CASE REPORT

Thoracic Spinal Anesthesia (TSA) in Patients with Congestive Heart Failure and Pleural Effusion Undergoing Breast Tumor Surgery: A Case Report

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ABSTRACT

Background: Thoracic spinal anesthesia (TSA) is a regional anesthesia technique that can serve as an alternative to general anesthesia, particularly for patients with cardiovascular and respiratory comorbidities, to reduce adverse effects and provide a more effective procedure.

Case: A 55-year-old female patient with a left breast tumor and comorbidities including uncontrolled hypertension and type 2 diabetes mellitus, as well as congestive heart failure (CHF) and bilateral pleural effusion, scheduled for lumpectomy by a surgical specialist. The preoperative assessment showed stable hemodynamics with no significant changes in laboratory results. The patient received hyperbaric bupivacaine 5 mg (1cc), fentanyl 25 mcg (0.5cc), and an adjuvant of dexamethasone 5 mg (1cc) for the TSA procedure at the T4-T5 level. Intraoperatively, there were no significant hemodynamic changes, and postoperatively, the patient had a good recovery and mobilization.

Discussion: The TSA procedure is an alternative anesthesia technique when patients undergoing general anesthesia have a high risk of morbidity and mortality, especially in geriatric patients with physiological body disorders and multiple comorbidities. TSA has been increasingly used as a safe anesthesia technique, capable of accelerating recovery time, minimizing side effects, and providing better outcomes in terms of perioperative morbidity and mortality compared to general anesthesia. The current limitations of the literature regarding TSA include the lack of large-scale studies, the absence of standardized protocols for TSA, a focus on specific surgeries only, and concerns about the safety of this procedure.

Conclusion: The TSA can be used as a regional anesthesia procedure for patients undergoing breast tumor surgery. TSA has a simple technique and is efficient in providing sensory and motor blockade.

Keywords: breast tumor surgery; congestive heart failure; dexamethasone; pleural effusion; thoracic spinal anesthesia

INTRODUCTION

General anesthesia is currently the standard technique used for breast tumor surgery. However, this general anesthesia technique has various drawbacks, including postoperative complications, poor pain control, heightened stress response, higher risk of nausea and vomiting, and prolonged use of mechanical ventilation. Therefore, thoracic spinal anesthesia (TSA) could be an alternative anesthesia technique for breast tumor surgery.[1]

TSA is still a subject of debate regarding the safety of this anesthesia technique. The greatest concern when performed at a level above the spinal cord is injury to the spinal cord itself, which can lead to temporary or permanent neurological sequelae. Concerns include the cephalad spread of local anesthesia leading to a total block, bradycardia, and hypotension due to the blockade of cardioaccelerator fibers above T4, and respiratory depression influenced by the technique and experience of the anesthesiologist. Other factors, such as anatomy and type of local anesthesia, do not significantly affect the cephalad spread of anesthesia. Here, we report a case of successful TSA in a 55-year-old patient with multiple comorbidities undergoing breast tumor surgery.[2]

CASE

A 55-year-old female patient, married, a housewife, and a resident of Cibendung Village, came to the surgery clinic at Dera As Syifa Hospital with a lump in her left breast for the past three months before hospital admission. The lump in the breast is immovable, painless, has not enlarged, and has not spread to the lymph nodes. The patient denied any weight loss and had no complaints of nausea, vomiting, or fever. There were no complaints regarding bowel movements or urination. The patient had never undergone routine checkups or taken any medication.

The patient had a history of uncontrolled hypertension and diabetes mellitus. She denied a history of asthma, pulmonary tuberculosis, and smoking. There was no family history of similar diseases. The patient also denied any previous surgeries. In terms of lifestyle habits, the patient rarely exercised but enjoyed salty and sweet foods. She did not consume alcohol or illegal drugs. At the hospital, she was diagnosed with a breast tumor, congestive heart failure (CHF), and pleural effusion. Given her condition, it was planned to refer her to a larger hospital for surgery, but the patient refused the referral, and the breast tumor surgery was carried out at our hospital despite limited equipment.

