Ultrasound Guided Thoracic Paravertebral Block versus Blind Landmark Technique for Breast Surgery. Does it Really Different?

RANDA I. BADAWY, M.D.; SAHAR S. ISMAIL, M.D.; MOHAMED AHMED MANSOUR, M.D. and AHMED M. ALI, M.D.
The Department of Anesthesiology, Faculty of Medicine, Cairo University

Abstract

Background and Aim: Thoracic Paravertebral Block (TPVB) is an effective intraoperative and postoperative technique for surgical anaesthesia and analgesia for breast surgery [1]. It offers a long-lasting effective analgesia with a significant decrease in anaesthetic and analgesic consumption. Ultrasound guidance helps identifying the Paravertebral Space (PVS), needle placement, and to real time monitor the spread of the local anesthetic around nerves which increases the efficacy of the block and minimizes the risk of complications.

Methods: A total of 48 adult females, ASA physical status I and III, 18-55 years, patients scheduled for unilateral breast surgery. Patients were randomly assigned into 2 groups of equal size (n=24).

Group A: Patients received TPVB using blind landmark technique.

Group B: Patients received TPVB using ultrasound guided technique.

Objective: The purpose of this study is to determine safety and efficacy of ultrasound guided TPVB versus blind technique in breast surgery.

Conclusion: This study demonstrated that the use US-guided TPVB is feasible, effective, has a high success rate, and decrease the incidence of complications due to direct visualization of anatomical structures, the needle and spread of local anesthetic.

Key Words: TPVB – US – Breast – Local anaesthetic – Perioperative pain.

Introduction

THORACIC paravertebral block is a century old technique used for intra-operative and peri-operative pain control as well as acute and chronic non-operative pain [1]. It is a technique of injecting local anaesthetic in the vicinity of the thoracic spinal nerve emerging from the intervertebral foramen [2]. Many practitioners, however, remained hesitant to perform thoracic paravertebral block for fear of pneumothorax, it is reported that the risk of it doesn't exceed 0.5%-1%. The risk of Dural puncture is also reported but it is more common with median approach [3].

Recently with the growth of ultrasound technology, our ability to visualize the pleura and other structures in and around the paravertebral space has fueled a tremendous increased interest in performing thoracic paravertebral block [4].

In the present study, an effort has been made to to determine efficacy and safety of TPVB in breast surgery using (blind technique) versus (ultrasound guided technique).

Patients and Methods

This study was conducted in accordance with principles of Ethical Committee of Kasr El-Ainy Hospital and Cairo University, from June 2014 to September 2015. Full written informed consent was obtained from all patients before inclusion in this study.

A total of 48 adult female patient scheduled for unilateral breast surgery (biopsy, fibroadenoma resection, simple mastectomy). Written consent obtained from all participants. Patients were divided into 2 groups of equal size (n=24).

Group A: Patients received TPVB using blind landmark technique.

Group B: Patients received TPVB using ultrasound guided technique.
Inclusion criteria:
1- ASA I-III patients.
2- Age 18-55 years.
3- Elective surgical patients needing unilateral breast surgery (biopsy, resection of fibroadenoma and simple mastectomy).

Exclusion criteria:
1- ASA IV or V patients.
2- Infection at the thoracic paravertebral injection site.
3- Coagulopathy disorders.
4- Patient refusal.
5- Has a BMI >35kg m$^2$.
6- Allergic to any drugs in the protocol.

Pre-operative assessment:
All patients were informed about the study design and objectives as well as tools and techniques. Informed consent had been signed by every patient prior to the study. Patients were randomly allocated to one of two groups by sealed closed envelop technique.

Routine preoperative assessment including history taking, clinical examination, and laboratory tests. The age, height, weight and BMI of the patients will be recorded. Monitoring was established (pulse oximeter, electrocardiogram and non-invasive blood pressure). All patients were been sedated with 0.05mg/kg of midazolam and 2mc/kg fentanyl i.v before anesthesia. They were been randomly assigned to receive an ipsilateral TPVB at T2, T4 and T6 with 3.5ml bupivacaine 5mg/ml and 3.5ml lidocaine 20mg/ml (7ml in each level).

