Original Article

Effectiveness of Segmental Thoracic Spinal Anaesthesia in Breast Surgery: An Observational Study

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ABSTRACT:

Background: *General anaesthesia is usually performed for breast surgery but the risks and complications of general anaesthesia outweigh its benefits. For this, segmental thoracic spinal anesthesia might be an alternative to general anesthesia.*

Objectives: *The objective of this study was to evaluate the effectiveness segmental thoracic spinal anaesthesia in breast surgery.*

Methods: *This prospective observational study was conducted at surgery operation theatre in the Shaheed Suhrawardy Medical College and Hospital, Dhaka, Bangladesh from January 2023 to December 2023. Patients of ASA (American Society of Anesthesiologist) class I and II, ageing above 18 years, and BMI < 35 kg/m2 scheduled for breast surgery (modified radical mastectomy for carcinoma breast, lumpectomy for breast lump/gynaecomastia, and wide local excision for phylloids tumor) were included in this study. Segmental thoracic spinal anaesthesia was performed at T5-T6 space with injection 0.5% hyperbaric bupivacaine 1 ml (5mg) and fentanyl 0.5 ml (25 microgram). Perioperative hemodynamic changes, unwanted effects, time of first rescue analgesic, total opioid consumption in first 24 h, patient and surgeon satisfaction score were recorded in a data sheet.*

Results: *Sixty patients were eligible for the study but 55 patients completed the study successfully. Modified radical mastectomy, Lumpectomy and Wide local excision were done in 42 (76%), 8 (15%) and 5 (9%) patients, respectively. The mean age of the patients was 50.78±8.98 years. There were no significant changes in haemodynamic parameters during the intraoperative period. The frequency of adverse effects were minimal. Mean time for 1st dose of analgesic was 5.8±1.8 hours and total opioid consumption was 76.77±15.7 mg in first 24 hours. Both patient (91%) and surgeon (95%) were highly satisfied with this technique.*

Conclusions: *Segmental thoracic spinal anaesthesia provides better satisfaction and fewer complications in patients undergoing breast surgery. This regional anaesthesia technique can be used effectively for breast surgeries.*

Key Words:
Thoracic, Segmental, Anaesthesia, Mastectomy, Lumpectomy

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Introduction

General anesthesia is currently the standard technique used for breast surgery[1,2]. However it has various disadvantages which include, but not limited to, inadequate pain control due to a lack of residual analgesia, higher stress response, higher incidence of nausea and vomiting, and increasing the length of hospitalization[3,4,5]. The side-effects and complications of general anesthesia preclude ambulatory surgery for most patients undergoing breast surgery[5]. Regional anaesthesia can attenuate surgical stress response and provide better analgesia with reduction in postoperative opioid consumption[2].

Several regional anaesthesia techniques has been used in breast surgeries with promising results. All these have several advantages and limitations. Paravertebral block is associated with multiple injections, risk of pneumothorax, epidural or intrathecal spread of local anaesthestic solution[6]. Thoracic epidural require expertisation and technically difficult and also associated with hypotension, urinary retention, PDPH and rarely epidural hematoma. Intrapleural block requires larger volumes of local anaesthetic to get anaesthesia but risk of pneumothorax, risk of retention of secretions, respiratory muscle dysfunction. Intercostal nerve blocks requires multiple injections and also associated with risk of incomplete block and greater risk of pneumothorax. PEC blocks associated with risk of intra vascular injection, pleural injury and risk of brachial plexus block. However, regional anaesthesia including central neuraxial block proved that it eliminate the need for airway manipulation and was associated with 50% Reduction in PPC (post-operative pulmonary complications)[7,8,9].

There is currently renewed attention to thoracic segmental spinal anaesthesia for several common surgeries[10,11]. It has been used for patients undergoing surgery with major medical problems and demonstrated as a safe and effective method for various surgeries including breast and abdominal cancer surgery[1-3]. However, there is significant debate regarding this practice around the world. The main concerns are fear of iatrogenic injury to the spinal cord, cephalad spread of local anaesthetic causing a complete block, and haemodynamic instability owing to blockade of cardio accelerator sympathetic fibres[12].

In recent studies, it was found that the space between the duramater and spinal cord in thoracic region measured with MRI was 5.19 mm at T2, 7.75 mm at T5, and 5.88 mm at T10 and also that the spinal cord and the cauda equina are touching the duramater posteriorly in the lumbar region and anteriorly in the thoracic region[13]. The angle of insertion of the spinal needle at T5 and T6 (almost 50°) further elongates the distance from the tip to the posterior surface of the cord[13].