A preoperative physical examination was conducted, showing that the patient weighed 53 kilograms, had a height of 155 centimeters, and a body mass index (BMI) of 22.06 (normal). The patient appeared to be moderately ill but was fully conscious (compos mentis). Vital signs showed a blood pressure of 170/100 mmHg, a pulse rate of 90 beats per minute, a respiratory rate of 22 breaths per minute, a temperature of 36.5°C, and an oxygen saturation of 97% with a nasal cannula at 3 lpm and a head-up position of 30°. A head examination revealed normocephaly, no conjunctival anemia, and no icterus in both sclerae. A thoracic examination revealed fine crackles with weakened vesicular sounds in both lung bases. An abdominal examination was within normal limits, as were the extremities.

Laboratory results show Hb 14.7 g/dL, Ht 45%, leukocytes 9,300/µL, platelets 165,000/µL, clotting time 5 seconds, bleeding time 3 seconds, random blood sugar 203 mg/dL, HIV rapid test non-reactive, HBsAg negative. Electrocardiography revealed an Inverted T Wave, and a chest X-ray indicated bilateral pleural effusion, as shown in Figure 1. The size of the heart and cardiothoracic ratio (CTR) were not valid for assessment. The patient was diagnosed with a left breast tumor, CHF, and bilateral pleural effusion.

Before surgery, the patient was classified as American Society of Anesthesiologists (ASA) Class III. During the pre-operative visit, the patient's hydration status was ensured to be good, and the maintenance fluid requirements were adjusted using Ringer's lactate. In the ward, the patient received therapy, including insulin to control blood sugar and captopril to manage blood pressure before the surgery. The patient was also given an injection of 4 mg of ondansetron IV. Vital signs such as blood pressure, pulse, respiratory rate, and oxygen saturation were monitored throughout the surgery. The patient was on nasal cannula oxygen at 3 liters per minute. Thoracic Spinal Anesthesia (TSA) was administered in the sitting position with a medial approach using a 26-G Quincke needle. The patient received 5 mg (1 cc) of hyperbaric bupivacaine, 25 mcg (0.5 cc) of fentanyl, and 5 mg (1 cc) of dexamethasone as an adjunct for the TSA, up to the T4-T5 level. The surgery lasted 50 minutes, and the patient was positioned supine with a slight head-up tilt of 15-30%. No sedative medications were administered during the intraoperative period, but the patient remained comfortable throughout the procedure, with no significant changes in hemodynamics, airway, or respiration.

The hemodynamic status during the surgical procedure was 150-170 mmHg for systolic blood pressure, 100-105 mmHg for diastolic blood pressure, and 90-95 bpm for pulse rate, while the respiratory rate was 20-24 breaths per minute, and oxygen saturation was 95-98%, as shown in Figure 2.

After the breast tumor surgery was completed, the patient was able to move to the transport bed without assistance, with no motor impairment from the TSA, and was transferred to the recovery room. The patient was fully conscious, with a blood pressure of 163/101 mmHg, a pulse rate of 90 bpm, a respiratory rate of 22 breaths per minute, and an oxygen saturation of 98% with a nasal cannula at 3 lpm. While in the care unit, the patient received an oral analgesic regimen of 1 gram of paracetamol every 8 hours. During observation in the room, the patient did not report any headaches or symptoms of dizziness, nausea, or vomiting post-surgery. Pain levels were measured 30 minutes post-surgery and up to 24 hours of care at hourly intervals using the numerical rating scale (NRS) (Figure 3).

