVBs before recommending routine use of PVB in all patients undergoing major breast operations. However, the results from this initial study are promising and suggest that PVB may be a useful tool to improve pain control in patients undergoing surgery for breast cancer.

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