In comparison to general anaesthesia or lumbar subarachnoid block, thoracic segmental spinal anaesthesia has several advantages. Segmental spinal anesthesia involves the blockade of specific segments at the thoracic level. Furthermore, the anesthetic dose requirement during the procedure is lower, which minimally affects cardiovascular stability[14]. This technique can be valuable for providing greater hemodynamic stability, better analgesia, with higher patient satisfaction, lesser incidence of nausea, vomiting and reduced postanaesthesia care stay[3-5,12]. This study was planned to evaluate the effectiveness of segmental thoracic spinal anaesthesia in different breast surgeries.

Materials and methods

The present study was conducted at Shaheed Suhrawardy Medical College and Hospital, Dhaka, Bangladesh from January 2023 to December 2023. The objectives of the study was explained to the patients in easily understandable local language and then informed written consent was obtained from them who fulfill the inclusion and exclusion criteria. Patients aging 18-65 years of both sex, ASA class I or II undergoing elective breast surgery (modified radical mastectomy for carcinoma breast, lumpectomy for breast lump/gynaecomastia, and wide local excision for phylloids tumor) and BMI < 35 Kg/m2 were included in this study. The exclusion criteria were as follows: Pregnant patient; patient with bleeding disorder and cardiovascular disease; presence of infection in the site of block; known allergy to local anesthetic; patients with abnormalities of the spine (kyphosis or scoliosis), and in cases with a change in surgical plan or more than two attempts for performing regional anaesthesia procedure.

After arrival in the operating room, an 18G IV cannula was inserted in a peripheral vein and infusion of balanced crystalloid solution was started. Patient's baseline vital parameters were recorded using pulse oxymeter, ECG and non-invasive blood pressure (NIBP). Patients were placed in sitting position and T5-T6 intervertebral space was identified. Under full aseptic precautions and skin

infiltration with (1% lignocaine) local anesthetics, a quincke babcock spinal needle 25G was placed in mid-line/paramedian approach. Correct placement was confirmed by free flow of clear CSF. Then, 1 ml of 0.5% hyperbaric bupivacaine (5 mg) mixed with 0.5 ml of fentany[l] (25 microgram) was injected and patients were placed in supine position immediately.

After that, clinical examination was done to assess the sensory and motor block along with heart rate, blood pressure, and SpO2. The vital parameters were recorded in regular interval until the end of surgery. The level of sensory block was assessed by pinprick, and motor block was assessed by Epidural scoring scale for arm movements (ESSAM) score for upper limb [hand grip (T1/C8), wrist flexion (C8/C7), and elbow flexion (C6/C5)]15 and modified Bromage scale for lower limb (0 = able to lift extended legs; 1 = just able to flex knees, full ankle movement; 2 = no knee movement, some ankle movement; 3 = complete paralysis)[3].

Once the block was considered adequate (minimum block T2–T8), and patients were sedated by 1 mg midazolam intravenously. All patients were given oxygen supplementation at 5 L/min with facemask. Adverse effects were treated accordingly e.g hypotension with ephedrine, bradycardia with atropine as i.v. boluses as required, and nausea or vomiting was treated with Ondansetron 4 mg. After surgery, patients were transferred to the recovery room and from there to ward after complete regression of the block. The objectives of this study were intraoperative hemodynamic changes, perioperative complications, time of first rescue analgesic, total opioid consumption in first 24 h, patient and surgeon satisfaction score.

Collected data were analyzed using SPSS (Statistical Package for Social Sciences) for Windows, version23.0. Qualitative variables were expressed as frequency and percentages. Quantitative data were expressed in mean ± standard deviation. The results were presented using tables and figures.

Results:

A total of 60 patients were eligible for the study out of which five patients were removed from the study (two of them due to a change in the surgical plan and three of them required general anesthesia). Therefore, 55 patients enrolled and completed the study successfully. The mean age of the patients was 50.78±8.98 years. The mean body mass index was 26.67±0.57 kg/m2. The demographic characteristics of all patients are demonstrated in Table 1.

Table 1: Distribution of the patients by demographic characteristics

Characteristics	Value (n-=55)	
Age in years	50.78 ± 8.98	
Gender	Male	3 (5.5%)
	Female	52 (94.5%)
BMI (kg/meter^2)		26.67 ± 0.57
ASA	Class I	33 (60%)
	Class II	22 (40%)
Types of surgery	MRM	42 (76%)
	Lumpectomy	8 (15%)
	Wide local excision	5 (9%)

Values were expressed as Mean ± SD and absolute number (within parenthesis percentage over column total)

There had been no significant changes in mean heart rate except at the end of the 6th hours during the postoperative period. It is shown in Figure 1.