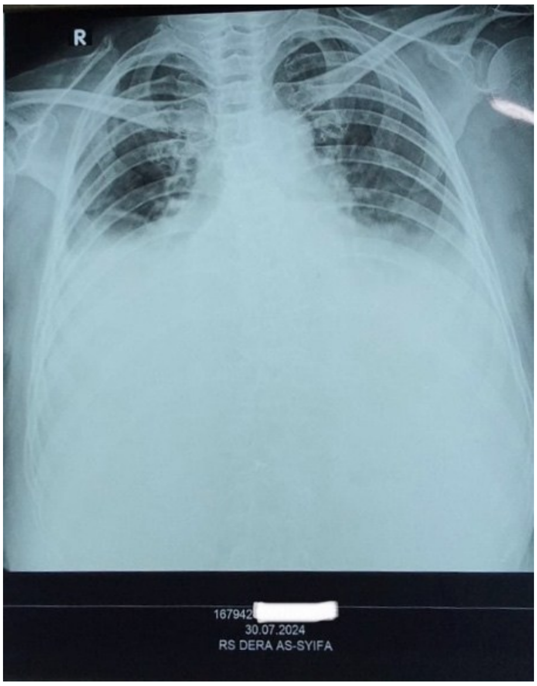

Figure 1. Chest X-Ray (source: author's documentation)

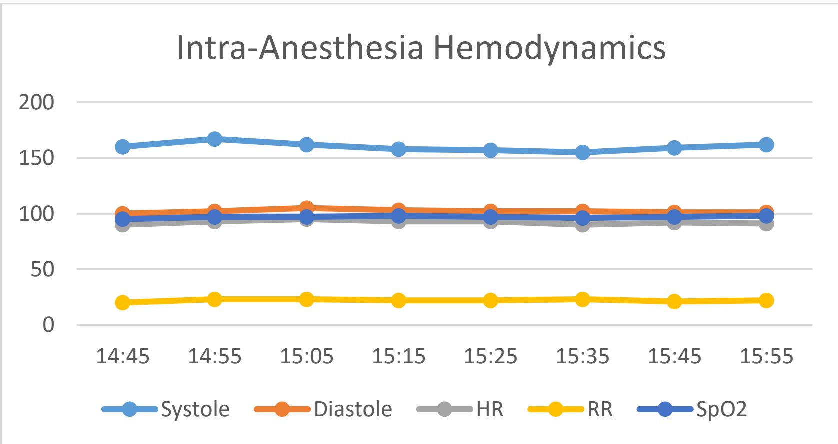

Figure 2. Intra-anesthesia hemodynamics (source: author's documentation)

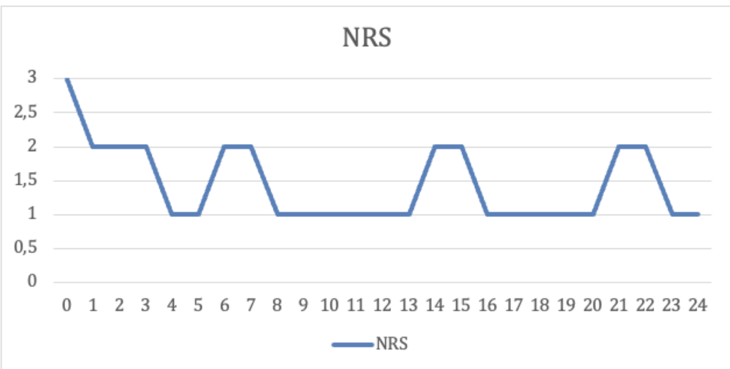

Figure 3. Numerical rating scale (NRS) (source: author's documentation)

DISCUSSION

We present a breast tumor surgery with multiple cardiovascular and respiratory comorbidities that was successfully managed with thoracic spinal anesthesia (TSA). Although breast tumor surgeries are typically performed using general anesthesia, for patients with multiple comorbidities, anesthesiologists need to carefully consider it due to the potential increase in postoperative morbidity and mortality. Several studies have described TSA as the primary anesthetic method for breast and axillary tumor surgeries. TSA has been increasingly used as a safe anesthesia technique, capable of accelerating recovery time, minimizing side effects, and providing better outcomes in terms of perioperative morbidity and mortality compared to general anesthesia. When compared to lumbar anesthesia, TSA offers more selective spinal blockade, ensuring better intraoperative control, improved cardiovascular and respiratory stability, as well as lower local anesthetic requirements, which in turn reduces the toxicity associated with local anesthetics.[3]

