Annals of Case Reports
Chandra R, et al. Ann Case Rep: 8: 1349
www.doi.org/10.29011/2574-7754.101349
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Research Article

A Prospective Observational Study on the Effectiveness of Segmental Spinal Anesthesia in Patients Posted for Modified Radical Mastectomies

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Citation: Chandra R, Misra G, Langoo SA (2023) A Prospective Observational Study on the Effectiveness of Segmental Spinal Anesthesia in Patients Posted for Modified Radical Mastectomies. Ann Case Report. 8: 1349. DOI:10.29011/2574-7754.101349

Received: 15 June 2023, **Accepted:** 19 June 2023, **Published:** 21 June 2023

Abstract

Background: Modified radical mastectomy is a treatment of choice in patients having carcinoma breast. The higher chances of complications with general anesthesia lead to a change in our clinical practice towards regional anesthesia. The current literature revealed that the maximum distance between the dura mater and the spinal cord is at the mid-thoracic level, but very few studies are advocating for the use of segmental spinal anesthesia for modified radical mastectomies. Therefore, the present study is planned to assess the effectiveness of segmental spinal anesthesia in patients posted for modified radical mastectomies.

Material and Methods: The present study was conducted at a tertiary care centre between April 2020 to November 2022 after approval by the institute's ethical and research committee. The study recruited 78 patients aged between 20-70 years with American Society of Anesthesiologists (ASA) physical status I-III who were scheduled for modified radical mastectomy with axillary dissection. A subarachnoid block was performed at T5-T6 or T6-T7 levels with 27 G Quincke Babcock needle using a midline approach with a 45° tilt of the needle in all the patients under aseptic precautions after. Once the free flow of Cerebrospinal fluid (CSF) was confirmed, 1.5 ml isobaric levobupivacaine with 5 mcg of Dexmedetomidine was administered.

Results: In the present study, 97% of the surgeons were satisfied with the procedure. All the patients had stable hemodynamics and adequate sensory and motor blockade. A single episode of hypotension was noted in 9% percent of the patients and 6% of them had bradycardia once during the procedure. However, the alterations in hemodynamics were successfully managed during the procedure. Paresthesia was found during needle insertion in 4% of patients, but none of them had any neurological damage.

Conclusion: Segmental spinal anesthesia is a safe alternative to general anesthesia in cases of carcinoma breast undergoing modified radical mastectomy.

Keywords: Breast Cancer ; Neuraxial Anaesthesia; Thoracic Segmental Spinal Anesthesia; Modified Radical Mastectomy

Introduction

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. In the current scenario, various approaches of anesthesia are available for the successful conduction of breast surgeries like general anesthesia and paravertebral blocks with Total Intravenous Anesthesia (TIVA). Modified Radical Mastectomy is considered to be a gold standard while treating patients with carcinoma breast. It is also documented that surgery should be done within 90 days after the disease is diagnosed [1]. It is proven that an early detection and surgery prolong the lives of patients. Patients with carcinoma breast are more prone to infections as they have multiorgan involvement including the liver, kidneys, and lungs. The lung is the second most common site of metastasis. Apart from these, bacterial, viral, and fungal pneumonia are common in these patients. They also always have depleted nutrition levels along with a stressed psychological status [2]. Successful conduction of anesthesia on these patients is the greatest challenge. The literature reveals the use of thoracic epidural anesthesia for surgical procedures on the breast in the past but the results are not appreciable. General anesthesia remains the gold standard in breast surgeries, which includes intubation and ventilation of the patients. However, regional administration anesthesia techniques are always considered superior in maintaining respiratory functions, avoiding airway manipulations, and limiting the complications of laryngoscopy and endotracheal intubation. Segmental spinal anesthesia involves the blockade of specific segments at the thoracic level. In a modified radical mastectomy, the blockade at lower cervical roots C5-6 and T 1-T 12 levels are required [3]. We planned the present study on the basis of the available literature with the aim to evaluate the effectiveness of segmental spinal anesthesia in patients posted for modified radical mastectomies.

