Original Article

Segmental Thoracic Spinal Anaesthesia for Modified Radical Mastectomy- A Novel use of Spinal Anaesthesia

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Abstract:
Background: Modified radical mastectomy operations are routinely performed under general anesthesia. A variety of local and regional techniques have been described for breast surgery with the goal of reducing the complications associated with general anaesthesia. **Objective:** To assess the feasibility of segmental thoracic spinal anaesthesia as a sole anesthetic technique for modified radical mastectomy operation. **Methods:** This study was conducted on 32 cooperative female patients of age group 35-70 year. T5-T6 space was used for the block to be performed. Once the free flow of CSF was confirmed, 1.5 ml of isobaric bupivacaine 0.5% in addition to 20 µg fentanyl were injected. Demographic characteristics of the study population, any coexisting disease, anaesthetic outcome, duration of surgery, degree of intraoperative analgesia, incidence of complications related to segmental thoracic spinal anaesthesia were observed and analysed. **Result:** Segmental spinal anesthesia was successful in all patients. Out of 32 patients, 29 blocks (90%) were performed using a single attempt of needle insertion and three patients (10%) required a second attempt for introduction of spinal needle into the subarachnoid space. No paresthesia during introduction of the spinal needle or injection of the local anesthetic occurred in any patient. Hypotension was observed in 4 patients (12%) and were managed by injection ephedrine. Two of the four patients complained of nausea during the event of hypotension that resolved after the correction of hypotension with no need for an antiemetic. Bradycardia was manifested in 1 (3 %) of the patients and was treated with a single dose of Inj. Atropine 0.6 mg IV. Two patients complained of respiratory discomfort, but they were relieved with reassurance only. 1 (3 %) patient required intraoperative analgesics and no patient required conversion to general anesthesia. No patients developed postdural puncture headache, postoperative nausea or vomiting, postoperative urine retention. The majority of the patients (94%) were very satisfied with the procedure, were comfortable during surgery and had a quick postoperative recovery. **Conclusion:** Segmental thoracic spinal anaesthesia is a safe anesthetic technique for modified radical mastectomy operation.

Keywords: Segmental thoracic spinal anaesthesia, modified radical mastectomy.

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Introduction:
Breast cancer is the most common cancer among women, representing about 25% of all cancers in women. In resource-poor countries 1 in 28 women will develop breast cancer in her lifetime and for every 2 women diagnosed with breast cancer 1 dies of cancer.[1] Breast cancer is treated by multimodal approach including surgery, radiotherapy, chemotherapy, hormone therapy and targeted therapy. Most commonly performed operation is modified radical mastectomy which includes mastectomy and axillary clearance to remove lymph nodes.[2] General anesthesia is currently the standard technique used for surgical treatment of breast cancer which includes intubation and ventilation of the patients. The drawbacks of general anesthesia include, but not limited to, inadequate pain control due to a lack of residual analgesia, high incidence of nausea and vomiting, and increasing the length of hospitalization.[3]

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The incidence of breast cancer increases with age. With increasing age, the possibility of coexisting major medical problems increases, which makes anesthetic management challenging. Hence, regional anesthesia is a preferable option for breast cancer surgery. Anesthesia management for breast cancer surgery has evolved over the past few decades, and the focus is now more on reducing stress, pain management, and early recovery. Regional anesthesia techniques can attenuate surgical stress response and provide better analgesia with reduction in postoperative opioid consumption. Neuraxial anesthesia is a reliable technique for surgeries involving the lower half of the body. It is performed by blocking the spinal cord transmission through the administration of local anesthetics via the intrathecal route. Regional anesthesia techniques are considered superior in maintaining respiratory functions, avoiding airway manipulations, and limiting the complications of laryngoscopy and endotracheal intubation.

Different regional techniques have been attempted during breast surgery, including thoracic epidural and thoracic paravertebral block.[4] Segmental Thoracic Spinal Anaesthesia is an alternative method to general anesthesia for patients undergoing breast surgery, because it provides a safe anesthesia with balanced hemodynamic response with unilateral somatic and sympathetic blockade, allows postoperative analgesia lowering narcotic usage, minimal nausea and vomiting rate, early discharge and low cost.

