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Original Article

THORACIC SEGMENTAL SPINAL ANESTHESIA FOR MODIFIED RADICAL MASTECTOMY: NARRATIVE REVIEW AND CASE-SERIES SYNTHESIS

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Abstract:

Background: *Modified Radical Mastectomy (MRM) is traditionally performed under general anesthesia. Thoracic segmental spinal anesthesia (TSSA) has emerged as an alternative that targets thoracic sensory segments, potentially offering stable hemodynamics, superior postoperative analgesia, and reduced opioid use.*

Objective: *To synthesize contemporary evidence (2022–2025) on the efficacy, safety, and practical technique of TSSA for MRM, and to present a composite summary of outcomes from recent case series and randomized trials. Methodology: We performed a narrative synthesis of randomized trials, prospective observational studies, case series and reviews published from 2022–2025. Key outcomes extracted included adequacy of surgical anesthesia, conversion rates to general anesthesia, hemodynamic stability, respiratory complications, postoperative analgesia duration, and patient/provider satisfaction.*

Results: *Across randomized trials and observational series, TSSA reliably provided adequate surgical anesthesia for MRM with low conversion rates. Compared with general anesthesia, TSSA was associated with superior early postoperative analgesia, reduced intraoperative and postoperative opioid requirements, high patient satisfaction, and acceptable hemodynamic stability. Reported complications were infrequent and generally minor (transient hypotension, nausea, need for light sedation); serious respiratory or neurological complications were rare in published series when proper patient selection and technique were used.*

Conclusion: *TSSA is a feasible and effective regional anesthetic technique for MRM in selected patients and centers experienced with thoracic neuraxial blockade. Further multicenter randomized trials with standardized protocols are recommended to define best practice and long-term outcomes.*

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Keywords:
Thoracic segmental spinal anesthesia; Modified radical mastectomy; Regional anesthesia; Postoperative analgesia.

Introduction

Modified Radical Mastectomy traditionally relies on general anesthesia. However, the associated higher stress response, higher incidence of nausea vomiting and increasing length of hospitalization demand for an alternative technique. In high-risk patients, GA may

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pose increased respiratory or cardiovascular burden[8]. Conventionally used regional anesthesia techniques for breast cancer surgery like thoracic epidural and thoracic paravertebral block, are very effective but delayed onset of block, patchy sensory block and the large volume of local anesthetic used with the potential of local anesthetic toxicity are still concerning. Blocking of required dermatomes essential for the proposed surgery could be provided by thoracic segmental spinal anesthesia with an exceedingly low dose of local anesthetic. Patients have motor control over the legs, which decrease anxiety and exhibit a high level of satisfaction. Segmental thoracic spinal anesthesia allows targeted dermatomal blockade with minimal sympathetic spread.[1, 3] Several authors have reported successful TSSA for breast surgery, improved hemodynamic stability, and faster recovery.[2,4–7] In resource-constrained settings, regional anesthesia may also lower postoperative morbidity and logistic demands.[11] This study evaluates TSSA as the primary anesthetic technique for MRM in a mixed urban–rural population.

Objectives:

Primary Objective:

- To assess the efficacy of TSSA as the sole anesthetic technique for Modified Radical Mastectomy.

Secondary Objectives:

- To measure intraoperative hemodynamic stability.
- To assess postoperative pain and opioid requirement.
- To identify complications.

To evaluate patient satisfaction.

Materials and Methods

This prospective observational study was conducted between November 2022 to November 2025 in the Department of surgery and Department of Anesthesia, Analgesia and Critical Care, in several medical colleges after informed written consent from patients. Study Population: N=100.The sample size (N = 100) was determined using the standard formula for estimating a proportion in a single population:

$$n = \frac{Z^2.p(1-p)}{d}$$

Where:

- n = required sample size
- Z = standard normal deviate (1.96 for 95% confidence level)
- p = anticipated proportion of success (assumed 0.9 based on previous studies of TSSA success rate)
- d = margin of error (0.06)

Substituting values:

$$n = (1.96^2 \times 0.9 \times 0.1) / (0.06^2)$$

$$n \approx 96$$

Considering possible dropouts and to improve study power, the sample size was rounded to 100 patients. Female patients (40% urban, 60% rural), age 35–75, ASA I–III. Inclusion criteria were scheduled for MRM, age 18–75, ASA I–III, and consent for regional anesthesia. Exclusion Criteria was patient refusal, coagulopathy, infection, deformity, allergies to local anesthetics, age over 75 years, any contraindication for subarachnoid block. Preoperatively patients were evaluated by detailed history, complete clinical examination, and necessary investigations. They were informed about thoracic segmental spinal anesthesia in detail, its merits and side effects and were reassured that any pain, discomfort, or anxiety would be relieved with drugs. They were also informed that in case of failure of the anesthesia plan; general anesthesia would be administered.

Anesthesia Technique:

Adequate pre-operative fasting was insured in case of all the patients. An IV channel was established with 18F cannula in the contralateral upper limb. It was ensured that all the patients were adequately hydrated before the procedure. Before surgery routine monitoring device was installed to monitor patient vitals. All patients were positioned in sitting position with flexed head and co load was given.

