Original Article

Surgical anaesthesia for mastectomy with interpleural block; a prospective observational study

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Abstract

Background
The risk provided by general anaesthesia is increased in patient undergoing mastectomy when co-morbidities exist. The need for a safe, easy and effective alternative anaesthetic technique that can provide an adequate postoperative analgesia in such group of patients was the main indication for this study.

Methods
Two hundred patients, with coexisting medical diseases, were the candidates for interpleural block to provide surgical anaesthesia, as a surrogate for general anaesthesia for mastectomy, supplemented with midazolam to achieve conscious sedation. The candidates were studied with regard to intraoperative analgesia, haemodynamic stability, the duration of postoperative analgesia and the incidence of complications related to the technique.

Results
The mean age of patients was 54.3 (STD 12.5) years and all of them were suffering from coexisting medical diseases. Following interpleural block, the intraoperative mean heart rate was 78.5 (STD 6.3) beats/min and the mean blood pressure was 82.7 (STD 7.0)

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mmHg. Pain score was 1 in 80 (40%) patients, 2 in 62 (31%) patients, 3 in 54 (27%) patients and 4 in only 4 (2%) patients. Neither postoperative pneumothorax nor pain in the first 3 hours was observed and the mean duration of postoperative analgesia was 9.3 (STD 1.8) hours. All candidates were fully satisfied with the procedure.

**Conclusion**

In this study, interpleural block provided satisfactory anaesthesia for mastectomy in patients having co-morbid diseases, with haemodynamic stability, less incidence of complication and long-lasting postoperative analgesia. The skill of this technique should be mastered by anaesthetist working in developing countries.

**Keywords:** Interpleural block, anaesthesia, analgesia, bupivacaine, mastectomy

**Introduction**

Knowledge of breast enervation is mandatory for a successful pain free mastectomy under local anaesthesia. The breast is supplied by the anterior and lateral cutaneous branches of the second to sixth intercostal nerves which convey sensory fibers to the skin and autonomic fibers to smooth muscles and blood vessels. The breast also receives fibers from the supraclavicular nerves. These nerves should be blocked to provide analgesia to the whole breast. Interpleural analgesia is induced by depositing local anaesthetic between the visceral and the parietal pleurae to produce analgesia of the ipsilateral chest and abdominal wall. This technique was first introduced in 1984 by Kvalheim and Reiestad. Since then, extensive reports have been written about the technique, its indications and complications. Reiestad et al have reported the use of interpleural block in adults to provide pain relief after mastectomy, cholecystectomy and renal surgery. Following studies have state that interpleural block is effective in pain management following pancreatitis, thoracotomy, rib fractures, flank surgery e.g. renal surgery and cholecystectomy. The technique can also provide surgical anaesthesia for lumpectomy and biopsy of the breast, percutaneous hepatic and renal drainage procedures and lithotripsy.

General anaesthesia for mastectomy may not provide a satisfactory pain relief in some cases particularly with extensive breast tissue excision that involves axillary node dissection. In this study, the technique of interpleural analgesia was assessed for the provision of adequate surgical anaesthesia in 200 patients presenting for mastectomy.

**Methodology**

This is a prospective observational study that describes the use of interpleural block to provide surgical anaesthesia for a major breast surgery (mastectomy) in a developing country. The study was conducted in Soba University and Khartoum Teaching Hospital (Khartoum-Sudan) in the period from June 1999 to February 2011. Two-hundred and twenty-seven patients, with moderate to severe attendant risk from general anaesthesia as a result of poor general health and co-morbidities, presented for mastectomy in the study period. Patients in whom the block was not satisfactory (12 patients), those refusing the block (7 patients) or having allergies that may be related to the study drugs (8 patients) were excluded. The study was approved by the hospitals ethical committees and a written consent was obtained from each patient. Candidates were subjected to full history, physical examination and investigations to assess the degree of systemic impairment resulting from the coexisting morbidity. Patients’ demographic data, diagnosis, coexisting diseases and the proposed surgeries were documented in the patient data form. The risk assessment findings were discussed with the patients and surgeon and decision was
made to perform the procedure under an interpleural block with conscious sedation. A standard monitoring and intravenous cannula were secured before the procedure. The block was achieved by a unilateral interpleural block, supplemented by an inverted L-shaped infiltration of 10 ml of 0.25% bupivacaine, deposited in the ipsilateral subclavicular and parasternal region. To perform interpleural block, the patient was positioned laterally, with the operative side being upper most. Facing the patient's back and under complete aseptic technique a skin wheal of local anaesthetic (1ml of 2% lignocaine) was raised in either the 7th or 8th intercostals space at the posterior axillary line. A short beveled 21 gauge needle was selected and connected by a primed drip giving set to a bag of normal saline (situated at 20 cm above the injection site to avoid false positive loss of resistance). The needle was introduced perpendicular to the skin to touch the upper border of the 8th or 9th rib (thus avoiding the neuro-vascular bundle). The drip was then turned on (fluid will not drop in the drip chamber). The needle was then advanced gradually over the rib until there was a free flow of saline (indicating that the negative pressure space between the visceral and parietal pleurae was reached). The drip was then turned off and twenty-five milliliters of local anaesthetic (0.5% bupivacaine in this study) was injected and the patient was immediately rolled into supine position to allow for even distribution of local anaesthetic in the interpleural space. All patients received midazolam to achieve conscious sedation (0.1 mg/kg IV at the start of the procedure, then 0.02 mg/kg slowly titrated to a desired effect and no rescue drugs were used) and surgery was allowed 15 minutes following a successful block. Response to cold and pin prick at the area of surgery was assessed and those who didn't achieve a satisfactory block (12 patients) were excluded from the study and were converted to general anaesthesia. During surgery, the heart rate, mean arterial blood pressure and pain score (visual analogue scale) were monitored every 3 minutes (zero time at the start of surgery). All patients were followed postoperatively for the incidence of pain in the first 3 hours following surgery (using the visual analogue scale), the total duration of postoperative analgesia, incidence of pneumothorax (postoperative chest X-ray was done for all patients) and patient’s satisfaction with the procedure. Obtained data was documented in the patient data form. Collected data were analyzed using SPSS and were presented in tables and figures, with reference p-value of 0.05 as the level of significance. Descriptive statistics done for categorical variables were frequency and percentage, while the mean and standard deviation (STD) were used for numerical variables; chi-square (goodness of fit) was used to test categorical variables frequency.