The research comparing general anesthesia and TSA on hemodynamic and respiratory stability during laparoscopic cholecystectomy concluded that the group receiving TSA had more stable hemodynamics during surgery. In contrast, the general anesthesia group showed an increase in hemodynamic parameters such as pulse rate, systolic blood pressure, and diastolic blood pressure. Oxygen saturation did not change in either group. Postoperative nausea and vomiting (PONV) were 15% more frequent in the general anesthesia group, and postoperative analgesia was better in the TSA group.[4]

The TSA procedure has more advantages compared to general anesthesia. A study by Paliwal *et al.*, which compared TSA with general anesthesia in breast cancer surgery, found that patients who underwent TSA had higher satisfaction with the anesthesia technique. This was due to the ability to control lower extremity motor function, quicker mobilization, better analgesia, and a lower incidence of PONV. Intraoperatively, there were no conversions from TSA to general anesthesia, and there were no cases of dyspnea, hypopnea, or hypoxia. For breast tumor surgeries, postoperative pain control is of utmost importance. This study found that TSA resulted in shorter postoperative pain duration. Recovery was also faster with TSA compared to general anesthesia, leading to a shorter time needed in the recovery room. In our case, similar findings were observed: the patient had no hemodynamic disturbances, no complaints of nausea or vomiting, good mobilization, and effective pain control. Therefore, it can be concluded that minimal doses of local anesthetics and opioids in TSA can replace general anesthesia in breast cancer surgery with better outcomes.[5]

Several magnetic resonance imaging (MRI) studies have been conducted to specifically evaluate the anatomy of the spinal canal, particularly the subarachnoid space, at various thoracic levels. These studies confirm that the thoracic spinal cord, especially from T4 to T10, is located more anteriorly compared to the lumbar spinal cord, resulting in a wider subarachnoid space in the thoracic region. The research also indicates that the greatest distance between the dura mater and the spinal cord can be observed at the T5/T6 level.[2] The study examining the thoracic spinal canal in the Indian population found that TSA is safe and applicable because the distance between the dura and the spinal cord is sufficient to avoid the possibility of injury to the spinal cord by the spinal needle.[6]

The TSA procedure was performed on this patient. Some considerations and concerns resulting from this procedure include partial or permanent spinal cord injury. However, several studies indicate that the posterior subarachnoid space in the mid-thoracic vertebrae is wider compared to the upper and lower thoracic vertebrae, reducing the potential for spinal cord injury. Additionally, studies using MRI have shown similar results, where the posterior distance between the dura and the spinal cord in the mid-thoracic vertebrae is greater (T5 = 5.8 +/- 0.8mm; T6 = 9.5 +/- 1.8mm; T2 = 3.9 +/- 0.8mm; T10 = 4.1 +/- 1.0mm).[7]

According to the literature, thoracic spinal anesthesia is generally performed at vertebral levels ranging from T4 to T12, depending on the type of surgical procedure. For surgical interventions in the thoracic region, such as breast surgery, thoracic spinal anesthesia is typically administered at the T5/T6 level with a local anesthetic volume between 1.1 and 1.4 ml, resulting in a sensory block coverage from T1 to T11. Meanwhile, for upper abdominal surgeries such as colon resection, gastrectomy, gastrostomy, and laparoscopic cholecystectomy, thoracic spinal anesthesia is administered between the T4 and T11 vertebral levels. For instance, in colon resection procedures, anesthetic injection at the T4/T5 level with a volume of 1.7 ml can produce a sensory block ranging from T3 to L5. In gastrectomy procedures, anesthesia is performed between T6 and T8 with a local anesthetic volume of 0.9 to 1.2 ml, which can provide sensory block up to the T4 dermatome it can be seen in Figure 4.[2,8,9,10]