Few studies have assessed the efficacy of segmental thoracic spinal anesthesia in laparoscopic cholecystectomy and breast cancer surgery with axillary lymph node clearance concluding that the technique could be a potential alternative to GA.[5] Encouraged by the results of these studies, we had decided to explore the feasibility, safety and outcome of using segmental thoracic spinal anesthesia in the Bangladeshi population as the sole regional anesthetic technique in patients undergoing modified radical mastectomy (MRM).

Methods:

This prospective observational study was conducted between March 2023 and April 2024, in the Department of surgery and Department of Anesthesia, Analgesia and Critical Care, Comilla Medical College Hospital after obtaining approval from institutional ethical committee and informed written consent from patients. Thirty two female patients aged between 35 and 70 years, belonging to American Society of Anesthesiologist (ASA) physical status I and II and scheduled for modified radical mastectomy were enrolled for the study. Exclusion were age above 70 years, BMI more than 35 kg/m2, conditions contraindicating spinal anesthesia, spinal deformities, allergy to local anesthetic drugs, patient refusal. Preoperatively patients were evaluated by detailed history, complete clinical examination, and necessary investigations. Patients were counseled regarding the need for surgery, the proposed anesthesia plan. They were informed about thoracic spinal anesthesia in detail, its merits and side effects and were reassured that any pain, discomfort, or anxiety would be relieved with drugs. Moreover, they were also informed that in case of failure of the anesthesia plan, general anesthesia would be administered.

Anaesthetic technique:

All patients were kept overnight fasting. An 18F cannula was inserted in the contralateral upper limb for administration of iv fluid and drugs and 1000 ml Hartmann's solution was started. Before surgery, routine monitor devices were installed, to monitor blood pressure, and oxygen saturation. Patients received intravenously1 μg.kg−1 of fentanyl before the blockade. All patients were positioned in the sitting position with head flexed.

The exact level for the block was determined by the landmark method which includes C7 prominent spine, lower level of scapula at T7, and 12th rib corresponding to L1 vertebrae. After cleansing the skin with antiseptic preparation, the skin of the puncture site was infiltrated with 2% lidocaine. The puncture was performed at the T5-T6 or T6-T7 levels with a 25G needle with a 45° angulation of the needle. After piercing the Ligamentum Flavum, the needle was advanced very slowly and CSF (Cerebrospinal fluid) flow was checked. Once the free flow of CSF was confirmed, 1.5 ml of isobaric bupivacaine 0.5% in addition to 20 μg fentanyl were injected.

The patients were placed in a supine position immediately after the block and supplemental oxygen was started with a mask at the rate of 3 liters per minute. After testing the quality of anesthesia (adequate sensory block to pin prick from the lower border of the clavicle to the inferior costal margin), the surgery was initiated. If the sensory block was inadequate after 15 minutes, would be administered.

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Hemodynamic parameters, oxygen saturation, and respiratory rate were recorded every 15 minutes till the end of surgery. Episodes of bradycardia and hypotension were monitored. Hypotension is defined as systolic blood pressure <90 mmHg, or diastole blood pressure <60 mmHg, treated with ephedrine 10 mg intravenously. Bradycardia is defined as a heart rate less than 60 beats/ minute, treated with atropine 0.5 mg intravenously.

In MRM, the entire breast tissue and the ipsilateral axillary contents (fatty tissue and lymph nodes) are removed, while the pectoral muscles are spared.

Evaluation tools used were:

1. Time to achieve adequate block
2. Hemodynamic variation
3. Intraoperative and postoperative complications such as postoperative nausea and vomiting (PONV), urine retention, headache and others.
4. Need for conversion to general anesthesia.
5. Overall experience of anesthesiologist regarding ease of anesthesia administration, which was assessed using the rating scale ranging from Easy to manage=5, comfortable=4, not so comfortable=3, somewhat difficult=2, very difficult=1.
6. Surgical satisfaction was evaluated by surgeon and recorded according to a 5-point score: Muscle relaxation, bleeding control, cautery fasciculation, ease of surgical closure, total surgical time taken linked to Likert scale (5: Excellent, 4: Good, 3: Satisfactory, 2: Poor, 1: Very poor).
7. Patient satisfaction score was calculated as mean value of 3 variables:
   a. Pain control was rated on scale as 5=Excellent, 4=Good 3=Satisfactory 2=Adequate, 1=Poor control.
   b. Nausea and Vomiting was rated on an ordinal scale as: 5=No PONV, 4=Some uneasiness but no nausea, 3=Only Nausea no vomiting, Nausea which require treatment 2=or Severe PONV=1.
   c. Headache: No headache 5, some discomfort 4, heaviness overhead 3, Intermittent headache 2 and severe headache=1.