Materials and Methods

The present study was conducted at a tertiary care centre from April 2020 to November 2022, after approval by the hospital's ethical and the research committee vide letter no. GDH/2020/019. The study included 84 patients aged 20-70 years with ASA (American society of Anesthesiologists) physical status I-III scheduled for modified radical mastectomy with axillary dissection. Informed and written consent was obtained from all the patients. The following categories of patients were excluded from the study: those with ASA IV/V status, Body mass index (BMI) > 35 kg/m2, any existing contraindications of regional anesthesia (local infection or coagulopathy), not giving consent for regional anesthesia, any known allergy to the drugs used in the study, those with abnormalities of the spine (kyphosis or scoliosis), patients requiring general anesthesia due to difficulty in placing them in a sitting position, and in cases with a change in surgical plan or more than two attempts for performing regional anaesthesia procedure. During their first visit patients were counseled regarding the need for surgery, the proposed anesthesia plan, its merits and side effects. They were informed about thoracic spinal anesthesia in detail and were reassured that any pain, discomfort, or anxiety would be supplemented with drugs. Moreover, they were also informed that in case of failure of the anesthesia plan, general anesthesia would be administered. A complete clinical examination was done and all standard laboratory investigations including ECG and ECHO were obtained as per the need. All the patients were admitted a day prior to surgery and clinical status was reviewed. On arrival to the operative room, 18 G iv cannula was secured in the contralateral upper limb and 500 ml of Ringer Lactate fluid was started. Standard monitors were placed in the operating room. 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. The depth of the dura mater was ascertained with the use of Ultrasonography. A subarachnoid block was performed at T5-T6 or T6-T7 levels with 26 G Quincke Babcock needle using the midline approach with a 45° angulation of the needle under aseptic precautions after local infiltration with 2ml of 2% xylocaine adrenaline solution. After piercing the Ligamentum Flavum, the needle was advanced in an incremental fashion of 0.5 mm on each advancement and CSF (Cerebrospinal fluid) flow was checked every time. Once the free flow of CSF was confirmed, 1.5 ml of isobaric levobupivacaine with 5 mcg of Dexmedetomidine was administered. The patients were placed in a supine position immediately after the block and supplemental oxygen was started with a mask at the rate of 5 liters per minute. While performing a lumbar subarachnoid block the anaesthesiologist's eyes are at a certain angle and height to ensure clear view during aspiration of CSF and ease of administration of drug. The usual distance between the lower lumbar level i.e. usual site for lumbar subarachnoid block and mid thoracic level is approximately 10-12 inches. So during mid thoracic subarachnoid block the performer's eyes remain parallel to level of needle, making it difficult to visualise the aspiration of CSF and leading to increased chances of migration of needle during drug administration. The author recommends standing on a 10-12 inches high platform while performing a thoracic subarachnoid block (RICHA'S ANGLE), thereby achieving a angle and position which is similar to performing a lumber subarachnoid block while standing on floor (Figure 1,2).