The TSA procedure is an alternative anesthesia technique when patients undergoing general anesthesia have a high risk of morbidity and mortality, especially in geriatric patients with physiological body disorders and multiple comorbidities.[8,11,12] In patients with CHF and pleural effusion, there are disturbances in the cardiovascular and respiratory systems. The goal of anesthesia management in patients with cardiovascular and respiratory issues is to maintain intraoperative hemodynamic stability. The aim of using TSA in patients with cardiovascular disorders is to reduce sympathetic blockade that extends to the lower extremities, which causes vasodilation of blood vessels, thereby decreasing preload and blood pressure. Meanwhile, the benefits of TSA for patients with respiratory system disorders include preventing prolonged mechanical ventilation, avoiding atelectasis, and having minimal effects on lung function, resulting in better respiratory outcomes compared to general anesthesia. One study also indicated that TSA is the only safe anesthesia technique for patients with chronic lung disease, including those with emphysema, as well as for patients with cardiomyopathy with a 20% reduced ejection fraction, hypertension, and diabetes mellitus.[2,13]

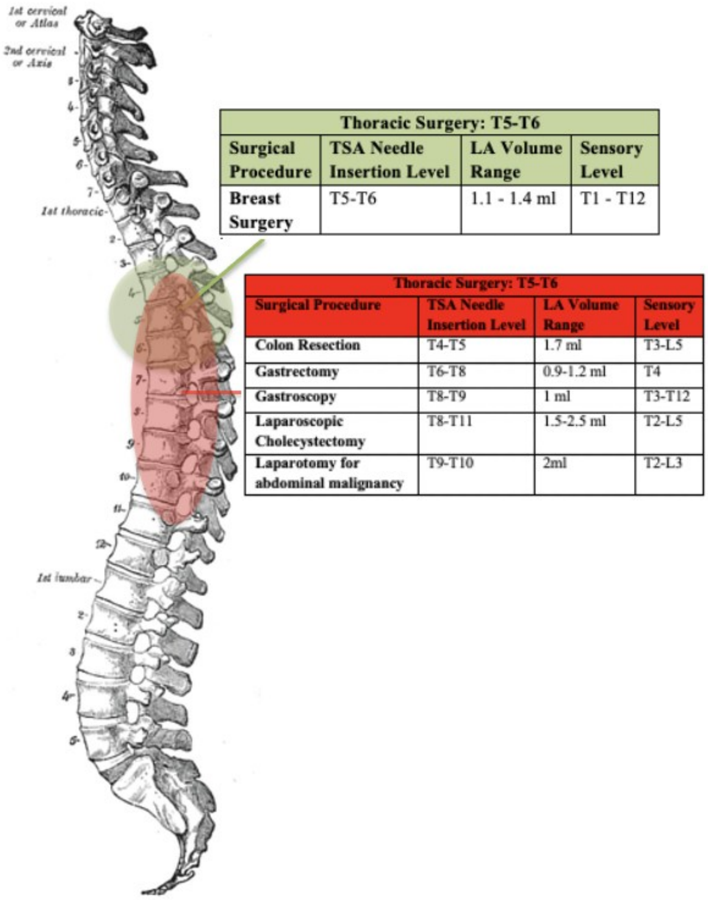

Figure 4. Illustration of dermatome coverage in TSA

This case report uses hyperbaric bupivacaine in a TSA procedure. Bupivacaine is an amide local anesthetic that has become the standard for spinal anesthesia use, but it is often associated with hypotension, slow motor recovery, and cardiotoxicity at high concentrations. A study comparing the use of isobaric levobupivacaine and hyperbaric bupivacaine in lumbar spinal anesthesia stated that the use of both drugs could produce similar anesthesia for procedures involving the lower abdomen and lower extremities. Isobaric levobupivacaine may be more beneficial in surgical procedures that require a longer duration, but hyperbaric bupivacaine has a faster onset of action and can be used in emergency surgical procedures.[14,15]