Interventions:
TPVB will be performed with the patient sitting, shoulders and head relaxed and leaning forward.

Blind landmark technique Group (A): After a strict aseptic precautions, a wheal of lidocaine 1% (1ml) is raised at each point marked on the parasagittal line (2.5-3cm lateral to spinous process). A Tuohy needle 18G with a 20cm injection line is used, the needle is advanced through the wheal perpendicular to the skin until the bony resistance of the transverse process is met at a variable depth (2-4cm) depending on the build of the individual.

When the transverse process is contacted the needle depth is noted. This will help to predict the depth of contact on the subsequent blocks. The needle is walked off the inferior border of the process and further advanced by approximately 1cm as measured by the needle markings.

After gentle aspiration to check for blood, CSF and air, the local anaesthetic 3.5ml bupivacaine 5mg/ml and 3.5ml lidocaine 20mg/ml (7ml in each level) will be administered over a period of 30s.

Ultrasound-guided technique Group (B): After surgical disinfection of both cervical-thoracic paravertebral areas and protection of the ultrasound probe and cable with a sterile cover, initial ultrasound scanning of the T2, T4 and T6 paravertebral region at the surgical side was performed. An ultrasound machine (SiemensTM, Acuson X300) a low-frequency ultrasound transducer (CH5-2, 2-5MHz) was used.

The ultrasound scanning was performed as follows:
Identification of (T2, T4, T6) spinous processes by decrement from C7 (vertebra prominens), positioning of the ultrasound probe at the spinous process of T2, lateral movement until the transverse process is visible, and oblique movement until the typical double layer of the Internal Intercostal Membrane (IIM), the transverse process, and the pleura are visualized in one image.

The block was performed after skin infiltration with lidocaine 1% (1ml). An in-plane approach was performed. (B. Braun, Stimuloplex® Ultra, 22G & 120mm) a 20cm injection line used. Once the tip of the needle in a position between the Internal Intercostal Membrane (IIM), the pleura, 3.5ml bupivacaine 5mg/ml and 3.5ml lidocaine 20mg/ml (7ml in each level) will be administered over a period of 30s after negative aspiration.

During administration of the local anaesthetic, an anterior displacement of the pleura (downward movement) was observed.

Monitoring and data collection:
Intraoperative:
• Hemodynamic measurement: (Bl.p and pulse) was taken just after assessment of the block and every 15min throughout surgery.
• Analgesic consumption: Recorded during intra-operative period to maintain maximum 20% change of basal vital signs after exclusion of other causes.

Postoperative:
• Pain score: VAS score at 2, 6, 12h post-operative.
• Postoperative nausea and vomiting: PONV scores (categorical scale: 0=None, 1=nausea, 2=nausea reaching vomiting) was documented.
• Rescue analgesia: Time of the first rescue analgesia was recorded. VAS >4 was given non-steroidal anti-inflammatory analgesic (ketorolac 30mg).

Monitoring of other side effects of local anesthetics:

Respiratory depression (respiratory rate <8 breath/min, and SpO2 <90% on the room air).

Nausea and vomiting were managed by IV injection of 10mg metoclopramide.

Primary outcome:

- Number of patients with a technique failure of the TPVB.
- Intraoperative hemodynamic changes.
- Intra-operative analgesic requirement.

Statistical analysis:

Data were coded and entered using the statistical package SPSS (Statistical Package for the Social Science; SPSS Inc., Chicago, IL, USA) Version 22. Data was summarized using mean, standard deviation, median, minimum and maximum in quantitative data and using frequency (count) and relative frequency (percentage) for categorical data. Comparisons between groups were done using the non-parametrical Mann-Whitney test (Chan, 2003a) [5]. For comparing categorical data, Chi square (χ²) test was performed. Exact test was used instead when the expected frequency is less than 5 (Chan, 2003b) [6]. p-values less than 0.05 were considered as statistically significant.

Results

Forty eight patients were enrolled in this study in Kasr El-Ainy-Hospital Cairo University (June 2014 to September 2015). Patient’s characteristics including age, Body Mass Index (BMI), and ASA score are demonstrated in (Tables 1,2). There was no significant difference in the demographic data of the two groups of the study.