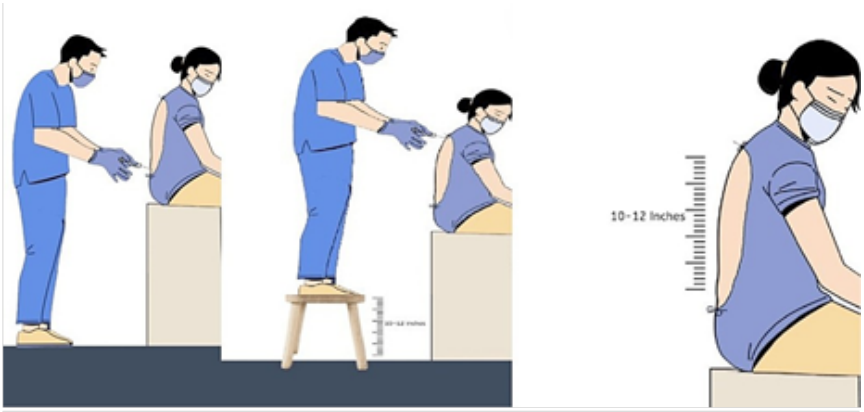

FIGURE 1: Placement of intrathecal block at mid-thoracic level

FIGURE 2: Implementation of subarachnoid block at mid thoracic level

The haemodynamic parameters [Heart rate (HR), non-invasive blood pressure (NIBP)] were recorded every three minutes for the first 15 minutes and then every five minutes till the completion of surgery. The sensory level was assessed with the pinprick method. Involvement of lower cervical roots C5, C6 to T12 level was considered adequate for the surgery. The degree of motor block in the upper and lower extremities were assessed. Epidural scoring scale for arm movements (ESSAM) score was used to assess the motor block in the upper limb; hand grip (T1/C8), wrist flexion (C8/C7), and elbow flexion (C6/C5) [4]. Four grades were given according to the number of absent movements [4]. The motor block in lower limbs were assessed using the Bromage score [5]. Any episodes of hypotension and bradycardia were noted. Hypotension was defined as systolic BP < 90 mm Hg or more than 25% fall in blood pressure from the baseline. Any episode of hypotension was treated with an incremental intravenous dose of Inj. Mephentermine 6 mg IV. Bradycardia was defined as a heart rate < 50 beats/minute and treated with an Inj. Atropine 0.6 mg IV. Sedation was achieved using Inj. Midazolam 1 mg IV. Any episode of intraoperative nausea or vomiting was treated with Ondansetron 4 mg. In the post-anesthesia care unit, hemodynamic parameters and any other adverse effects like nausea, vomiting, urinary retention and nasal congestion were noted.

The data was tabulated in a Microsoft Excel sheet and mentioned as a number (percentage).

Results

The study enrolled 84 patients out of which three patients were removed due to a change in the surgical plan, two patients needed lateral position for subarachnoid block, and general anesthesia was administered in one patient. Therefore, 78 patients successfully completed the study (Figure 3). The demographic profile of all patients are depicted in Table 1. The mean age of the patients was 52.78±8.98 years. The mean weight and height of the patients were 56.13±7.33 kg and 163.71±5.24 centimeters, respectively. However, the mean body mass index was 23.91±0.37 kg/m2 (Table 1).

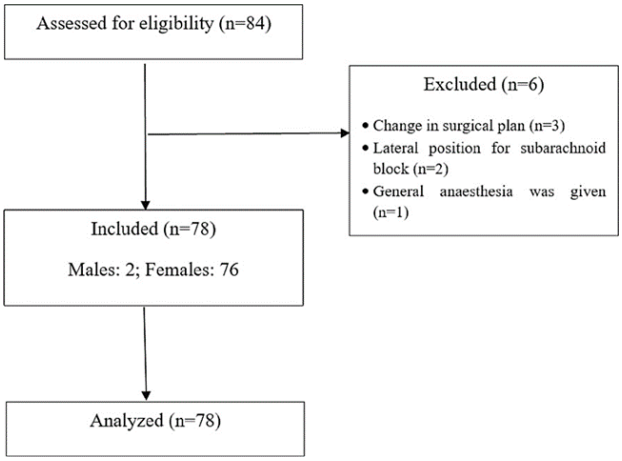

Figure 3: STROBE flow diagram.

Characteristics	Minimum-Maximum	Data
Age (in years)	38-69	52.78 ± 8.98
Weight (in kilograms)	48-71	56.13±7.33
Height (in centimeters)	154-178	163.71±5.24
BMI (in kg/m2)	20.55-26.38 23.91±0.37	
ASA Grading (I:II:III)	30 (38.46%):42 (53.84%):6 (7.69%)	
Comorbidity	48 (61.53%)	
Data presented as Mean ± SD or Number (percentage).		

Table 1: Demographic characteristics.

Table 2 states that 89% of patients had a successful sub-arachnoid block with a single attempt of needle insertion. However, in 11% of patients, the operator took two attempts for needle insertion. In addition, 97% of the surgeons were satisfied with the anesthesia technique (Table 2). Initially, two patients had jerky hand movements during the use of electrocautery in the axilla which was corrected with the use of low- current intermittent cautery or dissection with peanuts in the axilla.

Variables	Number	Percentage
Surgeon satisfaction	76	97
Surgeon unsatisfied	2	1.5
Single attempt	70	89
Double attempt	8	11
Data presented as Number (percentage).		

Table 2: Surgeon satisfaction and number of attempts.