The study conducted by Ullah *et al.* performed TSA on modified radical mastectomy (MRM) surgery using 5 mg of hyperbaric bupivacaine and 25 mcg of fentanyl. From the 55 patients who underwent TSA, there were no significant changes in the average heart rate and mean arterial pressure (MAP) during the surgery. This study involved 55 patients, with only 5 (9%) experiencing hypotension, 4 (7%) experiencing bradycardia, 7 (13%) experiencing nausea and vomiting, 2 (4%) experiencing mild respiratory distress, 1 (2%) experiencing paresthesia, and 1 (2%) experiencing itching. Additionally, 95% of the surgeons were highly satisfied with this anesthesia technique, while 91% of the patients were very satisfied with the procedure and felt comfortable during the surgery.[1]

Another study conducted by Imbelloni *et al.* compared the use of 15 mg hyperbaric bupivacaine and 20 mcg fentanyl in lumbar anesthesia with the use of 7.5 mg hyperbaric bupivacaine and 20 mcg fentanyl in low-dose TSA during laparoscopic cholecystectomy surgery. The results showed that with low-dose TSA, the level of blockade reached T3 dermatomally, there were no cases requiring conversion to general anesthesia, the incidence of hypotension and the use of norepinephrine decreased, and the duration of motor and sensory blockade was also reduced, allowing for quicker patient mobilization compared to the use of 15 mg hyperbaric bupivacaine.[16]

This case report also uses dexamethasone injection into the intrathecal space. Dexamethasone is a potent, long-acting glucocorticoid with minimal mineralocorticoid effects, commonly used for PONV. A study that used dexamethasone as an adjuvant with bupivacaine found an increase in the duration of sensory blockade without affecting motor function. Additionally, side effects of spinal anesthesia, such as hypotension, nausea, and vomiting, were reduced with the use of intrathecal dexamethasone.[17]

The effects of dexamethasone as an adjuvant are caused by several mechanisms, including local vasoconstriction, which can reduce the absorption of local anesthetics, inhibition of C-fiber transmission, and acting as a local anti-inflammatory by decreasing prostaglandin synthesis.[18,19] A study also found that the use of bupivacaine with dexamethasone as an adjuvant is very safe, and while the blockade effect and postoperative analgesia are better with the use of dexmedetomidine, dexamethasone can be another alternative to enhance postoperative analgesia.[20,21]

In a study comparing the use of dexamethasone as an adjuvant to bupivacaine versus bupivacaine alone in spinal anesthesia, it was found that the addition of intrathecal dexamethasone to bupivacaine significantly increased the duration of sensory block in spinal anesthesia without causing hemodynamic changes or complications.[22]

In a study comparing dexamethasone with fentanyl as adjuvants to intrathecal bupivacaine, which evaluated sensory and motor blockade, analgesic effects, and postoperative complications, the results showed that dexamethasone as an adjuvant can be a good alternative because it provides longer motor and sensory blockade, better analgesic effects, and minimal postoperative complications.[23]

The current limitations of the literature regarding thoracic spinal anesthesia (TSA) include the lack of large-scale studies, the absence of standardized protocols for TSA, a focus on specific surgeries only, and concerns about the safety of this procedure.

CONCLUSION

Thoracic spinal anesthesia (TSA) is an effective regional technique for breast tumor surgery, offering reliable sensory and motor block with a simple approach. TSA provides several benefits, including fewer postoperative complications, enhanced pain control, faster recovery, reduced drug use, and avoidance of general anesthesia side effects. While both isobaric levobupivacaine and hyperbaric bupivacaine yield similar outcomes, adding dexamethasone can prolong analgesia. The main limitation is patient discomfort during needle insertion. Further large-scale studies are needed to establish guidelines, assess broader applications, refine techniques, and evaluate long-term outcomes and risks.

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