In Group A mean age was 33.83, in Group B the mean age was 35.87. In Group A mean (BMI) was 29.83, in Group B the mean BMI was 29.96.

The primary outcome of this study was faild block in 10 cases and sucess block in 38 cases. In Group A there were 8 cases of faild block and 16 cases of sucess block. In Group B there were 2 cases of faild block and 22 cases of sucess block. And this was significantly different as shown in (Table 3).

There were significant differences between the 2 groups in the intraoperative vital signs (blood pressure and pulse rate) and total intraoperative fentanyl dose (Table 6).

Comparing the pain score (visual analogue score) of the two groups at 2, 6 and 12hr postoperatively revealed that there was a significant difference in analgesic effect between two groups as shown in Fig. (1).

As regard the time of 1st rescue of analgesia. There was a significant difference between two groups (Table 5).

There was higher incidence of post-operative nausea and vomiting in Group A as shown in (Table 6). (Categorical scale: 0=none, 1=nausea, 2=nausea reaching vomiting).

There were no recorded complications in both groups either intra or postoperatively in the form of hemodynamic instability, injury to underlying structures, hematoma formation, inadvertent vascular puncture, pleural puncture and pneumothorax.

Table (1): Age and BMI in both study groups.

<table>
<thead>
<tr>
<th></th>
<th>Group A</th>
<th></th>
<th>Group B</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>33.83</td>
<td>9.67</td>
<td>35.87</td>
<td>9.25</td>
<td>0.433</td>
</tr>
<tr>
<td>BMI</td>
<td>29.83</td>
<td>4.31</td>
<td>29.96</td>
<td>3.95</td>
<td>0.993</td>
</tr>
</tbody>
</table>

Data are given as mean ± SD.

BMI: Body Mass Index.

p-value is significant <=0.05.

Table (2): ASA in both study groups.

<table>
<thead>
<tr>
<th></th>
<th>Group A</th>
<th></th>
<th>Group B</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>ASA:</td>
<td></td>
<td>%</td>
<td></td>
<td>%</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>20</td>
<td>83.3</td>
<td>16</td>
<td>66.7</td>
<td>0.382</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td>12.5</td>
<td>7</td>
<td>29.1</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>1</td>
<td>4.2</td>
<td>1</td>
<td>4.2</td>
<td></td>
</tr>
</tbody>
</table>

* p-value is significant <=0.05.

Table (3): Succ and faild blocks in both study groups.

<table>
<thead>
<tr>
<th></th>
<th>Group A</th>
<th></th>
<th>Group B</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Outcome:</td>
<td></td>
<td>%</td>
<td></td>
<td>%</td>
<td></td>
</tr>
<tr>
<td>Faild</td>
<td>8</td>
<td>33.3</td>
<td>2</td>
<td>8.3</td>
<td>0.033</td>
</tr>
<tr>
<td>Succ</td>
<td>16</td>
<td>66.7</td>
<td>22</td>
<td>91.7</td>
<td></td>
</tr>
</tbody>
</table>

* p-value is significant <=0.05.
Table (4): Comparison of average Systolic Blood Pressure (SBP), average Diastolic Blood Pressure (DBP), average pulse rate and total fentanyl dose between both study groups during intra-operative period.

<table>
<thead>
<tr>
<th></th>
<th>Group A Mean</th>
<th>Std. deviation</th>
<th>Group B Mean</th>
<th>Std. deviation</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average intraopertive SBP</td>
<td>130.31</td>
<td>8.55</td>
<td>121.09</td>
<td>8.04</td>
<td>0.003</td>
</tr>
<tr>
<td>Average intraoperative DBP</td>
<td>77.69</td>
<td>8.00</td>
<td>71.50</td>
<td>5.71</td>
<td>0.028</td>
</tr>
<tr>
<td>Average intraoperative pulse rate</td>
<td>81.81</td>
<td>6.40</td>
<td>73.14</td>
<td>6.30</td>
<td>0.001</td>
</tr>
<tr>
<td>Total intraopertive fentanyl dose (ug)</td>
<td>168.75</td>
<td>51.23</td>
<td>75.00</td>
<td>29.88</td>
<td>0.001</td>
</tr>
</tbody>
</table>

* p-value is significant <=0.05.