Table 3 depicts that hypotension was observed in 12 patients and was managed with Inj. Mephentermine 6 mg IV. Bradycardia was manifested in 6% of the patients and was treated with a single dose of Inj. Atropine 0.6 mg IV. Inj. Ondansetron 4 mg IV was given to counteract any episode of nausea or vomiting (Table 3). Two patients complained of respiratory discomfort but they were relieved with reassurance only. Additionally, 4% of the patients had episode of nasal congestion (Table 3). Paresthesia was observed in 4% of the patients upon needle insertion but none of them had similar complaints during drug administration (Table 3).

Intraoperative complications	Number	Percentage
Hypotension	12	9
Bradycardia	8	6
Nausea	10	12
Vomiting	4	5.1
Respiratory discomfort	2	1.5
Nasal congestion	4	5.1
Paresthesia during needle insertion	5	4
Paresthesia during drug administration	0	0

Table 3: Intraoperative Complications.

The majority of patients (91.02%) were very satisfied with the procedure, were comfortable during surgery and had a quick postoperative recovery (Table 4). A total of seven patients reported average satisfaction, particularly, the patients who experienced nausea, vomiting or respiratory discomfort during the intraoperative period. However, post-dural puncture headache or any difficulty in resuming activity was not encountered by any patient during the postoperative period (Table 4).

Patient Satisfaction	Frequency	Percentage
Very Satisfied	71	91.02
Average Satisfaction	7	8.98
Dissatisfied	0	0
Total	78	100

Table 4: Patient satisfaction score.

Table 5 depicts the outcome characteristics of the patients. The time taken for full regression of motor and sensory block ranged from 244-283 and 122-154 minutes. Most of the patients (69) were discharged on the third day. The median postoperative stay time in the hospital of the patients was 68 days; however, 66 patients were ambulatory on the same day (Table 5).

Time to full block regression (min)	253 (244-283)
Time for regression of sensory block (min)	139 (122-154)
Discharge (same day:day 1:day 2:day 3) (n)	0:0:9:69
Postoperative time in hospital (hours) (n)	68 (42–83)
Ambulation: Day 0:1	66:12

Table 5: Outcome Characteristics.

Discussion

Segmental spinal anesthesia remains the most controversial technique amongst anesthesiologists due to the fear of 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. However, the biggest point of concern is neurological damage while puncturing the dura at a higher level. There are 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, which is discussed subsequently. Scherer published his thoracic epidural catheter placement data between T2-T3 and T11-T12 intervertebral spaces in 1071 surgical patients. Primary perforation of dura occurred in 13 patients but none of the patients suffered neurological damage [6]. In 1909, Jonnesco changed the previous trends of the subarachnoid block [7]. It has been more than a century since the puncture of the dura at T1-T2 intervertebral space and he also studied the feasibility of providing analgesia of the head, neck, and upper limbs [7]. Moreover, Jonnesco in their study described two approaches to the thoracic site puncture, one was the higher approach at T1-T2 and the other includes the lower approach at T12-L1 intervertebral space [7]. However, Giebler et al. found that unintentional dural perforation was higher in the lower (3.4%) as compared to the mid (0.9%) or upper (0.4%) thoracic region [8]. The overall incidence occurrence was 1.2% during the thoracic epidural catheter placement in 4185 patients. None of the patients had any neurological damage. They found the incidence of dura perforation in the upper space very less because the approach of the epidural space in a tangential fashion provides a greater margin of safety [8]. The above literature supports our decision to puncture the dura and perform sub arachnoid block at higher thoracic space. Madishetti gave 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 and the procedure was conducted successfully [9]. 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. The primary idea behind the choice of T5-T6 space is because in accordance to the literature, it has a maximum distance of 7.75 mm in comparison to T2 space and T10 spaces with 5.18 and 5.88, respectively. As 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. Imbelloni et al. researched 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. They observed no statistically significant difference between T2 and T10 levels. However, a statistically significant difference was observed upon comparing the distances at T5 and T2 thoracic levels [11]. The researchers also calculated the distance from the entry point of the needles at an angle of 60% at T5 which would double the distance to obtain cerebrospinal fluid when compared with a 90% angle at L3-4 to 8.64 (2.2) mm. As the distance from the duramater until the spinal cord at T5 is greater than at L1/2, the 60% angle could increase the safety margin [11]. In the present study, we selected the T5-T6 thoracic space for the subarachnoid block as it has the maximum distance between the dura mater and cerebrospinal fluid. Moreover, we kept our needle at an angle of 45° as it gives more distance for the needle tip to travel to the posterior surface of the dura, thereby minimizing the inadvertent chances of cord damage. The speed of injecting the isobaric intrathecal drugs should not be very fast as it causes more cephalad spread. However, this effect is less marked with hyperbaric drugs [12,13]. So, we kept the speed of intrathecal injection relatively slower. In the present study, Quincke Babcock cutting needles for the dural puncture were used. The use of this type of needle is supported by Imbelloni et al. who also preferred a cutting needle over pencil point needle in their study on 300 patients. They illustrated that cutting needles have a terminal hole facilitating the appearance of CSF immediately, whereas in pencil point needles, lateral orifice