**Results**

Interpleural block was performed for 200 patients planned for mastectomy. Histopathological diagnosis of the study population was as follows: carcinoma of the breast in 149 (74.5%) patients, cystsarcoma phylodes in 32 (16%) patients and giant fibroadenoma in 19 (9.5%) patients (Fig1).

**Fig 1: Histopathological diagnosis**

![Histopathological diagnosis](image)
Most patients were middle-aged (mean age of 54.3 (STD 12.5) years) and all were suffering from one or more coexisting medical diseases (Table 1).

### Table 1: Co-morbidities

<table>
<thead>
<tr>
<th>Co-morbidities</th>
<th>Frequency (Patients)</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Atrial fibrillation</td>
<td>9</td>
<td>4.5</td>
</tr>
<tr>
<td>Brain tumour</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Bronchial asthma</td>
<td>16</td>
<td>8.0</td>
</tr>
<tr>
<td>Cerebrovascular accident</td>
<td>8</td>
<td>4.0</td>
</tr>
<tr>
<td>Chronic bronchitis</td>
<td>10</td>
<td>5.0</td>
</tr>
<tr>
<td>Diabetes mellitus</td>
<td>39</td>
<td>19.5</td>
</tr>
<tr>
<td>Diabetes with renal impairment</td>
<td>6</td>
<td>3.0</td>
</tr>
<tr>
<td>End stage renal impairment</td>
<td>13</td>
<td>6.5</td>
</tr>
<tr>
<td>Hypertension</td>
<td>41</td>
<td>20.5</td>
</tr>
<tr>
<td>Hypertension with renal impairment</td>
<td>11</td>
<td>5.5</td>
</tr>
<tr>
<td>Hypertension&amp; Diabetes</td>
<td>20</td>
<td>10.0</td>
</tr>
<tr>
<td>Ischaemic heart disease</td>
<td>5</td>
<td>2.5</td>
</tr>
<tr>
<td>Moderately impaired liver function</td>
<td>15</td>
<td>7.5</td>
</tr>
<tr>
<td>Lung fibrosis</td>
<td>5</td>
<td>2.5</td>
</tr>
<tr>
<td>Total</td>
<td>200</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Mastectomy was done for 103 (51.5%) patients, mastectomy with axillary node dissection (axillary clearance (AC)) for 82 (41%) patients and wide local excision of the breast for 15 (7.5%) patients (Fig 2).

All surgeries took less than 3 hours. Interpleural block was supplemented in all patients with sedation, using midazolam. During surgery, the mean heart rate was 78.5 (STD6.3) beats/min, mean blood pressure was 82.7 (STD 7.0) mmHg and the pain score was 1 in 80 (40%) patients, 2 in 62 (31%) patients, 3 in 54 (27%) patients and 4 in only 4 (2%) patients (P-value 0.000) (Table 2 and Fig 3).

**Figure 3: Intraoperative mean pain score**

### Table 2: Intraoperative haemodynamic state and of postoperative analgesia

<table>
<thead>
<tr>
<th></th>
<th>Mean HR (beats/min)</th>
<th>Mean BP (mmHg)</th>
<th>Postoperative analgesia (hrs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>78.5686</td>
<td>82.7651</td>
<td>9.3897</td>
</tr>
<tr>
<td>STD</td>
<td>6.34025</td>
<td>7.09986</td>
<td>1.83671</td>
</tr>
</tbody>
</table>

With the use of interpleural block for mastectomy, neither postoperative pneumothorax nor pain in the first 3 hours was noted and the mean duration of post operative analgesia was 9.3 (STD 1.8) hours. All subjects of the study (100%) were fully satisfied with procedure as a safe alternative to general anaesthesia (Table 2 and 3).