Table (5): Time of first rescue of analgesia of both groups.

<table>
<thead>
<tr>
<th></th>
<th>Group A Mean</th>
<th>SD</th>
<th>Group B Mean</th>
<th>SD</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>First rescue analgesic dose (hr)</td>
<td>2.88</td>
<td>1.02</td>
<td>7.64</td>
<td>1.47</td>
<td>0.001</td>
</tr>
</tbody>
</table>

* p-value is significant <=0.05.

Table (6): Comparison of nausea and vomiting in both study groups.

<table>
<thead>
<tr>
<th></th>
<th>Group A Count</th>
<th>%</th>
<th>Group B Count</th>
<th>%</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Postoperative nausea and vomiting:</td>
<td>6</td>
<td>37.5</td>
<td>22</td>
<td>100.0</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>0</td>
<td>9</td>
<td>56.2</td>
<td>0</td>
<td>.0</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>6.2</td>
<td>0</td>
<td>.0</td>
<td></td>
</tr>
</tbody>
</table>

* p-value is significant <=0.05.

Discussion

Thoracic paravertebral block is a technique creating unilateral somatic and sympathetic nerve block as a result of local anesthetic solution injection in thoracic paravertebral space [4].

The ultrasound technology increases the ability to visualize the pleura and other structures in and around the paravertebral space and increase the interest in performing thoracic paravertebral block. Ultrasound technology has allowed us to broaden the depth of our knowledge of the anatomy of the paravertebral space in addition to enabling us to visualize the anatomic structures, the needle, and the spread of local anesthetic [3].

In our study, 48 female patients scheduled for elective breast surgery (biopsy, fibroadenoma resection, simple mastectomy). They were randomly divided into 2 groups each (n=24).

In our study there was faild block in 10 cases and succss block in 38 cases from total 48 patients. Sucess rate in Group A was (66.7%) and (91.7%) in Group B.

Study done by Greengrass et al., compared the safety and efficacy of paravertebral block as a sole anesthetic technique for intraoperative and postoperative management of modified radical mastectomy with those of general anesthesia. Surgery was successfully completed in (85%) of the cases attempted by using paravertebral block alone, and in (91%) of cases the surgery was completed by using paravertebral block supplemented with local anesthetic infiltration [7].

Similarly to our study Cheema and colleagues reported that ultrasound guidance, seem to increase the safety and success of the technique compared with the blind (loss of resistance) technique [8].

In our study the means to assess post operative pain control was the time to first analgesic consumption and the VAS scores at different times (2, 6, 12h) of post operative period.

The time to first analgesic in the postoperative period was significantly greater in Group B (7.64) than in Group A (2.88).

Klein and colleagues, found reduced pain scores even at 24h post-operatively. Which may be due to they use ropivacine instead of bupivacine in our study. But we had the same conclusion that multiple injection technique improve the duration and quality of analgesia of TPVB [9].
Also in the study of Pusch and colleagues, 86 women were included, 44 patients received a single-injection paravertebral block, while 42 patients were treated with general anaesthesia. Lower pain scores were found in the PVB group than the control group throughout the study [10].

Data represented in our study showed that the incidence of postoperative nausea and vomiting was higher in the Group A (64%). This may be a result of increase the requirement of opioids among the this group. But the overall incidence of PONV of both groups about (26%).

In a study done by Coopey and colleagues they found a significant improvement in the rates of antiemetic use postoperatively in patients who had a PVB, antiemetic used in 3 8.8% of PVB group and in 56.8% of control group who recievied general anathesia (p<0.0001) [11].

Arunakul and colleagues as well, found that the incidence of PONV is quite high in the patient undergoing modified radical mastectomy (64%). In their study, a PVB lowered the severity of PONV and antiemetic requirement (6.6%) [12].