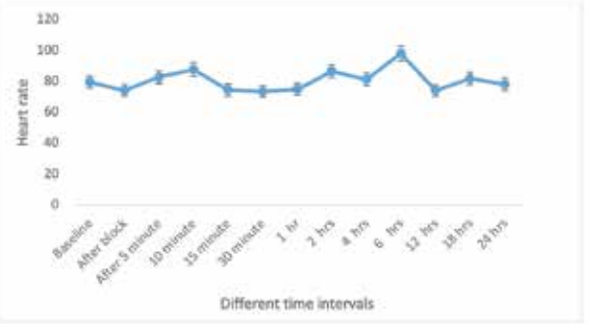

Figure 1: Changes of heart rate in different time intervals

Figure 2 depicted the perioperative mean arterial pressure and there were no significant changes except in the 6th hours of postoperative period.

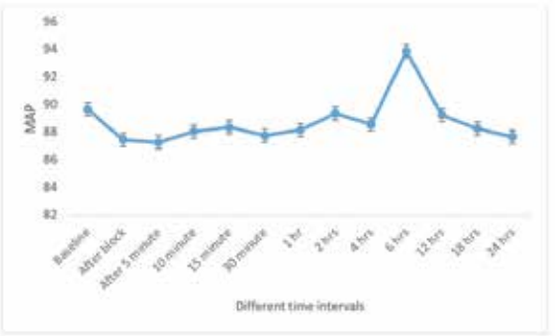

Figure 2: Changes of MAP (mean arterial pressure) in different time intervals

Only 5 (9%) patients developed hypotension and 4 (7%) developed bradycardia. Seven (13%) participants complained of nausea/vomiting. One patient experienced paraesthesia during needle insertion and 1 (2%) patient complained of mild itching. Two (4%) had mild respiratory distress. Table 2 showed the frequency of unwanted effects.

Table 2: Frequency of unwanted effects

Unwanted Effects	Value (n=55)
Nausea/Vomiting	7 (13%)
Hypotension	5 (9%)
Bradycardia	4 (7%)
Itching	1 (2%)
Paraesthesia during needle insertion	1 (2%)
Respiratory discomfort	2 (4%)

Values were expressed in absolute number (within parenthesis percentage over column total)

Most of the surgeons (95%) were satisfied with this anesthesia technique. The majority of the patients (91%) were very satisfied with the procedure and were comfortable during surgery (Table 3).

Table 3: Satisfaction of both patient and surgeon

Satisfaction level	Patient (n=55)	Surgeon (n=55)
Very satisfied	50 (91%)	52 (95%)
Average satisfaction	5 (9%)	3 (5%)
Dissatified	0 (0%)	0 (0%)

Values were expressed in absolute number (within parenthesis percentage over column total)

The time of 1st dose of analgesic demand and total opioid consumption of the patients were presented in Figure 3. The mean time for 1st dose of analgesic was 5.8±1.8 hours and total opioid consumption was 76.77±15.7 mg in first 24 hours.

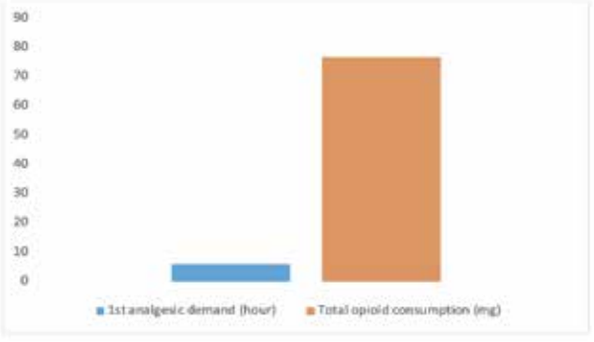

Figure 3: Time of 1st dose of analgesic demand and total opioid consumption

Discussion

Thoracic spinal anaesthesia was first performed by Thomas Jonnesco in early 190816,[17]. Subsequently anaesthetists around the world have gained interest in this unconventional technique. Kirschner described the technique for segmental spinal anaesthesia in 193217. In 1934 and 1935, Etherington-Wilson narrated some explanations for the block of spinal roots intratechally[18]. However, segmental spinal anesthesia in the thoracic level remains the most controversial technique amongst anesthesiologists due to the fear of spinal cord injury. Paliwal et al.[2] Chandra et al.[14] and Elakany[23] have provided some evidence that segmental spinal anaesthesia can be used for breast surgeries. This study reveals that thoracic spinal anaesthesia can be used to provide a segmental block sufficient enough to perform breast surgeries in ASA I and II patients.