In postoperative period, patients were followed up at 30 minutes, 4 hours, 24 hours, 48 hours and 72 hours after operation.

Result:

Thirty two female patients undergoing modified radical mastectomy were included in this study. Patient characteristics (age, weight, height, and BMI) are shown in Table 1.

Table-I: Demographic characteristics (n=32)

Characteristics	Minimum -Maximum
Age (years)	38-69
Weight (kg)	48-71
Height (cm)	150-168
BMI (kg/m2)	20.55 -26.38 23.91±0.37
ASA status ASA I ASA II	 13 19

Table-II: Presence of coexisting diseases

Diseases	No of patients
IHD	1
Hypertension	3
Diabetes mel litus	4
Asthma	1

Table-III: Anesthetic technique and anesthetic outcome

Anesthetic Technique	Outcome
Number of needle insertion attempts 1 2	 29 (90%) 3 (10%)
Paresthesia from spinal needle	0 (0%)
Paresthesia during injection	0 (0%)
Sensory block Adequate block level achieved (from T2 to T6)	32 (100%)
Time to achieve adequate block level At 10 min At 15 min	 19 (60%) 13 (40%)
Duration of surgery (min)	90 (80-100)
Time to full block regression (min)	157 (140–190)
Need for intraoperative analgesia	01 (3%)
Need for general anesthesia	0 (0%)

All blocks were performed at T5–T6 intervertebral level and segmental spinal anesthesia was successful in all patients. Out of 32 patients, 29 blocks (90%) were performed using a single attempt of needle insertion and three patients (10%) required a second attempt for introduction of spinal needle into the subarachnoid

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space. No paresthesia during introduction of the spinal needle or injection of the local anesthetic occurred in any patient. An adequate sensory level was achieved in all patients within 15 min after injection of local anesthetic. Sensory levels recorded at 15 min and before commencement of surgery were: upper level at T1 (T1–T2) and lower level at T11 (T11–T12). There was no significant lower limb motor block in any of the patients.

Table-IV: Degree of intraoperative analgesia

Degree of pain	No of patients
No pain	29
Discomfort	2
Mild pain	0
Unbearable pain	0

Table-V: Intraoperative and postoperative complications

Complications		No of patients
Intraoperative	Hypotension	4 (12 %)
	Bradycardia	1 (3 %)
	Respiratory discomfort	2 (6 %)
	O2 saturation <90%	0
	Nausea	2 (6 %)
	Vomiting	0
Postoperative	Nausea and vomiting	0
	Urine retention	0
	Postdural puncture headacl	0

Hypotension was observed in 4 patients (12%) and were managed by injection ephedrine. All four patients showed an adequate response to the vasopressor (ephedrine 5 mg intravenous single dose) and maintained hemodynamic stability after that. Two of the four patients complained of nausea during the event of hypotension that resolved after the correction of hypotension with no need for an antiemetic.

Bradycardia was manifested in 1 (3 %) of the patients and was treated with a single dose of Inj. Atropine 0.6 mg IV. Arterial oxygen saturation was maintained above 97% with supplemental oxygen through nasal prong at 3 L/min. Two patients complained of respiratory discomfort, but they were relieved with reassurance only. 1(3%) patients required intraoperative analgesics and no patient required conversion to general anesthesia. No patients developed postdural puncture headache, postoperative nausea or vomiting, postoperativeurine retention, or problems with restoring activity in the postoperative period.

Table-VI: Satisfaction of patient and surgeon

	Patient	Surgeon
Totally satisfied	30 (94%)	32 cases
Average satisfaction	2 (6%)	0
Not satisfied	0	0

The majority of patients (94%) were very satisfied with the procedure, were comfortable during surgery and had a quick postoperative recovery. 2 (6%) patients reported average satisfaction, particularly, the patients who experienced nausea, respiratory discomfort during the intraoperative period.