Our study shows that there were no incidence of complications especially with the direct visualization of paravertebral space and real time injection of the local anesthetic under ultrasound guidance.

Unlike our study, Pekka and colleagues reported one of the serious complications that a part of the solution might have been accidentally injected intravascularly [13].

Naja’s study, where nerve stimulation technique was adopted, included inadvertent vascular puncture (6.8%), hypotension (4.0%), hematoma (2.4%), pain at the site of skin puncture (1.3%), signs of epidural or intrathecal spread (1.0%), pleural puncture (0.8%), and pneumothorax (0.5%) were encountered in this study. Such complications are rare, but serious [14].

To conclude, the use US-guided TPVB is feasible, effective, has a high success rate, and decrease the incidence of complications due to direct visualization of anatomical structures, the needle and spread of local anesthetic.

References
المختصر العربي

تعتبر طريقة الحقن الجار فقاري للفترات الصدرية تقنية فعالة للتخدير الجراحي وتسمك الأم أثناء جراحات الثدي. فهي توفر تسکین فعال طوال الامن دون زيادة الآثار الجانبية، مع إنخفاض محوظ في إستهلاك المخدر والمسكن، مما يترتب عليه إرضا المريض بدرجة كبيرة وتبيل مدة الاستشفاء.

الحقن الجار فقاري هو أسلوب تخدير موضعي له العديد من الاستخدامات. عادة ما يتم إجراء الحقن الجار فقاري عن طريق التقنيات القائمة على المعالج أو الأساليب التي تعود على الاختلافات الضغط بين الفضاء المجاور للقورة من الخارج والداخل أو بواسطة الموجات فوق الصوتية الموجة.

تم تطوير تقنيات الموجات فوق الصوتية وقرنتنا على تصور الضغط البولوري وعمليا من الهياكل داخل وخلال الفراغ المجاور للفترات الاهتمام في الحقن الجار فقاري للفترات الصدرية حيث أن تكنولوجيا الموجات فوق الصوتية تزيد سلامة وفعالية الحقن الجار فقاري للفترات الصدرية. فهي تسمح بزيادة عمق المعرفة للصفات التشريحيه الخاصة بالفضاء المجاور للقورة بالإضافة إلى تصور كلا من الهياكل التشريحيه، وسهولة، وإدراك المجهر الموضعي.

في الدراسة الحالية، تم تقييم فعالية وسلامة الحقن الجار فقاري في التخدير الجراحي إجراء عمليات الثدي.

تم تقسيم الدراسة لمجموعتين:

الفئة الأولى: (24 مريض) حيث تم الحقن الجار فقاري حول الفترات الصدرية باستخدام أساليب التقنيات القائمة على المعالج التشريحي.

الفئة الثانية: (24 مريض) حيث تم الحقن الجار فقاري حول الفترات الصدرية باستخدام أساليب تصور الموجات فوق الصوتية الموجة.

تم عمل مقارنة بين المجموعتين فيما يتعلق بالآثاث: عدد الحالات التي نجى فيها الحقن إجراء الجراحة، والتأثير على استقرار الدورة الدموية، وتسهيل عقر الفنتالين أثناء العملية، وأول احتياجات المرضى بعد الجراحة، والشعر والإثارة بعد الجراحة.

تم تسجيل ثمانية وأربعين سيدة إتمام هذه الدراسة حيث أجريت في مستشفى القصر العين بالقاهرة، مصر، يتراوح عمر المرضى بين 18 و53 عام من ثامن تقسيم عشوائيا بنطاق الحقن الموصى إلى مجموعتين للدراسة. وكان من المقرر لكل المرضى لجراحة الثدي المختارة.

هذا الدراسة توضح أن الحقن الجار فقاري للفترات الصدرية الموجة بواسطة الموجات فوق الصوتية يتم أن إجراء بسيط وآمن في توفير طرق تسکین للألم فعالا ومسكن الآثار الجانبية المقابلة، بالإضافة إلى أن عدد من مرضى الجراحة بعد الجراحة وتبيل المقتنيات ضافية جبنا إلى جانب مع الآثار الجانبية المباشرة الخاصة بهم.