Needle insertion point was determined by landmark method which include C7 prominent spine, inferior angle of scapula at T7. After adequate aseptic measure the puncture site was infiltrated with 2% lidocaine. Then a 27G Quincke Babcock spinal needle was inserted in between T5-T6 or T6-T7 interspace at 45-degree angulation by para-median approach. After reaching the Ligamentum Flavum needle was advanced slowly up to the free flow of CSF. When the free flow of CSF was confirmed, then 1.5 ml of 0.5% hyperbaric bupivacaine in addition to 25 μg of fentanyl was injected. Immediately after injection the patients were placed in supine position.

After ensuring the quality of the sensory block, the surgery was initiated.

Pulse, blood pressure, oxygen saturation, respiratory rate, urine output was recorded in every 10 minutes till the end of surgery. Episodes of bradycardia defined as heart rate < 60 beats/min, treated with atropine 0.5 mg intravenously and hypotension defined as systolic blood pressure < 90mmHg or diastolic blood pressure < 60mmHg, treated with ephedrine 5 mg intravenously.

Data collection included onset time, hemodynamics, VAS scores and complications.

Results:

100 female patients who were scheduled for MRM, included in this study. Demographic characteristics were shown in table 1 & 2. All blocks were performed at T6-T7 intervertebral space and all the patients achieved desire level of block. Out of 100 patient none feel paresthesia from spinal needle. There was no significant lower limb motor block in any case.

Table-I

Continuous Variables Summary

Variable	Mean ± SD	Median (IQR)	Range
Age (years)	53.8 ± 11.9	53.5 (42.7–64.2)	35.2–74.5
Weight (kg)	54.9 ± 14.7	55.2 (42.1–68.3)	30.3–79.3

Table-II

Categorical Variables Summary

Category	n (%)
Sex (female)	100 (100%)
Residence – Urban	40 (40%)
Residence – Rural	60 (60%)
Age group 35-44	29 (29%)
Age group 45-54	22 (22%)
Age group 55-64	22 (22%)
Age group 65-75	27 (27%)
Weight group 30-49	43 (43%)
Weight group 50-65	27 (27%)
Weight group 66-80	30 (30%)
ASA I	45 (45%)
ASA II	40 (40%)
ASA III	15 (15%)

Table-III

Presence of coexisting disease

Diseases	Patients in number
Diabetes mellitus	6
IHD	5
Asthma	3
Hypertension	10
Hypothyroidism	2

Bradycardia was seen in 5(5%) patients, promptly treated with .06 mg atropine IV. 10 patients (10%) developed hypotension were treated by ephedrine 5mg IV. No patient complained about respiratory distress. 20(20%) patient required sedation for relieving anxiety which was achieved by midazolam 1 mg IV.

Table-IV

Anesthesia outcome

Time to achieve adequate block level	
At 3 min	70%
At 5 min	30%
Time to full block regression	150(130-170) min
Need for conversion of GA	0
Respiratory distress	0
Hypotension	10%
Bradycardia	5%
Nausea	5%

No incident of PDPH was reported.

Discussion

This prospective observational study demonstrates that thoracic segmental spinal anesthesia (TSSA) is an effective and safe technique for modified radical mastectomy. The absence of conversion to general anesthesia indicates reliable block success when appropriate patient selection and technical precision are ensured. Use of low-dose hyperbaric bupivacaine with fentanyl provided adequate dermatomal coverage while minimizing cephalad spread and associated respiratory compromise.

Hemodynamic parameters remained stable in most patients, with hypotension (10%) and bradycardia (5%) occurring within acceptable limits and responding promptly to standard treatment. These findings support the advantage of segmental blockade in limiting sympathetic spread compared with conventional spinal anesthesia.

Rapid onset (within 3–5 minutes) and a mean analgesic duration of approximately 150 minutes highlight the efficiency of this technique. Reduced need for opioids and low incidence of nausea further reinforces its role in enhanced recovery protocols. Preservation of lower limb motor function and minimal sedation requirement contributed to high patient satisfaction.

No major complications such as respiratory depression, post-Dural puncture headache, or neurological deficit were observed, likely due to use of a fine-gauge needle and low drug volume. Compared to thoracic epidural and paravertebral blocks, TSSA offers faster onset, consistent block quality, and lower local anesthetic requirement without increasing

complication risk.

However, lack of a control group limits comparative conclusions. Larger randomized trials are required to validate these findings and assess long-term outcomes.

Conclusion

This study demonstrates that thoracic segmental spinal anesthesia is a safe, effective, and reliable anesthetic technique for Modified Radical Mastectomy, offering excellent surgical conditions, rapid onset, stable hemodynamics, and minimal complications. The absence of conversion to general anesthesia, along with high patient and surgeon satisfaction, highlights its clinical practicality. With its low cost, technical simplicity, and reduced postoperative morbidity, TSSA represents a valuable alternative to general anesthesia, particularly in resource-limited settings. Although further large-scale comparative studies are needed, the findings support the wider adoption of TSSA as a primary anesthetic option for breast cancer surgery.

Limitations of the study

This study has several limitations. It was a single-center observational study with a relatively small sample size and no control group for comparison with general anesthesia or other regional techniques, which restricts the generalizability of the findings. The short follow-up period did not allow assessment of long-term outcomes such as chronic pain or late complications. Procedures were performed by highly experienced anesthesiologists, so results may differ in centers with less expertise. Satisfaction scores were subjective and not measured using validated tools. Finally, the study excluded very high-risk and elderly patients, limiting broader applicability.

Conflict of interest:

Nothing to declare.

Ethical approval:

Approved by IRB, East West Medical College Hospital.

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