Discussion:

Modified radical mastectomy (MRM) is usually performed under general anaesthesia which is associated with incidence of nausea and vomiting, increased opioid requirement, tracheal intubation which may lead to postoperative pulmonary complications.[6] Modern anesthesia techniques focus toward enhanced recovery after surgery (ERAS) protocols which has proven to shortened hospital stays and reduced use of analgesic requirements after surgical procedure[7]. Regional anaesthesia techniques offers these advantages by attenuation of the surgical stress response, provides excellent postoperative analgesia, reduction in PONV and earlier mobilisation.

While performing thoracic segmental spinal anesthesia for MRM, main concerns include the fear of spinal cord injury and neurological damage because of a puncture at a higher level, ventilation impairment due to the involvement of the diaphragm by cephalad spread of local anesthesia causing high or total block; and hemodynamic or respiratory compromise due to block of cardio accelerator fibers or intercostal nerves, satisfaction of surgeon and patient.8 Regarding the first concern, we rely on the fact that the posterior subarachnoid space is wider in the middle thoracic region than the upper and lower thoracic regions. A study where in 50 patients underwent MRI of the thoracic spine and found that the posterior dural–spinal cord distance was significantly greater at the mid-thoracic region (T5 = 5.8 ± 0.8 mm) compared with the upper (T2 = 3.9 ± 0.8 mm) and lower thoracic levels (T10 = 4.1 ± 1.0 mm).[9]

In our study, no patient suffered neurological complications. Paresthesia can occur with any technique of spinal anesthesia, but are of potentially greater significance when the needle is inserted above

the termination of the spinal cord. It was noticed that the spinal cord lies anteriorly in the thoracic region and posteriorly in the lumbar region, this space gets more enlarged in the sitting position.[10] Therefore, the sitting position was chosen for the administration of intrathecal block in the present study.

The second concern is the cephalad spread of local anesthesia in subarachnoid space leading to high or complete spinal block which is defined as a block above the level required for surgical anesthesia[11]. To avoid such problem we limited our selection of patients to ASA physical status I and II, aged below 70 years, patients with a BMI less than 35 kg/m2 to minimize the sequelae of a high spinal block or any hemodynamic or respiratory compromise, which may be worse in the presence of comorbidity or any limited functional capacity. None of our patients in this study showed any cranial nerve symptoms.

The last concern is about hemodynamic or respiratory compromise. Hypotension is a well-known adverse event of spinal anesthesia. However, it was quickly managed and did not significantly affect the procedure. Hypotension happens due to sympathetic block. The incidence of hypotension is lower in segmental thoracic spinal anesthesia (10%) compared to conventional lumbar spinal (41-59%).[12] In this study 4(12%) patients developed hypotension during operation and were managed by iv ephedrine.

Sensory innervation to the breast is derived from branches of the intercostal nerves T3-T5. Initial feasibility of segmental spinal anesthesia in laparoscopic cholecystectomy was shown in a study among 20 patients where upper sensory block level obtained ay T2–T4 using T10 level for performing the block13. We chose T5 level to perform the block on the basis of the anatomical studies stated above, and also because this level was nearer to the required level to be blocked (T2–T6) to perform breast surgery. Our sensory block range was limited to the thoracic region (T1–T12). Intraoperatively quality of anesthesia was adequate in all patients and there was no conversion to GA. No respiratory complications like affective dyspnea, hypopnea, or hypoxia (SpO2 <94%) were noted. This can be explained by the fact that the main inspiratory muscle is the diaphragm, which is innervated by the phrenic nerve (C3–C6), which is unaffected and expiration occurs passively. Similar results were obtained in a case report, where a patient with COPD with severe emphysema on oxygen therapy underwent cholecystectomy under the thoracic segmental spinal anaesthesia technique, with a minute dose of local anesthetic, without any respiratory complications.[5]

PONV is one of the most troublesome complications associated with breast surgery done under general anaesthesia and can prolong recovery. Regional anesthesia has a lower incidence of PONV, as demonstrated in several studies[6]. In our study, the incidence of PONV was only 6%, which was significantly lower. Adequate pain control is very important in breast cancer surgery. In our study, the pain assessed throughout any time in post-operative period was significantly lesser which was attributed to the residual sensory block of local anesthetic and fentanyl in subarachnoid space; which is comparable to a previous study.[12]

Limitations:

The main limitations to this study are the small number of patients included as well as the absence of comparison with other anesthetic techniques for this type of surgery, whether general or regional. Further studies with larger sample sizes are required to detect any potential disadvantages or complications associated with this anesthetic technique, especially in patients with concurrent diseases. The comparison of this segmental spinal anesthesia technique with other regional blocks, such as thoracic epidural and thoracic paravertebral blocks, and with general anesthesia for breast surgery patients should also be looked at.