Issues related to thoracic spinal anaesthesia includes neurological damage because of a puncture at a higher level, ventilation impairment due to the involvement of the diaphragm, and hemodynamic alterations due to the higher block. Many studies in the literature that showed that the accidental puncture of the dura, even at high thoracic space, does not lead to any neurological damage[14]. Lee et al. measured medial sagittal slices of the thoracic and lumbar region with the help of magnetic resonance imaging in 19 patients. The maximum statistical distance between the posterior dura and cord was found to be more at T6 with 9.5±1.8 mm than at T12 level with 3.7±1.2 mm. They found a greater space at the mid-thoracic level than the lumbar region, sufficient enough for intrathecal drugs[13]. Imbelloni et al. investigated on magnetic resonance imaging of the thoracic spine and concluded that the maximum distance between the dura mater and the spinal cord is usually at the level of T5-T6 intervertebral space[12]. In this study, T5-T6 space was chosen because it has a maximum distance of 7.75 mm in comparison to other spaces.

There is the possibility of high spinal from cephalad spread of local anesthetic and effect on ventilatory mechanism. In our study, ventilatory parameters were well preserved and peripheral oxygen saturation (SpO2) was maintained around 97-99%. The diaphragm which is the main inspiratory muscle is unaffected as it is innervated from the cervical level and the process of expiration is normally a passive phenomenon but forceful expiration

and coughing may be affected under this technique[19]. Large dose of local anesthetics can produce disastrous effects. To minimize the risk, we have used lower volume of local anaesthetics (1.5 ml).

Another important concern of thoracic spinal anaesthesia is the hemodynamic derangement. In the present study, haemodynamic changes were minimal throughout the intraoperative period. It may be due to the fact that all the patients were belong to ASA I and II, and adequately preloaded. Another possible mechanism is the presence of low CSF volume and thinner nerve route at the thoracic level and sparing of the lower extremities led to less vasodilatation in comparison to the block at the lumbar leve[12]. Fewer hemodynamic alterations were also reported in the other studies[2,13,14,23].

In many published literature, plain bupivacaine was used for thoracic segmental block[1,2,3,10]. Madishetti successfully conducted segmental thoracic anesthesia to a patient with bronchiectasis with 1 ml 0.5% Bupivacaine heavy and 20 mcg Fentanyl in T5-T6 Space using the Quincke Babcock needle[20]. Heisnam et al. also performed segmental spinal anaesthesia with heavy bupivacaine at T10-T11 interspace for laparoscopic cholecystectomy[21]. In our study, we have used 1 ml 0.5% Bupivacaine heavy and 0.5 ml (25 mcg) Fentanyl.

In the present study, the frequency of all side-effects were low and easily managed. Minimal hemodynamic changes were also reported by Gupta et al.[22] during their study about thoracic epidural anaesthesia for elective laparoscopic cholecystectomy. van Zundert et al.3 and Heisnam et al.[21] also observed minimal side effects in segmental thoracic spinal anaesthesia for laparoscopic cholecystectomy. Paliwal et al.[2] and Chandra et al.[14] also reported fewer unwanted effects in thoracic segmental block for breast surgery. Paresthesia is not desired but can occur with any technique of spinal anaesthesia. Imbelloni et al. showed the incidence of paresthesia in a study with 300 patients subjected to thoracic spinal puncture at T10-11 was 4.67% in the cut needle and 8.67% in the pencil point needle group[24]. Paraesthesia was also reported by other investigators[2,3,14,23]. In this study, one patient (2%) experienced paresthesia during insertion of the spinal needle, symptoms promptly responded to needle withdrawal and did not lead to any postoperative sequelae.

Thoracic segmental spinal anaesthesia technique has been studied for patient satisfaction and results were expressed in percentage[1,2,14,23]. In our study, we have assessed both patient and surgeon satisfaction which demonstrated higher satisfaction related to this technique due to motor control of lower limbs, early mobilization, good analgesia, and low incidence of PONV. Paliwal et al.[2], Chandra et al.[14] and Elakany[23] also found better patient and surgeon satisfaction score in breast surgery under thoracic spinal anaesthesia.

Adequate pain control is very important for better postoperative period and early hospital discharge[23]. Paliwal et al.[2], Chandra et al.[14] and Elakany[23] have found that the length of stay in the recovery room and in the hospital was less due to less postoperative pain. We have also found that the duration of analgesia was longer. This is attributed to the residual analgesic effect of local anesthetic and fentanyl in subarachnoid space.

Limitation of the study

The study was conducted in a single center and was accomplished on a small group of patients, so that the results may not reflect the entire population of the country.

Conclusion

This study demonstrates that breast surgery can be done successfully and effectively under segmental thoracic spinal anaesthesia. It provides better intraoperative conditions which increase the satisfaction level of surgeons and patients. This technique can be an alternative to general anaesthesia in patients undergoing MRM and other localized breast surgeries.

Conflict of interest: The authors declare that they have no competing interests.

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