### Table 3: Postoperative follow-up

<table>
<thead>
<tr>
<th></th>
<th>Pain in the first 3 hours</th>
<th>Postoperative Pneumothorax</th>
<th>Patient's satisfaction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>0%</td>
<td>0%</td>
<td>100%</td>
</tr>
<tr>
<td>No</td>
<td>100%</td>
<td>100%</td>
<td>0%</td>
</tr>
</tbody>
</table>
Discussion
Mastectomy is a painful surgical procedure, especially when axillary node dissection is performed. Patients scheduled for mastectomy are usually middle age to elderly, with a multitude of co-morbidities related to their age group, a situation that may either increases the risk if mastectomy is done under general anaesthesia or makes anaesthetic management more difficult. In this study, interpleural block, used as an anaesthetic technique for mastectomy, was applied for 200 patients, with co-morbidities to assess the efficiency of the technique in terms of quality and safety (Intraoperative haemodynamic stability, extent of intra and postoperative analgesia and the incidence of reported, technique related, complications).

The observations derived from this study showed that interpleural block is a good alternative to general anaesthesia for breast surgery in situations where selection of general anaesthesia is considered to carry a moderate to maximum risk to the patient. The mechanism of action of interpleural block is not clear, but these have been postulated:

1. The diffusion of the local anaesthetic from the pleural space through the parietal pleural and the inner most intercostal muscles, causing multiple intercostal unilateral nerve blocks.

2. A unilateral block of thoracic sympathetic chain and the splanchnic nerve is produced by drug traversing the parietal pleural para-spinally.

3. Diffusion of the local anaesthetic to the ipsilateral brachial plexus.

Patient positioning will determine where the local anaesthetic pools and where it traverses the parietal pleura and which nerves are affected. Positioning the patient in the lateral position following the block (blocked side up) will promote blockade of the sympathetic chain while a supine or lateral position (blocked side down) will promote blockade of the intercostals nerves. A Trendelenburg position will promote upper thoracic and cervical sympathetic blockade (producing Horner syndrome) and even, at times, blockade of inferior roots of the ipsilateral brachial plexus. In this study, a satisfactory surgical anaesthesia was obtained with conscious sedation, using midazolam, with little need for supplementary analgesia (Four patients whose pain score was 4 received 100µg of IV fentanyl which was quite satisfactory). Sedation with midazolam was always needed to reduce discomfort when axillary node dissection was recommended.

The technique provided a good haemodynamic stability (mean heart rate was 78.56 beats/min and the mean blood pressure was 82.76 mmHg) and prolonged postoperative analgesia. In this study, the mean duration of postoperative analgesia (the post operative moment at which pain relive, for the first time, was needed) following interpleural block was 9.38 hours. The volume and concentration of local anaesthetic used in the study does not reach a toxic level. Seltzer et al reported that, following 30 ml of 0.5% bupivacaine injected interpleurally, plasma levels of 2.07(SD = 0.58) µg/ml were achieved. Jorfeldt et al reported the toxic level of bupivacaine to be above 4.0µg/ml. With successful block, no local anaesthetic toxicity was encountered and no patient was intubated or converted to general anaesthesia. In this study, using a closed system to identify the interpleural space may have a great influence on the reduced incidence of pneumothorax (with a reported incidence of less than 5%) to a negligible value (0.00%). Laceration of neurovascular bundle is another reported complication, which was not noticed in this study, a complication that can be avoided by meticulous technique. The combined technique was associated with significantly reduced perioperative opiate requirement with better emergence from anesthesia, fewer side effects, a prolonged pain-free period, and overall better quality of
postoperative recovery\(^{(16)}\). Although our study have extended from 1999 to 2011 aiming to collect an acceptable amount of data, authors of a case report, published in 2005, mentioned that they can find no other reports of an interpleural block being used as the sole anaesthetic for mastectomy\(^{(17)}\).

In conclusion in this study, interpleural technique for mastectomy using 25 ml of 5% bupivacaine supplemented by an inverted L-shaped infiltration of bupivacaine, deposited in the ipsilateral subclavicular and parasternal region, with midazolam for conscious sedation provided haemodynamic stability and a mean postoperative analgesic duration of 9.38 hours. With meticulous technique, the incidence of technique related complications were negligible.

A controlled randomised group of patients undergoing mastectomy under general anaesthesia with more traditional pain management (opioids or paravertebral blockade) would strengthen the findings derived from this study.

References
8. Stromskag KE, Reistad F, Holmquist ELOL. Intrapleural administration of 0.25%, 0.37%, and 0.5% bupivacaine with epinephrine after cholecystectomy. Anesth Analg 198;67:420.