Conclusion:

In segmental thoracic spinal anaesthesia, dose of local anesthetic agent required to block selected spinal segments is exceedingly low when given at specific site and it ensures effect of drug only on selected section of the spinal cord thus causing less fluctuations in hemodynamic parameters, good quality of analgesia and muscle relaxation without obtundation of central reflexes and other neurological complications, lower incidence of nausea and vomiting. Patients can move their lower limbs and take control over micturition, so no need of urinary catheter. All these factors are associated with early recovery and high patient satisfaction rate.

References:

1. O'Connell, P. Ronan, McCaskie, A. W., Sayers, Robert D. Bailey & Love's short practice of surgery, 28th edition. CRC Press 6000 Broken Sound Parkway NW: CRC Press, Taylor & Francis Group, 2023. 930p.

DOI:https://doi.org/10.3329/jcomcta.v29i1.81463

2. Belzarena SD. Comparative Study between thoracic epidural block and general anesthesia for oncologic mastectomy. Rev Bras Anestesiol 2008;58:561-8.

3. Oddby-Muhrbeck E, Jakobsson J, Andersson L, Askergren J. Postoperative nausea and vomiting. A comparison between intravenous and inhalation anaesthesia in breast surgery. Acta Anaesthesiol Scand 1994;38:52-6.

4. Greengrass R, O'Brien FO, Lyerly K, Hardman D, Gleason D, D'Ercole F, Steele S. Paravertebral block for breast cancer surgery. Can J Anaesth 1996; 43:858–861.

5. Van Zundert AA, Stultiens G, Jakimowicz JJ, van den Borne BE, van der Ham WG, Wild smith JA. Segmental spinal anaesthesia for cholecystectomy in a patient with severe lung disease. Br J Anaesth 2006;96:464–6.

6. Borgeat A, Ekatodramis G, Schenker C. Postoperative nausea and vomiting in regional anaesthesia: A review. Anaesthesiology 2003;98:530–47.

7. Dumestre DO, Redwood J, Webb CE, Temple-Oberle C. Enhanced recovery after surgery (ERAS) protocol enables safe same-day discharge after alloplastic breast reconstruction. Plast Surg (Oakv) 2017;25:249-54. doi: 10.1177/2292550317728036, PMID: 29619347; PMCID: PMC5871068

8. Mahmoud AAA, Hussein HA, Girgis K, Kamal AM, Nafady HA. The novel use of spinal anesthesia at the mid-thoracic level: a feasibility study. The Egyptian Journal of Cardiothoracic Anesthesia. 2014;8(1):21.

9. Imbelloni LE, Quirici MB, Ferraz Filho JR, Cordeiro JA, Ganem EM. The anatomy of the thoracic spinal canal investigated with magnetic resonance imaging. Anesthesia & Analgesia. 2010;110(5):1494-1495.

10. Lee RA, van Zundert AA, Breedveld P, Wondergem JH, Peek D, et al (2007) The anatomy of the thoracic spinal canal investigated with magnetic resonance imaging (MRI). Acta Anaesthesiol Belg. 58: 163-167.

11. Newman B. Complete Spinal Block Following Spinal Anaesthesia Anaesthesia Tutorial Of The Week 180 on 24th May 2010. World Federation of Societies of Anaesthesiologist. 2010.

12. Yousef GT, Lasheen AE. General anesthesia versus segmental thoracic or conventional lumbar spinal anesthesia for patients undergoing laparoscopic cholecystectomy. Anesthesia, essays and researches. 2012;6(2):167.

13. Van Zundert AA, Stultiens G, Jakimowicz JJ, Peek D, van der Ham WG, Korsten HH, Wildsmith JA. Laparoscopic cholecystectomy under segmental thoracic spinal anaesthesia: a feasibility study. Br J Anaesth 2007; 98:682–686.

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