starts at 0.8 mm and ends only at 1.7 mm. Therefore, there is a need to penetrate 2 mm more in the subarachnoid space for CSF to appear, making it more vulnerable for injury to the underlying structures [14]. Mahmoud et al. performed segmental spinal anesthesia at the T5 level with injection Bupivacaine 5 mg and 0.3 ml Fentanyl in 25 patients undergoing breast surgeries. They observed that the block was found to be satisfactory for patients with minimal hemodynamic instability and no neurological damage [15]. El Moutaz et al. compared segmental spinal thoracic anesthesia with thoracic epidural anesthesia in 35 patients undergoing laparoscopic cholecystectomies. They found that the spinal group had better surgeon satisfaction scores [16]. Vincenzi et al. found thoracic segmental spinal anesthesia at T6-T8 levels in four patients who had undergone unilateral mastectomy ± axillary dissection ± sentinel lymph node biopsy. They concluded it as a safe and effective alternative to general anesthesia [17]. Similar to these findings, we also observed that 97% of surgeons were satisfied with the technique. Hogan et al. studied the size of the human lower thoracic and lumbosacral nerve roots in cadavers. He concluded the facilitation of neural block in the thinner thoracic route was better than thicker lumbosacral route [18]. The CSF content was found to be low in the mid-thoracic region, leading to increased efficacy of epidural local anesthetics at those levels [19]. A low CSF volume and thinner nerve route at the thoracic level lead to an early and dense block in spite the usage of a low volume of local anesthetics in our study. This site-specific subarachnoid block leading to sparing of the lower extremities led to less vasodilatation in comparison to the block at the lumbar level; thus, fewer hemodynamic alterations were reported in the present study [20]. The other advantage was an appreciable patient satisfaction level as there was no motor involvement of the lower extremities [21]. Elakany et al. conducted unilateral mastectomy with axillary dissection under thoracic segmental spinal anesthesia. They compared it with the same number of patients under general anesthesia and concluded that thoracic segmental spinal anesthesia imparted better results [22]. Elakany et al. also observed that patients in the thoracic spinal group spent less time in the hospital and recovery area as compared to the general anesthesia group [22]. In the present study, the median post- operative time in the hospital was 68 hours and most of the patients were discharged on the third day after the operation.

Limitations

One of the limitations of the present study is that our satisfaction score is not the same as proposed by Goth et al. [23]. It would be better if we had taken multiple aspects that govern patient satisfaction scores. Moreover, the study was accomplished on a small group of patients and the results may be more trustworthy if the same study is conducted on a large set of patients population.

Conclusions

Segmental spinal anesthesia at T5-T6 level with intrathecal injection of local anesthetic with Dexmedetomidine is a safe and feasible technique for modified radical mastectomies. The technique is particularly helpful in patients with difficult airways and comorbidities. The use of thoracic spinal anesthesia can provide better intraoperative parameters to the satisfaction of surgeons and patients. Although the technique demands a learning curve, the present study recommends its use in routine and high-risk breast cancer patients.

Disclosures

Human subjects: Consent was obtained or waived by all participants in this study. GD Hospital issued approval GDH/2020/019. Animal subjects: All authors have confirmed that this study did not involve animal subjects or tissue. Conflicts of interest: In compliance with the ICMJE uniform disclosure form, all authors declare the following: Payment/services info: All authors have declared that no financial support was received from any organization for the submitted work. Financial relationships: All authors have declared that they have no financial relationships at present or within the previous three years with any organizations that might have an interest in the submitted work. Other relationships: All authors have declared that there are no other relationships or activities that could appear to have influenced the submitted work.

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